



1 X 800 MW GSECLWANAKBORI TPS

**COMPRESSED AIR SYSTEM
TECHNICAL SPECIFICATION
(ELECTRICAL PORTION)**

SPECIFICATION No: PE-TS-408-555-A001

VOLUME: II B

SECTION : C-3

REV. 00

DATE: 14.08.2015

SECTION: C-3

TECHNICAL SPECIFICATION (ELECTRICAL PORTION)



TITLE:
**ELECTRICAL EQUIPMENT SPECIFICATION
FOR
COMPRESSED AIR SYSTEM

1X800 MW WANAKBORI TPS**

SPECIFICATION NO.
VOLUME NO. : **II-B**
SECTION: **C**
REV NO. : **00** DATE: 10/08/2015
SHEET: 1 OF 1

CONTENTS

SECTION	TITLE	NO OF SHEETS
C	SPECIFIC TECHNICAL REQUIREMENTS	1
C	ELECTRICAL SCOPE BETWEEN BHEL & VENDOR	1
C	ELECTRICAL LOAD DATA FORMAT	1
C	DATASHEET-A	1
C	CABLE SCHEDULE FORMAT	1
C	SUB VENDOR LIST	1
D	DATA SHEET C	1
D	QUALITY PLAN (FOR MOTORS BELOW 55 KW)	2
D	QUALITY PLAN (FOR MOTORS ABOVE & 55 KW)	9
D	SECTION II: TECHNICAL SPECIFICATION FOR AC & DC MOTORS	14
D	SECTION IV: TECHNICAL SPECIFICATION FOR CABLES	23



SPECIFIC TECHNICAL REQUIREMENTS: ELECTRICAL

1.0 EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER:

- a) Services and equipment as per “Electrical Scope between BHEL and Vendor”.
- b) Any item/work either supply of equipment or erection material which have not been specifically mentioned but are necessary to complete the work for trouble free and efficient operation of the plant shall be deemed to be included within the scope of this specification. The same shall be provided by the bidder without any extra charge.
- c) Supply of mandatory spares as specified in the specifications of mechanical equipments.
- d) Electrical load requirement for Compressed Air System.
- e) All equipment shall be suitable for the power supply fault levels and other climatic conditions mentioned in the enclosed project information.
- f) Bidder to furnish list of makes for each equipment at contract stage, which shall be subject to customer/BHEL approval without any commercial and delivery implications to BHEL
- g) Various drawings, data sheets as per required format, Quality plans, calculations, test reports, test certificates, operation and maintenance manuals etc shall be furnished as specified at contract stage. All documents shall be subject to customer/BHEL approval without any commercial implication to BHEL.
- h) Motor shall meet minimum requirement of motor specification.
- i) Vendor to clearly indicate equipment locations and local routing lengths in their cable listing furnished to BHEL.
- j) Cable BOQ worked out based on routing of cable listing provided by the vendor for “both end equipment in vendor’s scope” shall be binding to the vendor with +10 % margin to take care of slight variation in routing length & wastages.

2.0 EQUIPMENT & SERVICES TO BE PROVIDED BY PURCHASER FOR ELECTRICAL & TERMINAL POINTS:

Refer “Electrical Scope between BHEL and Vendor”.

3.0 DOCUMENTS TO BE SUBMITTED ALONG WITH BID

- 3.1 The electrical specification without any deviation from the technical/quality assurance requirements stipulated shall be deemed to be complied by the bidder in case bidder furnishes the overall compliance of package technical specification in the form of compliance certificate/No deviation certificate.
- 3.2 No technical submittal such as copies of data sheets, drawings, write-up, quality plans, type test certificates, technical literature, etc, is required during tender stage. Any such submission even if made, shall not be considered as part of offer.



TECHNICAL SPECIFICATION FOR
COMPRESSED AIR SYSTEM
(ELECTRICAL PORTION)

SPECIFICATION NO.
VOLUME II B
SECTION-C
REV 0 DATE 10.08.2015
PAGE 2 OF 2

4.0 List of enclosures :

- a) Electrical scope between BHEL & vendor (Annexure –I)
- b) Technical specification for motors.
- c) Datasheets & quality plan for motors.
- d) Electrical Load data format (Annexure –II)
- e) BHEL cable listing format (Annexure –III)
- f) Electrical mandatory spares (As per spec.)

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)

PACKAGES : COMPRESSED AIR SYSTEM

SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT

PROJECT: 1 X 800 MW WANAKBORI TPS

<u>S.NO</u>	<u>DETAILS</u>	<u>SCOPE SUPPLY</u>	<u>SCOPE E&C</u>	<u>REMARKS</u>
1	11 kV/ 6.6 KV / 3.3 KV / 415 V Switchgear	BHEL	BHEL	415 V AC (3 ph 4 wire)/240 V AC (supply feeder) shall be provided by BHEL based on load data provided by vendor at contract stage for all equipment supplied by vendor as part of contract. Any other voltage level (AC/DC) required will be derived by the vendor.
2	Local Push Button Station (for motors)	BHEL	BHEL	Located near the motors.
3	Power cables, control cables and screened control cables for a) both end equipment in BHEL's scope b) both end equipment in vendor's scope c) one end equipment in vendor's scope	BHEL BHEL BHEL	BHEL Vendor BHEL	1. For 3.b) & c): Sizes of cables required shall be informed by vendor at contract stage (based on inputs provided by BHEL) in the form of cable listing. Finalisation of cable sizes shall be done by BHEL. Vendor shall provide lugs & glands accordingly. 2. Termination at BHEL equipment terminals by BHEL. 3. Termination at Vendor equipment terminals by Vendor.
4	Junction box for control & instrumentation cable	Vendor	Vendor	Number of Junction Boxes shall be sufficient and positioned in the field to minimize local cabling (max 10-12 mtrs) and trunk cable.
5	Any special type of cable like compensating, co-axial, prefab, MICC, etc.	Vendor	Vendor	Refer C&I portion of specification for scope of fibre Optical cables if used between PLC/ microprocessor & DCS.
6	Cable trays, accessories & cable trays supporting system. 100/50 mm cable trays/Conduits/Galvanised steel cable troughs for local cabling	BHEL Vendor	BHEL Vendor	Local cabling from nearby main route cable tray (BHEL scope) to equipment terminal (vendor's scope) shall be through 100/ 50 mm. cable trays/ conduits/ Galvanised steel cable troughs as per approved layout drawing during contract stage.
7	Cable glands, lugs & bimetallic strip for equipments supplied by Vendor	Vendor	Vendor	1. Double compression Ni-Cr plated brass cable glands 2. Solder less crimping type heavy duty tinned copper lugs for power & control cables.
8	Conduit and conduit accessories for cabling between equipments supplied by vendor.	Vendor	Vendor	Conduits shall be medium duty, hot dip galvanised cold rolled mild steel rigid conduit as per IS: 9537.
9	Lighting	BHEL	BHEL	--
10	Equipment grounding (including electronic earthing) & lightning protection	BHEL	BHEL	Refer note no. 4 for electronic earthing
11	Below grade grounding	BHEL	BHEL	--
12	Motors with base plate and foundation hardware	Vendor	Vendor	Makes shall be subject to customer/ BHEL approval at contract stage.
13	Mandatory spares	Vendor	-	Vendor to quote as per specification.

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)

PACKAGES : COMPRESSED AIR SYSTEM

SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT

PROJECT: 1 X 800 MW WANAKBORI TPS

14	Recommended O & M spares	Vendor	-	As specified elsewhere in specification
15	Any other equipment/material/service required for completeness of system based on the system offered by vendor (to ensure trouble free and efficient operation of the system).	Vendor	Vendor	--
16	a. Input cable schedules (C & I) b. Cable interconnection detail for the above c. Cable block diagram	Vendor Vendor Vendor	- - -	Cable listing for Control and Instrumentation Cable and electronic earthing cable in enclosed excel format shall be submitted by vendor during detailed engineering stage.
17	Cabling layout drawings	BHEL/ Vendor	-	a. In case of Compressor are HT motors, cable tray/trench layout inside compressed air building shall be prepared by BHEL. Vendor to furnish drawing (both in print form as well as in AUTOCAD) of compressor room layout clearly indicating all motors, panels, JB's etc. which require cabling alongwith their terminal box/location/ Foundation etc. b. In case of Compressor are LT motors, for ensuring cabling requirements are met, vendor shall prepare & submit cable tray/trench & equipment layout (both in print form as well as in AUTOCAD) of the complete plant (including electrical area) indicating location and identification of all equipment requiring cabling for BHEL review & approval.
18	Electrical equipment GA drawing	Vendor	-	For necessary interface review.

NOTES:

1. Make of all electrical equipments/items supplied shall be reputed make & shall be subject to approval of BHEL/customer after award of contract.
2. All QPs shall be subject to approval of BHEL/customer after award of contract without any commercial implication.
3. In case the requirement of junction box arises on account of power cable size mismatch due to vendor engineering at later stage, vendor shall supply the junction box for suitable termination.
4. Vendor shall indicate location of Electronic Earth pit in their Civil assignment drawing.

LOAD TITLE	RATING (KW / A)		UNIT (U)/STN (S)	Nos.		VOLTAGE CODE*	FEEDER CODE**	EMER. LOAD (Y)	CONT.(C)/ INTT.(I)	STARTING TIME >5 SEC (Y)	LOCATION	BOARD NO.	CABLE		BLOCK CABLE DRG. No.	CONT ROL CODE	REMA RKS	LOAD No.	VERIFICATI ON FROM MOTOR DATASHEE T (Y/N)	KKS NO
	NAME PLATE	MAX. CONT. DEMAND (MCR)		RUNNING	STANDBY								SIZE CODE	NOs						
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21

ANNEXURE-II

NOTES: 1. COLUMN 1 TO 12 & 18 SHALL BE FILLED BY THE REQUISITIONER (ORIGINATING AGENCY); REMAINING COLUMNS ARE TO BE FILLED UP BY PEM (ELECTRICAL)/ CUSTOMER
 2. ABBREVIATIONS : * VOLTAGE CODE (7):- (ac) A=11 KV, B=6.6 KV, C=3.3 KV, D=415 V, E=240 V (1 PH), F=110 V (cc): G=220 V, H=110 V, J=48 V, K=+24V, L=-24 V
 : ** FEEDER CODE (8):- U=UNIDIRECTIONAL STARTER, B=BI-DIRECTIONAL STARTER, S=SUPPLY FEEDER, D=SUPPLY FEEDER (CONTACTER CONTROLLED)

LOAD DATA (ELECTRICAL)	JOB NO.	408		ORIGINATING AGENCY		PEM (ELECTRICAL)		
	PROJECT TITLE	1x800 MW WANAKBORI TPS		NAME			DATA FILLED UP ON	
	SYSTEM	COMPRESSED AIR SYSTEM		SIGN.			DATA ENTERED ON	
	DEPTT. / SECTION	ELECTRICAL		SHEET 1 OF 1	REV. 00	DE'S SIGN. & DATE		



TITLE

LV MOTORS**DATA SHEET-A**

SPECIFICATION NO.


VOLUME II B

SECTION D

REV NO. 00 DATE 10/08/2015


SHEET 1 OF 1

1.0	Design ambient temperature	:	50 °C
2.0	Maximum acceptable kW rating of LV motor	:	Upto 160KW
3.0	Installation (Indoors/ Outdoors)	:	As required
4.0	Degree Of Protection	:	IP55
5.0	Cooling	:	TEFC
6.0	Details of supply system		
	a) Rated voltage (with variation)	:	415V ± 10%
	b) Rated frequency (with variation)	:	50 Hz (Variation: +5% TO -5%)
	c) Combined voltage & freq. variation	:	10% (sum of absolute values)
	d) System fault level at rated voltage	:	50 kA for 1 sec
	e) Short time rating for terminal box	:	50 kA for 0.25 sec
	f) LV System grounding	:	Solidly
7.0	Class of insulation	:	Class 'F', with temp rise limited to class B.
8.0	Minimum voltage for starting (As percentage of rated voltage)	:	80% of rated voltage
9.0	Power cables data	:	Shall be given during Detailed engg.
10.0	Earth Conductor Size & Material	:	Shall be given during Detailed engg.
11.0	Space heater supply(30KW & ABOVE)	:	240 V, 1Φ , 50 Hz
12.0	Rating up to which Single phase motor	:	Acceptable below 0.20 Kw
13.0	TYPE OF STARTER PROVIDED IN MCC	:	DOL
14.0	Locked rotor current		
	a) Limit as percentage of FLC	:	As per IS 12615
	b) Permissible tolerance, if any	:	
15.0	Additional tests	:	As per QP
16.0	Flame-proof motor		
	a) Enclosure suitable (As per IS:2148)	:	As per requirement
	b) Classification of Hazardous area (As per IS: 5572 part-I)	:	As per requirement
	c) Degree of protection	:	IP65
17.0	Makes	:	AS PER ANNEXURE-I
18.0	Terminal box	:	Suitable to rotate at 90 degrees
19.0	Paint shade	:	Shade 632 of IS-5

	TITLE	SPECIFICATION NO.
	LV MOTOR DATA SHEET - C	VOLUME II B
		SECTION D
		REV NO. 00 DATE
		SHEET 1 OF 2

S. No.	Description	Data to be filled by successful bidder
A.	General	
1	Manufacturer & country of origin	
2	Motor type	
3	Type of starting	
4	Name of the equipment driven by motor & Quantity	
5	Maximum Power requirement of driven equipment	
6	Rated speed of Driven Equipment	
7	Design ambient temperature	
B.	Design and Performance Data	
1	Frame size & type designation	
2	Type of duty	
3	Rated Voltage	
4	Permissible variation for	
5	a) Voltage	
6	b) Frequency	
7	c) Combined voltage & frequency	
8	Rated output at design ambient temp (by resistance method)	
9	Synchronous speed & Rated slip	
10	Minimum permissible starting voltage	
11	Starting time in sec with mechanism coupled	
12	a) At rated voltage	
13	b) At min starting voltage	
14	Locked rotor current as percentage of FLC (including IS tolerance)	
15	Torque	
	a) Starting	
	b) Maximum	
16	Permissible temp rise at rated output over ambient temp & method	
17	Noise level at 1.0 m (dB)	
18	Amplitude of vibration	
19	Efficiency & P.F. at rated voltage & frequency	
	a) At 100% load	
	c) At 75% load	

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			

	TITLE	SPECIFICATION NO.
	<p style="text-align: center;">LV MOTOR</p> <p style="text-align: center;">DATA SHEET - C</p>	VOLUME II B
		SECTION D
		REV NO. 00 DATE
		SHEET 2 OF 2

S. No.	Description	Data to be filled by successful bidder
	c) At starting	
C.	Constructional Features	
1	Method of connection of motor driven equipment	
2	Applicable Standard	
3	DOP of Enclosure	
4	Method of cooling	
5	Class of insulation	
6	Main terminal box	
	a) Type	
	b) Power Cable details (Conductor, size, armour/unarmour)	
	c) Cable Gland & lugs details (Size, type & material)	
	d) Permissible Fault level (kArms & duration in sec)	
7	Space heater details (Voltage & watts)	
8	Flame proof motor details (if applicable)	
	a) Enclosure	
	b) suitability for hazardous area	
	i Zone	O / I / II
	ii Group	IIA / IIB / IIC
9	No. of Stator winding	
10	Winding connection	
11	Kind of rotor winding	
12	Kind of bearings	
13	Direction of rotation when viewed from NDE	
14	Paint Shade & type	
15	Net weight of motor	
16	Outline mounting drawing No (To be enclosed as annexure)	
D.	Characteristic curves/ drawings (To be enclosed for motors of rating $\geq 55KW$)	
	a) Torque speed characteristic	
	b) Thermal withstand characteristic	
	c) Current vs time	
	d) Speed vs time	

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			

ANNEXURE-I

SUB-VENDOR LIST

The list of approved make of the LT Motors are as mentioned below:

S.No.	LIST OF LT MOTORS
1.	BHARAT BIJLEE LTD.
2.	CROMPTON GREAVES
3.	ASEA BROWN BOVERI
4.	KIRLOSKAR ELECTRIC CO LTD.
5.	NGEF
6.	SIEMENS
7.	MARATHON
8.	GE-POWER
9.	RAJINDRA ELECT INDUSTRIES
10.	LAXMI HYDRAULICS PVT. LTD

However, the final list of makes for the LT Motors is subjected to BHEL/Customer approval, during contract stage, without any commercial implications.

SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
1.0	ASSEMBLY	1.WORKMANSHIP 2.DIMENSIONS 3.CORRECTNESS COMPLETENESS TERMINATIONS/ MARKING/COLOUR CODE	MA MA MA	VISUAL -DO- VISUAL	100% -DO- 100%	MANUF'S SPEC MFG. DRG./ MFG. SPEC. MFG.SPEC./ RELEVANT IS	MANUF'S SPEC MFG. DRG./ MFG. SPEC. MFG.SPEC. RELEVANT IS	-DO- -DO- -DO-	2 2 2	- - -	- - -	
2.0	PAINTING	1.SHADE	MA	VISUAL	SAMPLE	MANUFR'S SPEC/BHEL SPEC./RELEVANT STANDARD	BHEL SPEC. SAME AS COL.7	LOG BOOK	2	-	-	
3.0	TESTS	1.ROUTINE TEST INCLUDING SPECIAL TEST AS PER BHEL SPEC. 2.OVERALL DIMENSIONS & ORIENTATION	MA MA	-DO- MEASUREMENT & VISUAL	100% 100%	IS-325/ BHEL SPEC./ DATA SHEET APPROVED DRG/DATA SHEET	SAME AS COL.7 APPROVED DRG/DATA SHEET & RELEVANT IS	TEST REPORT INSPN. REPORT	2 2	1 1	- -	NOTE -1 & NOTE-3 NOTE -1 & NOTE-3
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									



QUALITY PLAN

SHEET 1 OF 2

CUSTOMER :

BIDDER/ :

VENDOR :

SYSTEM :

PROJECT :

TITLE :

QUALITY PLAN

NUMBER PED-506-00-Q-006, REV-01

ITEM AC ELECT. MOTORS BELOW 55KW (LV)

SPECIFICATION :

NUMBER :

SPECIFICATION

TITLE :

SECTION VOLUME III



QUALITY PLAN

CUSTOMER :
 BIDDER/ :
 VENDOR :
 SYSTEM :

PROJECT
 TITLE
 QUALITY PLAN
 NUMBER PED-506-00-Q-006, REV-01
 ITEM AC ELECT. MOTORS BELOW 55KW (LV)

SPECIFICATION :
 NUMBER :
 SPECIFICATION :
 TITLE :
 SECTION VOLUME III

SHEET 2 OF 2

SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
		3.NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPN. REPORT	2	1	-	
<p>NOTES:</p> <p>1 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON</p> <p>2 WHERE EVER CUSTOMER IS INVOLVED IN INSPECTION, (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER.</p> <p>3 FOR EXHAUST/VENTILATION FAN MOTORS OF RATING UPTO 1.5KW , ONLY ROUTINE TEST CERTIFICATES SHALL BE FURNISHED FOR SCRUTINY.</p> <p><u>Legends for Inspection agency</u></p> <p>1. BHEL/CUSTOMER 2. VENDOR (MOTOR MANUFACTURER) 3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER)</p> <p>P. PERFORM W. WITNESS V. VERIFY</p>												
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			



QUALITY PLAN

SHEET 1 OF 9

CUSTOMER :

PROJECT

SPECIFICATION :

BIDDER/ :

QUALITY PLAN

NUMBER :

VENDOR :

NUMBER PED-506-00-Q-007, REV-03

SPECIFICATION :

SYSTEM

ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)

SECTION

VOLUME III

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
1.0	RAW MATERIAL & BOUGHT OUT CONTROL											
1.1	SHEET STEEL, PLATES, SECTION, EYEBOLTS	1.SURFACE CONDITION	MA	VISUAL	100%	-	FREE FROM BLINKS, CRACKS, WAVINESS ETC	LOG BOOK	3	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANFR'S DRG./SPEC	MANFR'S DRG./SPEC	-DO-	3	-	-	
		3.PROOF LOAD TEST (EYE BOLT)	MA	MECH. TEST	-DO-	-DO-	-DO-	INSPEC. REPORT	3	-	2	
1.2	HARDWARES	1.SURFACE CONDITION	MA	VISUAL	100%		FREE FROM CRACKS, UN-EVENNESS ETC.	-DO-	3	-	-	
		2.PROPERTY CLASS	MA	VISUAL	SAMPLES	MANFR'S DRG./SPEC BOOK	RELEVANT IS/SPEC.	SUPPLIERS TC & LOG	3	-	2	PROPERTY CLASS MARKING SHALL BE CHECKED BY THE VENDOR
1.3	CASTING	1.SURFACE CONDITION	MA	VISUAL	100%		FREE FROM CRACKS, BLOW HOLES ETC.	LOG BOOK	3	-	2	
		2.CHEM. & PHY. PROP.	MA	CHEM & MECH TEST	1/HEAT NO.	MANFR'S DRG./SPEC	RELEVANT IS/	SUPPLIER'S TC	3	-	2	HEAT NO. SHALL BE VERIFIED
		3.DIMENSIONS	MA	MEASUREMENT	100%	MANFR'S DRG.	MANFR'S DRG.	LOG BOOK	3	-	2	
1.4	PAINT & VARNISH	1.MAKE, SHADE, SHELF LIFE & TYPE	MA	VISUAL	100% CONTINUOUS	MANFR'S DRG./SPEC	MANFR'S DRG./SPEC	LOG BOOK	3	-	2	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			



QUALITY PLAN	CUSTOMER :	PROJECT TITLE	SPECIFICATION : NUMBER :
	BIDDER/ VENDOR SYSTEM	QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03	SPECIFICATION : TITLE
	SHEET 2 OF 9	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)	SECTION VOLUME III

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
1.5	SHAFT (FORGED OR ROLLED)	1. SURFACE COND.	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	-	VENDOR'S APPROVAL IDENTIFICATION SHALL BE MAINTAINED
		2. CHEM. & PHYSICAL PROPERTIES	MA	CHEM. & PHYSICAL TESTS	1/HEAT NO. OR HEAT TREATMENT BATCH NO	MFG. DRG. SPEC.	RELEVANT IS	SUPPLIER'S TC	3	-	2	
		3. DIMENSIONS	MA	MEASUREMENT	100%	-DO-	MANUFR'S DRG.	LOG BOOK	3	-	2	
		4. INTERNAL FLAWS	CR	UT	-DO-	ASTM-A388	MANUFR'S SPEC. BHEL SPEC.	-DO-	3	2	1	
1.6	SPACE HEATERS, CONNECTORS, TERMINAL BLOCKS, CABLES, CABLE LUGS, CARBON BRUSH TEMP. DETECTORS, RTD, BTD'S	1. MAKE & RATING	MA	VISUAL	-DO-	MANUFR'S DRG. SPEC.	MANUFR'S DRG. SPEC.	-DO-	3	-	2	
		2. PHYSICAL COND.	MA	-DO-	-DO-	-	NO PHYS. DAMAGE, NO ELECTRICAL DISCONTINUITY	-DO-	3	-	2	
		3. DIMENSIONS (WHEREVER APPLICABLE)	MA	MEASUREMENT	SAMPLE	MANUFR'S DRG./ SPEC.	MANUFR'S DRG. / SPEC.	-DO-	3	-	2	
		4. PERFORMANCE/ CALIBRATION	MA	TEST	100%	-DO-	-DO-	INSP. REPORT	3	-	2	
BHEL			PARTICULARS		BIDDER/VENDOR							
			NAME									
			SIGNATURE									
			DATE					BIDDER'S/VENDORS COMPANY SEAL				



QUALITY PLAN

SHEET 3 OF 9

CUSTOMER :	PROJECT TITLE	SPECIFICATION : NUMBER :
BIDDER/ VENDOR :	QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03	SPECIFICATION : TITLE
SYSTEM	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)	SECTION VOLUME III

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
1.7	OTHER INSULATING MATERIALS LIKE SLEEVES, BINDINGS CORDS, PAPERS, PRESS BOARDS ETC.	1. SURFACE COND. ETC.	MA	VISUAL	100%	-	NO VISUAL DEFECTS	INSPT. REPORT	3	-	2	
		2. OTHER CHARACTERISTICS	MA	TEST	SAMPLE	MANUF'S SPEC.	MANUF'S SPEC.	LOG BOOK AND OR SUPPLIER'S TC	3	-	2	
1.8	SHEET STAMPING (PUNCHED)	1. SURFACE COND.	MA	VISUAL	100%	-	NO VISUAL DEFECTS (FREE FROM BURS)	LOG BOOK	3	-	-	
		2.DIMENSIONS INCLUDING BURS HEIGHT	MA	MEASUREMENT	SAMPLE	MANUFR'S DRG. .	MANUFR'S DRG.	-DO-	3	-	2	
		3. ACCEPTANCE TESTS	MA	ELECT. & MECH TESTS	-DO-	MANUF'S SPEC./ RELEVANT IS	RELEVANT IS	SUPPLIER'S TC	3	-	2	
1.9	CONDUCTORS	1. SURFACE FINISH	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	LOG BOOK	3*	-	2*	* MOTOR MANUFACTURER TO CONDUCT VISUAL CHECK FOR SURFACE FINISH ON RANDOM BASIS (10% SAMPLE) AT HIS WORKS AND MAINTAIN RECORD FOR VERIFICATION BY BHEL/CUSTOMER.
		2.ELECT. PROP. & MECH. PROP	MA	ELECT. & MECH.TEST	SAMPLES	RELEVANT IS/ BS OR OTHER STANDARDS	RELEVANT IS/ BS OR OTHER STANDARDS	SUPPLIERS TC & VENDOR'S INSPN. REPORTS	3	-	2	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			



QUALITY PLAN

SHEET 4 OF 9

CUSTOMER :

PROJECT
TITLE

SPECIFICATION :
NUMBER :

BIDDER/ :
VENDOR

QUALITY PLAN
NUMBER PED-506-00-Q-007, REV-03

SPECIFICATION :
TITLE

SYSTEM

ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)

SECTION VOLUME III

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
1.10	BEARINGS	3.DIMENSIONS	MA	MEASUREMENT	-DO-	-DO-	-DO-	Log Book	3	-	2	
		1.MAKE & TYPE	MA	VISUAL	100%	MANFR'S DRG./ APPROVED DATASHEET	MANFR'S DRG./ APPROVED DATASHEET	-DO-	3	-	2	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	BHEL DATA SHEET	BHEL DATA SHEET BEARING MANUF'S CATALOGUES	-DO-	3	-	2	
1.11	SLIP RING (WHEREVER APPLICABLE)	3.SURFACE FINISH	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	2	
		1.SURFACE COND.	MA	VISUAL	100%	-	-DO-	-DO-	3	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANUF'S DRG	MANUF'S DRG	-DO-	3	-	-	
		3.TEMP.WITH-STAND CAPACITY	MA	ELECT.TEST	-DO-	MANUF'S SPEC./ BHEL SPEC.	MANUF'S SPEC./ BHEL SPEC.	-DO-	3	-	2	
1.12	OIL SEALS & GASKETS	4.HV/IR	MA	-DO-	100%	-DO-	-DO-	-DO-	3	-	2	
		1.MATERIAL OF GASKET	MA	VISUAL	100%	MANUF'S DRG/SPECS	MANUF'S DRG./ SPECS.	-DO-	3	-	-	
		2.SURFACE COND.	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	-	
		3.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANUF'S DRG	MANUF'S DRG	-DO-	3	-	-	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE									BIDDER'S/VENDORS COMPANY SEAL



QUALITY PLAN

SHEET 5 OF 9

CUSTOMER :

PROJECT TITLE

SPECIFICATION : NUMBER :

BIDDER/ VENDOR

QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03

SPECIFICATION : TITLE

SYSTEM

ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)

SECTION VOLUME III

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
2.0	IN PROCESS											
2.1	STATOR FRAME WELDING (IN CASE OF FABRICATED STATOR)	1.WORKMANSHIP & CLEANNESS	MA	VISUAL	100%	-DO-	GOOD FINISH	LOG BOOK	3/2	2	-	
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	MANUF'S DRG	MANUF'S DRG	-DO-	2	-	-	
2.2	MACHINING	1.FINISH	MA	VISUAL	100%	-DO-	GOOD FINISH	LOG BOOK	2	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	MANUF'S DRG	MANUF'S DRG	-DO-	2	-	-	
		3.SHAFT SURFACE FLOWS	MA	PT	-DO-	RELEVANT SPEC./ ASTM-E165	MANUF'R'S SPEC./ BHEL SPEC./	-DO-	2	-	1	
2.3	PAINTING	1.SURFACE PREPARATION	MA	VISUAL	100%	MANFR'S SPEC/BHEL SPEC./ RELEVANT STAND	BHEL SPEC. SAME AS COL.7	LOG BOOK	2	-	-	
		2.PAINT THICKNESS (BOTH PRIMER & FINISH COAT)	MA	MEASUREMENT BY ELCOMETER	SAMPLE	-DO-	-DO-	-DO-	2	-	-	
		3.SHADE	MA	VISUAL	-DO-	-DO-	-DO-	Log Book	2	-	-	
		4.ADHESION	MA	CROSS CUTTING & TAPE TEST	-DO-	-DO-	-DO-	Log Book	2	-	-	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			



QUALITY PLAN

SHEET 6 OF 9

CUSTOMER :

PROJECT
TITLE

SPECIFICATION :
NUMBER :

BIDDER/
VENDOR

QUALITY PLAN
NUMBER PED-506-00-Q-007, REV-03

SPECIFICATION :
TITLE

SYSTEM

ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)

SECTION

VOLUME III

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS	
									P	W	V		
1	2	3	4	5	6	7	8	9	10			11	
2.4	SHEET STACKING	1.COMPLETENESS	MA	MEASUREMENT	SAMPLE	MANUFR'S SPEC.	MANUFR'S SPEC.	Log Book	2	-	-	(FOR MOTORS OF 2MW AND ABOVE) * ON 10% RANDOM SAMPLE	
		2.COMPRESSION & TIGHTENING	MA	MEASUREMENT	100%	-DO-	-DO-	Log Book	2	-	-		
		3.CORE LOSS & HOTSPOT	MA	ELECT.TEST	-DO-	-DO-	-DO-	Log Book	2	1*	1		
2.5	WINDING	1.COMPLETENESS	CR	VISUAL	100%	MANUFR'S SPEC./BHEL SPEC.	MANUFR'S SPEC./BHEL SPEC.	Log Book	2	-	-		
		2.CLEANLINESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-		
		3.IR-HV-IR	CR	ELECT. TEST	-DO-	-DO-	-DO-	Log Book	2	-	1		
		4.RESISTANCE	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1		
		5.INTERTURN INSULATION	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-		
2.6	IMPREGNATION	6.SURGE WITH STAND AND TAN. DELTA TEST	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1		FOR MV MOTOR
		1.VISCOSCITY	MA	PHY. TEST	AT STARTING	-DO-	-DO-	Log Book	2	-	-		
		2.TEMP. PRESSURE VACCUM	MA	PROCESS CHECK	CONTINUOUS	-DO-	-DO-	Log Book	2	-	-		
		3.NO. OF DIPS	MA	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	THREE DIPS TO BE GIVEN	
BHEL			PARTICULARS			BIDDER/VENDOR							
			NAME										
			SIGNATURE										
			DATE						BIDDER'S/VENDORS COMPANY SEAL				



QUALITY PLAN

SHEET 7 OF 9

CUSTOMER :

BIDDER/ VENDOR :

SYSTEM

PROJECT TITLE

QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03

ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)

SPECIFICATION : NUMBER :

SPECIFICATION : TITLE

SECTION VOLUME III

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
2.7	COMPLETE STATOR ASSEMBLY	4.DURATION 1.COMPACTNESS & CLEANLINESS	MA	-DO- VISUAL	-DO- 100%	-DO- -DO-	-DO- -DO-	Log Book	2	-	1	VERIFICATION FOR MV MOTOR ONLY
2.8	BRAZING/COMPRESSION JOINT	1.COMPLETENESS 2.SOUNDNESS	CR	-DO- MALLETT TEST & UT	-DO- -DO-	-DO- -DO-	-DO- -DO-	Log Book	2	-	-	
2.9	COMPLETE ROTOR ASSEMBLY	3.HV 1.RESIDUAL UNBALANCE	MA	ELECT. TEST DYN. BALANCE	-DO- -DO-	-DO- MFG SPEC./ ISO 1940	-DO- MFG. DWG.	Log Book	2	-	1	
		2.SOUNDNESS OF DIE CASTING	CR	ELECT. (GROWLER TEST)	-DO-	MFG. SPEC.	MFG. SPEC.	Log Book	2	-	1	
2.10	ASSEMBLY	1.ALIGNMENT	MA	MEAS.	-DO-	-DO-	-DO-	Log Book	2	-	-	
		2.WORKMANSHIP	MA	VISUAL	-DO-	-DO-	-DO-	Log Book	2	-	-	
		3.AXIAL PLAY	MA	MEAS.	-DO-	-DO-	-DO-	Log Book	2	-	1	
		4.DIMENSIONS	MA	-DO-	-DO-	MFG.DRG./ MFG SPEC.	MFG. DRG/ RELEVANT IS	Log Book	2	-	-	
		5.CORRECTNESS, COMPLETENESS TERMINATIONS/ MARKING/ COLOUR CODE	MA	VISUAL	100%	MFG SPEC. RELEVANT IS	MFG SPEC. RELEVANT IS	Log Book	2	-	-	
		6. RTD, BTD & SPACE HEATER MOUNTING.	MA	VISUAL	100%	MFG SPEC. RELEVANT IS	MFG SPEC. RELEVANT IS	Log Book	2	-	1	
BHEL			PARTICULARS		BIDDER/VENDOR							
			NAME									
			SIGNATURE									
			DATE					BIDDER'S/VENDORS COMPANY SEAL				



QUALITY PLAN

SHEET 8 OF 9

CUSTOMER :

PROJECT
TITLE

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NUMBER :

BIDDER/
VENDOR :

QUALITY PLAN
NUMBER PED-506-00-Q-007, REV-03

SPECIFICATION :
TITLE

SYSTEM

ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)

SECTION

VOLUME III

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
3.0	TESTS	1.TYPE TESTS INCLUDING SPECIAL TESTS AS PER BHEL SPEC.	MA	ELECT.TEST	1/TYPE/SIZE	IS-325/ BHEL SPEC./ DATA SHEET	IS-325/ BHEL SPEC./ DATA SHEET	TEST REPORT	2	1*	1	* NOTE - 1
		2.ROUTINE TESTS INCLUDING SPECIAL TEST AS PER BHEL SPEC.	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1 ^s	1	^s NOTE - 2
		3.VIBRATION & NOISE LEVEL	MA	-DO-	100%	IS-12075 & IS-12065	IS-12075 & IS-12065	-DO-	2	1 ^s	1	^s NOTE - 2
		4.OVERALL DIMENSIONS AND ORIENTATION	MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPC. REPORT	2	1	-	
		5.DEGREE OF PROTECTION	MA	ELECT. & MECH. TEST	1/TYPE/ SIZE	RELEVANT IS	BHEL SPEC. AND DATA SHEET	TC	2	-	1	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3
		6. MEASUREMENT OF RESISTANCE OF RTD & BTD	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1 ^s	1	^s NOTE - 2
		7. MEASUREMENT OF RESISTANCE, IR OF SPACE HEATER	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1 ^s	1	^s NOTE - 2
		8. NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPC. REPORT	2	1 ^s	1	^s NOTE - 2
		9.EXPLOSION FLAME PROOF NESS (IF SPECIFIED)	MA	EXPLOSION FLAME PROOF TEST	1/TYPE	IS-3682 IS-8239 IS-8240	IS-3682 IS-8239 IS-8240	TC	2	-	1	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3
		10. PAINT SHADE, THICKNESS & FINISH	MA	VISUAL & MEASUREMENT BY ELKOMETER	SAMPLE	BHEL SPEC. & DATA SHEET	BHEL SPEC. & DATA SHEET	TC	2	1 ^s	1	SAMPLING PLAN TO BE DECIDED BY INSPECTION AGENCY ^s NOTE - 2
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			



QUALITY PLAN

SHEET 9 OF 9

CUSTOMER :	PROJECT TITLE	SPECIFICATION : NUMBER :
BIDDER/ VENDOR :	QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03	SPECIFICATION : TITLE
SYSTEM	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)	SECTION VOLUME III

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11

NOTES:

- 1 DEPENDING UPON THE SIZE AND CRITICALLY, WITNESSING BY BHEL SHALL BE DECIDED.
- 2 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON.
- 3 IN CASE TEST CERTIFICATES FOR THESE TESTS ON SIMILAR TYPE, SIZE AND DESIGN OF MOTOR FROM INDEPENDENT LABORATORY ARE AVAILABLE, THESE TEST MAY NOT BE REPEATED.
- 4 WHEREVER CUSTOMER IS INVOLVED IN INSPECTION, AGENCY (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER.

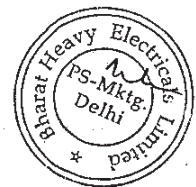
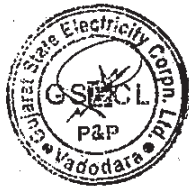
Legends for Inspection agency

1. BHEL/CUSTOMER
2. VENDOR (MOTOR MANUFACTURER)
3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER)

- P. PERFORM
W. WITNESS
V. VERIFY

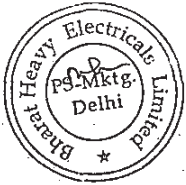
BHEL	PARTICULARS	BIDDER/VENDOR	BIDDER'S/VENDORS COMPANY SEAL
	NAME		
	SIGNATURE		
	DATE		

VOLUME : IIF/1
SECTION-II
TECHNICAL SPECIFICATION
FOR
A.C. & D.C. MOTORS



CONTENT

CLAUSE NO.	DESCRIPTION
1.00.00	SCOPE
2.00.00	STANDARDS
3.00.00	SERVICE CONDITIONS
4.00.00	TYPE AND RATING
5.00.00	PERFORMANCE
6.00.00	SPECIFIC REQUIREMENTS
7.00.00	ACCESSORIES
8.00.00	TESTS
9.00.00	DRAWINGS, DATA & MANUALS
ATTACHMENT	
ANNEXURE-A	DESIGN DATA



VOLUME : IIF/1

SECTION-II

TECHNICAL SPECIFICATION
FOR
A.C. & D.C. MOTORS

1.00.00 SCOPE

1.01.00 This section covers the general requirements of the drive motors for power station auxiliary equipment.

1.02.00 Motors shall be furnished in accordance with both this general specification and the accompanying driven equipment specification.

1.03.00 In case of any discrepancy, the driven equipment specification shall govern.

2.00.00 STANDARDS

2.01.00 All motors shall conform to the latest applicable IS, IEC and CBIP Standards/Publications except when otherwise stated herein or in the driven equipment specification.

2.02.00 Major standards, which shall be followed, are listed below other applicable Indian Standards for any component part even if not covered in the listed standards shall also be followed :

IS-325

IS-12615

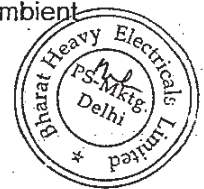
IEC-34

3.00.00 SERVICE CONDITIONS

3.01.00 The motors will be installed in hot, humid and tropical atmosphere, highly polluted at places with coal dust and/or fly ash.

3.02.00 Unless otherwise noted, electrical equipment/system design shall be based on the service conditions and auxiliary power supply given in the annexure to this specification.

3.03.00 For motor installed outdoor and exposed to direct sunrays, the effect of solar heat shall be considered in the determination of the design ambient temperature.



4.00.00 TYPE AND RATING

4.01.00 A.C. Motors

4.01.01 Motors shall be general purpose, constant speed, squirrel cage, three/single phase, induction type.

4.01.02 All motors shall be rated for continuous duty. They shall also be suitable for long period of inactivity.

4.01.03 The motor name-plate rating at 50°C shall have at least 10% margin over the input power requirement of the driven HT equipment and 15% for LT driven equipment at rated duty point unless stated otherwise in driven equipment specification or in general electrical specification.

4.01.04 The motor characteristics shall match the requirements of the driven equipment so that adequate starting, accelerating, pull up, break down and full load torques are available for the intended service.

4.01.05 All HT & LT motors shall be energy efficient type as per IS. However for HT motors, if the same is not specified in IS, minimum efficiency of all HT motors shall be considered as 90%.

4.02.00 D.C. Motors

4.02.01 D.C. motor provided for emergency service shall be shunt/compound wound type. All DC motors shall be energy efficient type with minimum efficiency of 80%.

4.02.02 Motor shall be sized for operation with fixed resistance starter for maximum reliability.

Starter panel complete with all accessories shall be included in the scope of supply.

5.00.00 PERFORMANCE

5.01.00 Running Requirements

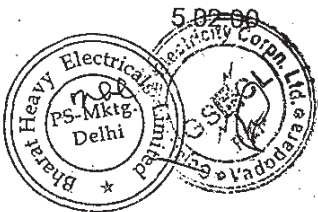
5.01.01 Motor shall run continuously at rated output over the entire range of voltage and frequency variations as given in the annexure

5.01.02 The motor shall be capable of operating satisfactorily at full load for 5 minutes without injurious heating with 75% rated voltage at motor terminals.

5.01.03 The motor shall be designed to withstand momentary overload of 60% of full load torque for 15 second without any damage.

5.02.00 Starting Requirements

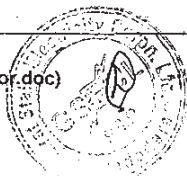
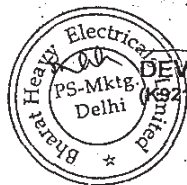
Motor shall be designed for direct online starting at full voltage. Starting current shall not exceed 6 times full load current for all HT motors except boiler feed pump motor where the starting current shall be limited to 4.5 times. No further tolerances are applicable on starting current specified above



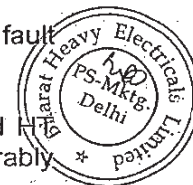
for HT motors. For LT motors, the applicable starting current shall be limited to 7.2 times of full load current including all tolerance.

- 5.02.01 The motor shall be capable of withstanding the stresses imposed if started at 110% rated voltage.
- 5.02.02 Motor shall start with rated load and accelerate to full speed with 80% rated voltage at motor terminal except BFP motor. In case of BFP motor, it shall be 80% rated voltage. Minimum starting requirement for mill motor (double cage) shall be 80% rated voltage at motor terminals. However for mill motors if the minimum starting voltage is more than 80% rated voltage at motor terminal and within 90% rated voltage, bidder shall provide necessary arrangement to keep the motor terminal voltage above that voltage to achieve smooth start of the motor.
- 5.02.03
- a) Motor shall be capable of three equally spread starts per hour, two starts in quick succession from cold condition and one restart from hot condition.
 - b) Cranking motor shall be capable of six equally spread starts per hour, three starts in quick succession from cold condition and one restart from hot condition. The coal conveyor and crusher motors shall be suitable for 3 consecutive hot starts with maximum 20 starts per day.
 - c) Pump motor subject to reverse rotation shall be designed to withstand the stresses encountered when starting with shaft rotating at 125% rated speed in reverse direction.
- 5.02.04 HT pump motors shall be suitable to start with forward rotation.
- 5.02.05 The motors shall be designed to withstand 120% of rated speed for 2 minutes without any mechanical damage
- 5.03.00 **Stress During Bus Transfer**
- 5.03.01 The motor may be subjected to sudden application of 150% rated voltage during bus transfer, due to the phase difference between the incoming voltage and motor residual voltage.
- 5.03.02 The motor shall be designed to withstand any torsional and/or high current stresses, which may result, without experiencing any deterioration in the normal life and performance characteristics.
- 5.04.00 **Locked Rotor Withstand Time**
- 5.04.01 The locked rotor withstand time under hot condition at 110% rated voltage shall be more than motor starting time by at least 2.5 seconds for motors up to 20 seconds starting time and by 5 seconds for motor with more than 20 seconds starting time.
- 5.04.02 Starting time mentioned above is at minimum permissible voltage of 80% rated voltage.
- 5.04.03 Hot thermal withstand curve shall have a margin of at least 10% over the full load current of the motor to permit relay setting within motor rated capacity.

- 6.00.00 **SPECIFIC REQUIREMENTS**
- 6.01.00 **Enclosure**
- 6.01.01 All motor enclosures for outdoor, semi-outdoor & indoor application shall conform to the degree of protection IP-55 unless otherwise specified. Motor for outdoor or semi-outdoor service shall be of weather-proof construction with canopy.
- 6.01.02 Motors for circulating water pumps of large output ratings, located indoor and not directly exposed to coal dust or fly ash, could have screen protected drip proof enclosure conforming to IP-23.
- 6.01.03 For hazardous area approved type of increased safety enclosure shall be furnished.
- 6.02.00 **Cooling**
- 6.02.01 The motor shall be self ventilated type, either totally enclosed fan cooled (TEFC) or closed air circuit air-cooled (CACW) or totally enclosed tube ventilated (TETV) type. Totally enclosed tube ventilated (TETV) type motors shall be acceptable for HT motors only.
- 6.02.02 For large capacity motors, closed air circuit water cooled (CACW) may be considered for acceptance.
- 6.03.00 **Winding and Insulation**
- 6.03.01 All insulated winding shall be of copper.
- 6.03.02 All motors shall have class F insulation but limited to class B temperature rise.
- 6.03.03 Windings shall be impregnated to make them non-hygroscopic and oil resistant.
- 6.04.00 **Tropical Protection**
- 6.04.01 All motors shall have fungus protection involving special treatment of insulation and metal against fungus, insects and corrosion.
- 6.04.02 All fittings and hardwares shall be corrosion resistant.
- 6.05.00 **Bearings**
- 6.05.01 Motor shall be provided with antifriction bearings, unless sleeve bearings are required by the motor application.
- 6.05.02 Vertical shaft motors shall be provided with thrust and guide bearings. Thrust bearing of tilting pad type is preferred.
- 6.05.03 Bearings shall be provided with seals to prevent leakage of lubricant or entrance of foreign matters like dirt, water etc. into the bearing area.
- 6.05.04 Sleeve bearings shall be split type, ring oiled, with permanently aligned, close running shaft sleeves.



- 6.05.05 Grease lubricated bearings shall be prelubricated and shall have provisions for in-service positive lubrication with drains to guard against over lubrication.
- 6.05.06 Oiled bearing shall have an integral self cooled oil reservoir with oil ring inspection ports, oil sight glass with oil level marked for standstill and running conditions and oil fill and drain plugs.
- 6.05.07 Forced lubricated or water cooled bearing shall not be used without prior approval of Owner.
- 6.05.08 Lubricant shall not deteriorate under all service conditions. The lubricant shall be limited to normally available types with IOC equivalent.
- 6.05.09 Bearings shall be insulated as required to prevent shaft current and resultant bearing damage.
- 6.06.00 **Noise & Vibration**
- 6.06.01 The noise level shall not exceed 85db (A) at 1.5 metres from the motor at no load condition.
- 6.06.02 The peak amplitude of the vibration shall be within IS/IEC specified limits.
- 6.07.00 **Motor Terminal Box**
- 6.07.01 HT Motor terminal box (Phase side) shall be Phase Segregated (PSTB) type and LT motor terminal box shall be non-phase segregated type. Both HT & LT motor terminal box shall be located in accordance with Indian Standards clearing the motor base- plate/ foundation.
- 6.07.02 Terminal box shall be capable of being turned 360 Deg. in steps of 180 Deg. for HT motors and 90 Deg. for LT motors unless otherwise approved.
- 6.07.03 The terminal box shall be split type with removable cover with access to connections and shall have the same degree of protection as motor.
- 6.07.04 The terminal box shall have sufficient space inside for termination/connection of XLPE insulated armoured aluminium cables.
- 6.07.05 Motor main terminal box shall be located right hand side of motor body looking from driving end.
- 6.07.06 Terminals shall be stud or lead wire type, substantially constructed and thoroughly insulated from the frame.
- 6.07.07 The terminals shall be clearly identified by phase markings, with corresponding direction of rotation marked on the non-driving end of the motor.
- 6.07.08 The terminal box shall be capable of withstanding maximum system fault current for a duration of 0.25 sec.
- 6.07.09 HT motor phase side terminal box shall be phase-segregated type and HT motor neutral leads shall be brought out in a separate terminal box preferably



opposite side of phase terminal box & may not be necessarily phase segregated type with shorting links for star connection.

6.07.10 Motor terminal box shall be furnished with suitable cable lugs and nickel plated double compression brass glands to match with cable used.

6.07.11 The gland plate for single core cable shall be non-magnetic type.

6.08.00 Grounding

6.08.01 The frame of each motor shall be provided with two separate and distinct grounding pads complete with tapped hole, GI bolts and washer.

6.08.02 The grounding connection shall be suitable for accommodation of ground conductors as follows :

HT Motor (11kV, 6.6kV & 3.3 kV) : 75 X 10 mm GS Flat

LT Motor above 90 KW : 50 x 6 mm GS Flat

Motor above 30 KW up to 90 KW : 35 x 6 mm GS Flat

Motor above 5 KW up to 30 KW. : 25 x 3 mm GS Flat

Motor up to 5 KW : 8 SWG GI Wire

6.08.03 The cable terminal box shall have a separate grounding pad.

6.09.00 Rating Plate

In addition to the minimum information required by IS, the following information shall be shown on motor rating plate :

- a) Temperature rise in Deg.C under rated condition and method of measurement.
- b) Degree of protection.
- c) Bearing identification no. and recommended lubricant.
- d) Location of insulated bearings.

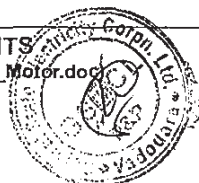
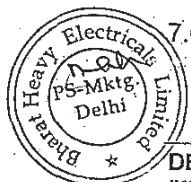
7.00.00 ACCESSORIES

7.01.00 General

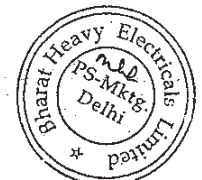
Accessories shall be furnished, as listed below, or if otherwise required by driven equipment specification or application.

7.02.00 Space Heater

7.02.01 Motor of rating 30 KW and above shall be provided with space heaters, suitably located for easy removal or replacement.



- 7.02.02 The space heater shall be rated 240 V, 1 phase 50 Hz and sized to maintain the motor internal temperature above dew point when the motor is idle.
- 7.03.00 **Temperature Detectors**
- 7.03.01 All 11000V, 6600V and 3300V motors shall be provided with twelve (12) nos. simplex type winding temperature detectors, four (4) nos. per phase. Six (6) nos. duplex type winding temperature detectors, two (2) nos. per phase shall only be acceptable for special application motors only subject to approval of owner.
- 7.03.02 11000V, 6600V and 3300V motor bearing shall be provided with duplex type temperature detectors.
- 7.03.03 The temperature detector mentioned above shall be resistance type, 3 wire, platinum wound, 100 Ohms at 0°C.
- 7.03.04 Leads of all simplex type motor winding RTDS and motor bearing RTDS shall be wired up to respective switchgear metering & protection compartment. From which one set of RTDS will be connected to numerical protection relay and another set shall be kept free for DCS connectivity.
- 7.03.05 Five numbers of Temperature detectors / thermisters shall be provided for L.T. motors above 90 KW (3 nos. winding temperatures & 2 nos. bearing temperatures)
- 7.04.00 **Indicator/Switch**
- 7.04.01 Dial type local indicator with alarm contacts shall be provided for the following:
- a) 11000 V, 6600V and 3300V motor bearing temperature.
 - b) Hot and cold air temperature of the closed air circuit for CACA and CACW motor.
- 7.04.02 Flow switches shall be provided for monitoring cooling water flow of CACW motor and oil flow of forced lubrication bearing, if used.
- 7.04.03 Alarm switch contact rating shall be minimum 0.5 A at 220V D.C. and 5A at 240V A.C.
- 7.05.00 **Current Transformer for Differential Protection**
- 7.05.01 Motor 1000 KW and above shall be provided with three differential current transformers mounted over the neutral leads within the enclosure. Loose 3 nos. CT for mounting on switchgear side shall be in bidder's scope.
- 7.05.02 The arrangement shall be such as to permit easy access for C.T. testing and replacement. Current transformer characteristics shall match Owner's requirements to be intimated later.
- 7.06.00 **Accessory Terminal Box**



7.06.01 All accessory equipment such as space heater, temperature detector, current transformers etc., shall be wired to and terminated in terminal boxes, separate from and independent of motor (power) terminal box.

7.06.02 Accessory terminal box shall be complete with double compression brass glands and pressure type terminals to suit cable connections.

7.07.00 **Drain Plug**

Motor shall have drain plugs so located that they will drain the water, resulting from the condensation or other causes from all pockets of the motor casing.

7.08.00 **Lifting Provisions**

Motor weighing 25 Kg. or more shall be provided with eyebolt or other adequate provision of lifting.

7.09.00 **Dowel Pins**

The motor shall be designed to permit easy access for drilling holes through motor feet or mounting flange for installation of dowel pins after assembling the motor and driven equipment.

7.10.00 **Painting**

Motor including fan shall be painted with corrosion proof paints of colour battle ship grey shade 632 of IS-5.

8.00.00 **TESTS**

Routine and Type Tests are to be conducted in presence of customer's representative as per IS:325 and required copies of test certificates are to be furnished for approval. In addition, following tests shall have to be carried out on the motors in presence of OWNER's representative on 3.3kV/6.6kV/11kV motors.

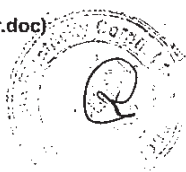
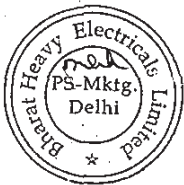
- a. Impulse test by 1.2 / 50 micro sec. On sample coil of Stator winding insulation as type test as per IEC-60034, part -15 test voltages as under :

Voltage rating of motor	Impulse Test Voltage
3.3 kV	18 kV peak
6.6 kV	31 kV peak
11 kV	49 kV peak

- b. Tan delta, charging current and dielectric loss measurements on each phase of motor stator winding as routine test.

- c. Polarization Index Test as per IS:7816 as routine test

- d. Test for suitability of IPW- 55 (Weather proof) as per IS 4691 as type test. Type test certificate for first numeral shall be acceptable in lieu of test, provided the test motor is identical to motor being supplied.



Second numeral test shall be carried out on one motor of each type and rating.

- e. Fault Withstand Test for main terminal box as type test. Type test certificate shall be acceptable, if the test is conducted on exactly identical terminal box.
- f. Test for noise level as routine test.
- g. Test for vibration as routine test.
- h. Tan delta measurement on coils.
- i. Surge withstand test for inter turn insulation.

Tests indicated at (h), (i), shall be carried out during manufacture of the coils and shall be furnished for verification.

Furnished type test certificates of motor shall not be older than five (5) years from the date of Inspection, otherwise type test shall be conducted without any price implication.

9.00.00 DRAWINGS, DATA & MANUALS

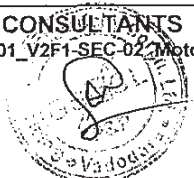
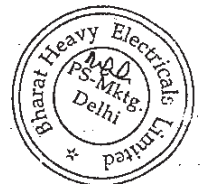
Drawings, data & manuals for the motors shall be submitted as indicated below:

9.01.00 Along with the bid

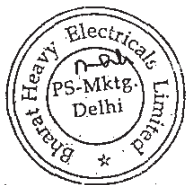
- a) List of the motors
- b) Individual motor data sheet as per format of the proposal data sheets.
- c) Scheme & write up on forced lubrication system, if any
- d) Type test report

9.02.00 After Award of the Contract

- a) Dimensional General Arrangement drawing
- b) Foundation Plan & Loading
- c) Cable end box details
- d) Space requirement for rotor removal
- e) Thermal withstand curves hot & cold
- f) Starting and speed torque characteristics at 80% & 100% voltage
- g) Complete motor data
- h) Erection & Maintenance Manual



- i) Test reports
- j) Data sheets to be enclosed



ANNEXURE-A
DESIGN DATA

1.0 AUXILIARY POWER SUPPLY

Supply	Description	Consumer
H.T. Supply	11000 V, 3Ø, 3W, 50 Hz, non-effectively earthed	Motors above 2000 KW & all mill motors
	Fault level 44 KA symm.	
	3300 V, 3Ø, 3W, 50 Hz, non-effectively earthed	Motors above 160 KW upto and including 2000 KW
	6600 V, 3Ø, 3W, 50 Hz, non-effectively earthed	Motors of CHP system and Water System above 160kW
	Fault level 40 KA symm for 3300V & 6600V	
L.T. Supply	415V, 3Ø, 3W, 50 Hz effectively earthed	Motors upto and including 160KW
	Fault level 50 KA symm.	
	240V, 1Ø, 2W, 50 Hz effectively earthed	Lighting, space hea- ting, A.C. control & protective devices
D.C. Supply	220V, 2W, unearthed	D.C. alarm, control & protective devices
	Fault level 25* KA.	

* Indicative only, the actual value will be decided by the Bidder, after substantiating the same by calculation.

2.0 RANGE OF VARIATION

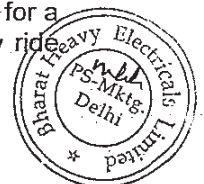
A.C. Supply :

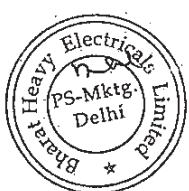
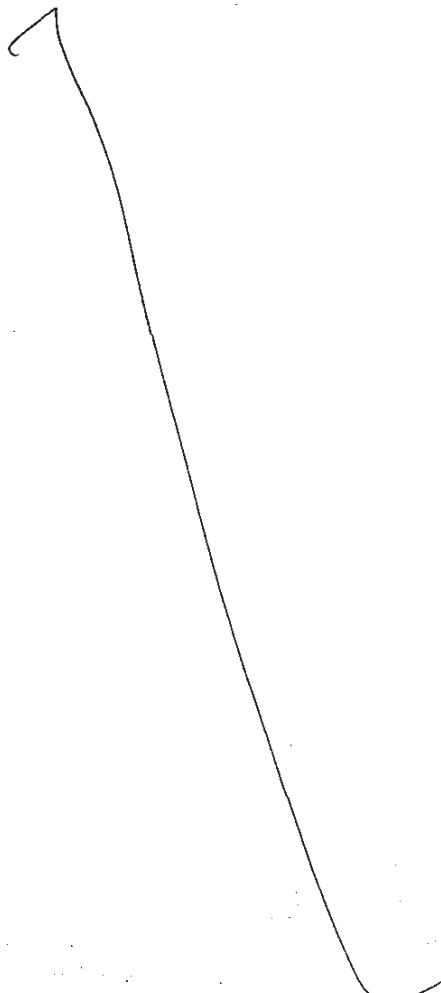
Voltage : $\pm 10\%$ Frequency : $\pm 5\%$ Combined Volt : 10% (absolute sum)
+ frequency

During starting of large motor, the voltage may drop to 80% of the rated voltage for a period of 60 seconds. All electrical equipment while running shall successfully ride over such period without affecting system performance.

D.C. Supply :

Voltage : 187 to 242 Volt

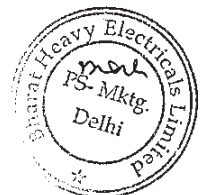




VOLUME : IIF/2

SECTION-IV

TECHNICAL SPECIFICATION
FOR
CABLES

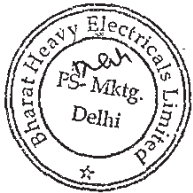


CONTENT

CLAUSE NO.	DESCRIPTION
1.00.00	SCOPE OF SUPPLY
2.00.00	CODES & STANDARDS
3.00.00	DESIGN CRITERIA
4.00.00	SPECIFIC REQUIREMENTS
5.00.00	TESTS
6.00.00	DRAWINGS DATA & MANUALS

ATTACHMENTS

ANNEXURE-A	RATINGS AND REQUIREMENTS - H.V POWER CABLES (11KV, 6.6KV & 3.3 KV)
ANNEXURE-B	RATINGS AND REQUIREMENTS - L.V POWER CABLES
ANNEXURE-C	RATINGS AND REQUIREMENTS - CONTROL CABLES
ANNEXURE-D	RATINGS AND REQUIREMENTS - 1.1KV FS POWER CABLE
ANNEXURE-E	RATINGS AND REQUIREMENTS - 1.1KV FS CONTROL CABLE
ANNEXURE-F	RATINGS AND REQUIREMENTS - FLEXIBLE TRAILING CABLES
ANNEXURE-G	CABLE SIZES



DEVELOPMENT CONSULTANTS
(K9213R-EPC-SPC-001_V2F2-SEC-04_Cables.DOC)

074

SECTION-IV

TECHNICAL SPECIFICATION
FOR
CABLES

1.00.00 SCOPE OF SUPPLY

1.01.00 Power and Control Cables shall cover the requirement of entire Plant including the switchyard. The cables shall be furnished in accordance with this specification and annexure.

Other cables including special cables if any which are necessary as per proven engineering practice for satisfactory & trouble free operation of the entire cable system of the plant shall also be within the scope of supply. These shall include all such cables for electrical integral with mechanical equipment systems and subsystems.

1.02.00 Cable shall be furnished in accordance with this specification and the following annexures :

- a) 11 kV, 6.6kV & 3.3 kV Power cables : Annexure - A
- b) 1100V Power Cables : Annexure – B
- c) Control Cables : Annexure – C
- d) Fire Survival Cables : Annexure – D & E
- e) Flexible Trailing cable : Annexure – F

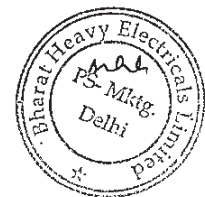
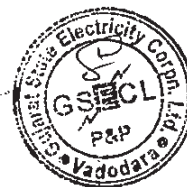
1.03.00 All relevant drawings, data and instruction manuals

2.00.00 CODES & STANDARDS

2.01.00 All cable and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) and IEC except where modified and/or supplemented by this specification.

2.02.00 Cable and material conforming to any other standard which ensures equal or better quality, may be accepted. In such case, copies of the English version of the standard adopted shall be submitted along with the bid.

2.03.00 The electrical installation shall meet the requirements of Indian Electricity Rules as amended upto date and relevant IS Code of Practice. In addition, other rules and regulations applicable to the work shall be followed.



3.00.00 DESIGN CRITERIA

- 3.01.00 Cables will be generally laid on ladder type trays, perforated type cable trays or drawn through rigid steel conduits [Rigid steel conduits shall be used for interconnection of cables from near-by cable tray to equipment where cable tray cannot be installed as well as to prevent mechanical damage of cables for critical equipment. Moreover in dust prone area the lay out of cable tray shall be in vertical plane].
- 3.02.00 For continuous operation at specified rating, maximum conductor temperature shall be limited to the permissible value as per relevant standard and/or this specification which one is more stringent.
- 3.03.00 The insulation and sheath materials shall be resistant to oil, acid and alkali and shall be tough enough to withstand mechanical stresses during handling.
- 3.04.00 Armouring shall be single round wire of galvanized steel for multicore cables and aluminum for single core cable for power and control cables. For fire survival control cable, the armouring over inner sheath shall consist of single layer of wire / round galvanized steel wire as per IS 3975 amended upto date. For Fire survival power cable, Single core cables to be used in A.C. system, the armouring over inner sheath shall consist of single layer of round copper wire, for multi-core cables to be used in A.C. system and single/two core cables in D.C. System, the armouring over inner sheath shall consist of single layer of round galvanized steel wire.
- 3.05.00 The outer sheath shall have flame retardant low smoke halogen evolution (FRLS) characteristics or fire survival characteristics as applicable and shall meet the requirements of additional tests specified for the purpose.
- 3.06.00 Core identification for multicore cable shall be provided by colour coding.
- 3.07.00 HT cables shall be manufactured by triple extrusion dry cured (CCV) process using pressurized nitrogen.

4.00.00 SPECIFIC REQUIREMENTS

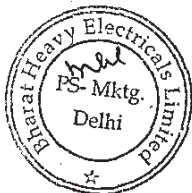
4.01.00 General Description

All Cables shall be furnished in strict compliance with ratings and requirements and sizes as given in Annexures to this Specification.

4.02.00 Drum Length and Tolerance

The cables shall be supplied in non-returnable packing steel drum for 11 kV, 6.6 kV & 3.3 kV power cables, wooden drums for 1100V power and control cables, each containing minimum 500 meters length of larger sizes of cable unless specifically asked for. For smaller sizes of cables, each drum shall contain 1000 meters length of cable. Allowable tolerance on individual drum length is $\pm 5\%$.

4.03.00 Non-Standard Length



076



- Non-standard lengths upto 5% of the total ordered quantity may be accepted. However the Contractor will be required to obtain approval before packing the Cables on drums. Non-standard lengths shall not be less than 100 metres in any case.

4.04.00 Cable identification

Cable identification shall be provided by embossing on every meter on the outer sheath the following :

- a) GSECL
- b) Manufacturer's name or trade mark
- c) Voltage grade
- d) Year of manufacture
- e) Type of insulation, e.g. XLPE/PVC/HR85/IE2 etc.
- f) No. of core and size of cables.
- g) Type of improved fire performance, e.g. FR/FRLS/FS
- h) IS number

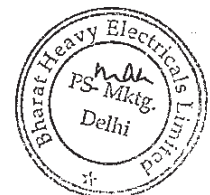
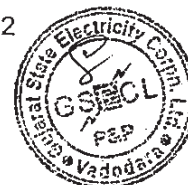
4.05.00 Packing

4.05.01 Cables shall be supplied in non returnable drums. The drums shall be of heavy construction. All wooden parts shall be manufactured from seasoned wood. All ferrous parts used shall be treated with suitable rust preventive finish or coating to avoid rusting during transit or storage. Wooden cable drum shall be treated by immersing in copper-nitrate solution.

4.05.02 Cable shall be wound and packed on drums in such a manner that it will be properly sealed and firmly secured to the drum. The ends of each length shall be sealed before shipment.

4.05.03 The cable drums should carry the following details in printed form:

- a) MSPGCL
- b) Manufacturer's name or trade make
- c) Type of cable & voltage grade
- d) Year of manufacture
- e) Type of insulation e.g. XLPE/HRPVC/IE2
- f) No. of core and size of cables
- g) Cable code e.g. FRLS/FS
- h) Length of cable on drum



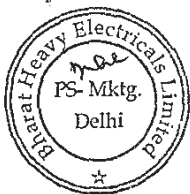
- i) No. of length on drum, if more than one
- j) Direction of rotation, by arrow
- k) Approx. gross mass.
- l) IS/IEC number and ISI mark

4.06.00 **Joints and Terminations**

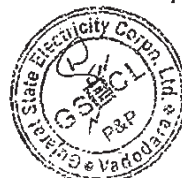
Materials of construction for a joint/termination shall perfectly match with the dielectric chemical and physical characteristics of the associated cables. The material and design concepts shall incorporate a high degree of operating compatibility between the cable and joints. The protective outer covering (jacket) used on the joints/terminations shall have the same qualities as that of the cable outer sheath in terms of ambient/operating temperature withstand capability and resistance to hazardous environments and corrosive elements. Straight through joints and terminations for HT cables shall be heat shrinkable type.

4.07.00 **Selection Criteria**

- 4.07.01 a) HT and LT power cables shall be selected on the basis of current carrying capacity, short circuit rating and permissible voltage drop.
- b) While sizing power cables, following aspects shall be reckoned:
 - i) Ground/Ambient Air temperature
 - ii) Depth of Laying.
 - iii) Power Cables touching each other.
- c) Cables, for circuit breaker controlled feeders, shall withstand the short circuit current for the fault clearing time. 0.2 Sec.
- d) HT cables shall be sized based on the following considerations:
 - Rated current of the equipment and ground/ambient temperature.
 - Touching/spacing of cable.
 - Depth of laying.
 - The voltage drop of the cable , during motor starting condition , shall be limited to 15% and during full load running condition shall be limited to 3 % rated voltage. Other outgoing feeder /transformer feeder shall be limited to 3% rated voltage.
 - Short circuits withstand capability
- e) For fuse/MCCB/Breaker protected circuits the conductor size shall depend upon full load current subject to voltage drop limited to 3% during running of all feeders and 15% during starting for motor feeders. In addition, transformer regulation shall also be considered



078



for loads fed from 415V PMCC. In case of other outgoing line feeder voltage drop shall be limited to 3%.

- f) For loads fed from local panels, the total running voltage drop in cable from 415V PMCC to local panel and from local panel to individual motor shall be limited to 3% at full load motor current while the same during starting shall be limited to 15%.
- g) As per national electric code (NEC) current rating capacity of motor feeder/cables should be 125% of full load current.
- h) For welding receptacle, 3% running drop shall only be considered.

The minimum sizes of L.T cable to be chosen are as below:

AL - 16 mm² (3 core) & 16mm² (2 core); Cu - 2.5 mm²

4.07.02 Apart from above, consideration shall also be given to limit the cable to some standard sizes instead of using too many types.

4.07.03 The standard cable sizes, amp capacities, derating factors, as given in IS/IEC will be generally followed.

4.07.04 a) For breaker protected circuits minimum size of the cable shall be as follows:

1100V Power Cable : 240 Sq mm XLPE AL

6600V & 3300V Power Cable : 185 Sq mm XLPE AL

11000V Power Cable : 240 Sq mm XLPE AL

b) For motor circuits the selection of size will be made ensuring that the cable shall withstand a short circuit fault directly following a second hot start.

4.07.05 For fuse/MCCB protected circuit, the conductor size will depend on full load current subject to voltage drop not exceeding 3%. For practical purposes, the minimum size chosen is as below :

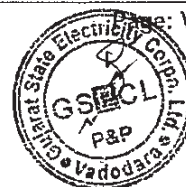
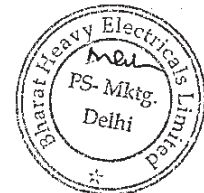
a) Aluminium : 16 Sq mm.

b) Copper : 2.5 Sq mm.

4.07.06 All control cables shall be 2.5 Sq mm stranded copper cable.

4.07.07 Multicore control cables will generally have spare conductor (s) in accordance with the following chart :

Conductors required	Cables
1 or 2	1-3/C
3 or 4	1-5/C
5 or 6	1-7/C



7 or 8	1-9/C
9 or 10	1-12/C
Above 10	Two or more of above cables

4.07.08 Separate cables for each type of following services/functions as applicable shall be used for each feeder. Same multicore cable using different services shall not be acceptable.

- a) Power.
- b) Control, interlock and indication.
- c) Metering and measuring.
- d) Alarm and annunciation.
- e) C.T. Cables.
- f) V.T. Cables.

4.08.00 **Cable Identification**

Cable identification shall be provided by embossing on the outer sheath the following :

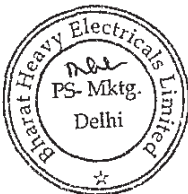
- a) Manufacturer's name or trade mark
- b) Manufacturer's name or trade mark
- c) Voltage grade
- d) Year of manufacture
- e) Type of insulation, e.g. XLPE, HRPVC & IE2 etc.
- f) No. of core & size of cables
- g) Type of outer sheath e.g. FRLS, FS etc.

4.09.00 Selected sizes of power and control cables are given in Annexure-G.

4.10.00 Fire Survival Cables shall be used for important auxiliaries / area as recommended by Standard Technical Specification by CEA as below for the following :

Fire Survival Power & Control Cables shall be used for important auxiliaries/ areas like:

- i. DC emergency lube oil pump
- ii. DC hydrogen seal pump
- iii. Turbine lube oil pump/barring gear



- iv. DC emergency lighting for main building and service building
- v. DC cables for battery to charger & DC distribution boards
- vi. Jacking oil pump
- vii. Emergency turbine trip in control room
- viii. Boiler Turbine : Generator inter trip which include the interconnection between
 - Boiler master fuel trip and turbine trip relays
 - Generator trip relays & turbine trip relays
 - Generator trip relays & generator breaker
 - Generator trip relays & field breaker
 - Generator trip relays & unit auxiliary transformer breaker
 - Incomer cables for DG board, emergency board, DC lighting board etc.

5.00.00 TESTS

5.01.00 Shop Tests

The Cables shall be subject to shop tests in accordance relevant IS/IEC standards to prove the design and general qualities of the Cables as below:

5.01.01 Routine tests on each drum of cables.

5.01.02 Acceptance Tests on 1 drum out of every 10 drums chosen at random for acceptance of the lot for every size.

5.01.03 Type test on each type and size of cable, inclusive of measurement of armour DC resistance of power cables on one drum out of every 10 drums of cable.

5.02.00 Additional Tests

Following additional acceptance tests shall also be performed on each type of cables having outer sheath with improved fire performance (Type FRLS, FS):

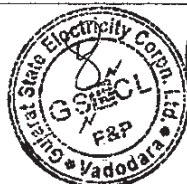
5.02.01 Oxygen index test

The Oxygen index shall not be less than 29.

5.02.02 Temperature Index Test

The measured value of temperature index shall be 21 at a temperature of 250°C for FRLS cables and 350°C for FS cables

5.02.03 Flame Retardance test on single cable and on bunched cables



After the test, there should be no visible damages on the test specimen within 300mm from its upper end.

After burning has ceased, the cables should be wiped clean and the charred or affected portion should not have reached a height exceeding 2.5 meter above the bottom edge of the burner, measured at the front and rear of the cable assembly. 3 Hours fire rating test shall be carried out for FS cable as per IEC331

5.02.04 Halogen acid gas evolution test

The level of HCL evolved shall not exceed 20 per cent by weight. HCL evolved shall not be exceed 2% for FS cable.

5.02.05 Smoke density test

The test shall be smoke generation by the outer sheath under fire as per ASTM D 2843. The FRLS cables shall meet the requirements of light transmission of minimum 40% after the test. Minimum transmission shall be 80% for Fire Survival cables.

5.02.06 Test for specific optical density of smoke

The cables shall meet the requirements of IS/IEC.

5.02.07 Test for rodent & termite repulsion property

The test shall be carried out to note the presence of rodent and termite repelling chemical in PVC compound. Normal procedure is that a few chippings of the PVC compound are slowly ignited in a porcelain dish or crucible in a muffle furnace at about 600°C. The resulting ignited ash is boiled with a little ammonium acetate solution (10%)... A drop of aqueous sodium sulphide solution is placed on a thick filter paper and it is allowed to soak. The spot is touched with a drop of above extract. A black spot indicates the presence of anti-termite & rodent compound.

Flammability test shall be carried on finished cables as per following standards-

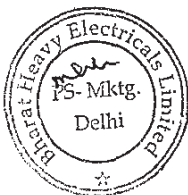
- a) Swedish Chimney test – SS: 424-14-75
- b) IEEE std.383 – 1974 latest
- c) IEC std. 332-1 and IEC 331

5.03.00 Test Witness

Tests shall be performed in presence of Owner/Purchaser's representative. The Contractor shall give at least thirty (30) days' advance notice of the date when the tests are to be carried out.

5.04.00 Test Certificates

5.04.01 Certified reports of all the tests carried out at the works shall be furnished for approval of the Owner/Purchaser.



5.04.02 Test reports shall be completed with all details and shall also contain IS/IEC specified limit values, wherever applicable, to facilitate review.

5.04.03 The cables shall be dispatched from works only after receipt of Owner/Purchaser's written approval of the test reports.

6.00.00 **DRAWINGS, DATA & MANUALS**

6.01.00 Drawings, Data and Manuals shall be submitted with the bid and for approval/reference and subsequent distribution after the issue of Letter of Intent in quantities and procedures as specified in General condition of contract and/or elsewhere in this specification.

6.02.00 **To be submitted with the Bid**

- a) Manufacturer's catalogues giving cable construction details and characteristics.
- b) Cable current ratings for different types of installation, inclusive of derating factors for ambient temperature, grouping etc.
- c) Write-up on Manufacturer's recommended method of splicing, jointing, termination etc. of the cables.
- d) Type test reports on 11 KV, 6.6KV, 3.3 KV Power, LT FRLS Power & control, FS power and control cables
- e) Filled-up proposal particulars.

6.03.00 **To be submitted after award of contract**

6.03.01 Guaranteed Technical Particulars

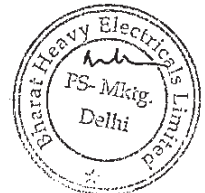
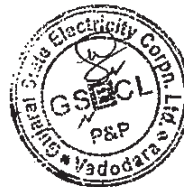
6.03.02 Quality assurance plan

6.03.03 Shop Test reports

6.03.04 **Instruction manuals**

The manual shall clearly indicate method of laying, termination, check-ups and tests to be carried out before commissioning.

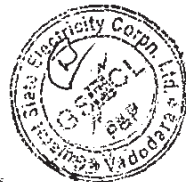
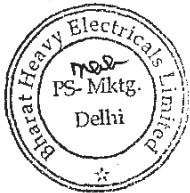
6.04.00 The bidder may note that the drawings, data and manuals listed herein are minimum requirement only. The bidder shall ensure that all other necessary write-up, information, etc required to fully describe the cable are to be submitted with the bid.



ANNEXURE-A

RATINGS AND REQUIREMENTS
HV POWER CABLES (11 KV, 6.6KV & 3.3 KV)

- 1.0 11000/11000V, 6600/6600V & 3300/3300V grade 90°C continuous rating under normal condition and 250°C rating under short circuit condition heavy duty XLPE power cable suitable for use in 11000V/6600V/3300V non-effectively earthed system conforming to following requirement and in line with IS-7098, IS-8130, IS-5831 & IS-3975, manufactured by Triple Extrusion Dry Cure (CCV) process using pressurized Nitrogen.
- 1.1 Conductor : Stranded and compacted aluminium conductor of grade H2 & class 2 for all sizes, generally conforming to IS: 8130.
- 1.2 Conductor Screen : Extruded semi-conducting compound.
- 1.3 Insulation : Extruded cross linked polyethylene (XLPE) conforming to IS: 7098 (Part-2)
- 1.4 Insulation Screen : Extruded semi-conducting compound with a layer of non-magnetic metallic tape. For single core armoured cables, the armouring shall constitute the metallic part of screening. The semi-conducting tape shall be easily strippable.
- 1.5 Core Identification : By coloured strips applied on (For three core cables) cores or by numerals.
- 1.6 Inner Sheath : Extruded HRPVC/FRLS compound conforming to type ST2 of IS: 5831 for three core cables. Single core cables shall have inner sheath. Filler material shall also be of type ST2 PVC.
- 1.7 Armour : Galvanised single round steel wire armour for twin and multicore cables.
Non-magnetic hard drawn aluminum single round wire conforming to H4 of IS-8130 latest for single core cables
- 1.8 Overall Sheath : Extruded FRLS HRPVC compound conforming to type ST2 of IS: 5831.
- 1.9 Drum : Steel Drum

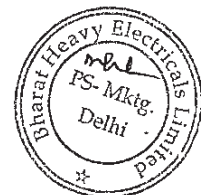
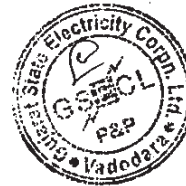


ANNEXURE-B

RATINGS AND REQUIREMENTS
LV POWER CABLES [1.1KV (XLPE TYPE)]

- 1.0 1100 V grade, 90°C continuous rating under normal condition and 250°C under short circuit condition rating, XLPE heavy duty, power cable conforming to following requirement and in line with IS 7098 Part-I. IS 8130 & IS 5831 and IS 3975.
- 1.1 Conductor : Stranded and compacted plain aluminium of grade H2 and class 2 stranded, high conductivity annealed plain copper for cable sizes upto 2.5 mm² conforming to IS:8130.
- 1.2 Insulation : Extruded cross-linked polyethylene (XLPE) conforming to IS: 7098 (Part-1)
- 1.3 Core Identification : By color coding
- 1.4 Inner Sheath : Extruded HRPVC FRLS compound conforming to type ST2 of IS: 5831 for multicore cable. Single core cables shall have no inner sheath. Filler shall be of same material as of inner sheath i.e. ST2
- 1.5 Armour : Galvanized single round steel wire armour for twin and multicore cables.

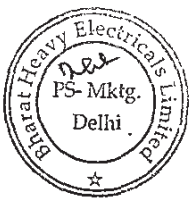
Non-magnetic hard drawn aluminum single round wire conforming to H4 of IS-8130 latest for single core cables
- 1.6 Overall Sheath : Extruded FRLS HRPVC compound conforming to type ST2 of IS: 5831.
- 1.7 Drum : Conforming to IS-10418 (Wooden drum)



ANNEXURE-C

RATINGS AND REQUIREMENTS
CONTROL CABLES

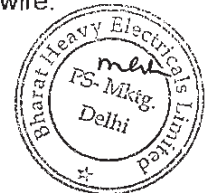
- 1.0 1100 V grade 85°C continuous rating under normal condition and 160°C under short circuit condition rating HRPVC Control cable (YWY) conforming to following requirement and in line with IS:1554, IS:8130, IS:5831 and IS:3975.
- 1.1 Conductor : Stranded, non-compacted & circular, high conductivity annealed plain copper, generally conforming to IS: 8130.
- 1.2 Insulation : Extruded HRPVC type-C compound conforming to IS: 5831. The minimum volume resistivity of insulation shall be 3.5×10^{14} ohm-cm at 27°C and 3.5×10^{11} OHM-CM at 85°C.
- 1.3 Core Identification : By color coding and numbering at interval of 100mm or less
- 1.4 Inner sheath : Extruded HRPVC compound conforming to type ST2 FRLS of IS: 5831 for multicore cables. Single core cables shall have no inner sheath. Filler shall be of same material as of inner sheath i.e. ST2.
- 1.5 Armour : Galvanised single round steel wire for twin and multicore cables.
- 1.6 Overall sheath : Extruded FRLS HRPVC compound conforming to type ST2 of IS: 5831.
- 1.7 Drum : conforming to IS: 10418 (Wooden drum)



ANNEXURE-D

RATINGS AND REQUIREMENTS
(1.1KV GRADE COPPER CONDUCTOR FS POWER CABLES)

- 1.1 Conductor : Conductor shall be of stranded construction, consisting of high conductivity annealed tinned copper wires conforming to Class-II of IS 8130.
- A suitable heat barrier tape, preferably glass mica tape shall be provided over the conductor.
- 1.2 Insulation : The insulation shall consist of heat resisting electrometric material EPR (Ethylene Propylene rubber) and shall conform to Type IE-2 of IS: 6380/1984 amended up to date.
- 1.3 Laying up of cores
(For multicore cables only) : The core shall be suitably identified in accordance with IS: 9968 (Part-I).
- The suitable fire retardant material fillers shall be used for filling in the interstices.
- Two layers of plain glass fibre binder tape shall be applied over the laid up cores.
- 1.4 Inner Sheath : An inner sheath of extruded special low smoke and very low halogen content (acid gas generation shall be less than 2% by weight) elastomeric (HOFR) compound of black colour conforming to Type SE-3 of IS - 6380/1984, ammended up to date, shall be provided over the laid up cores. This shall be provided even for single core cables after providing two layers of plain glass fibre tape over the insulation.
- 1.5 Armour : For Single core cables to be used in A.C. system, the armouring over inner sheath shall consist of single layer of round copper wire.
- For multi-core cables to be used in A.C. system and single/two core cables in D.C. System, the armouring over inner sheath shall consist of single layer of round galvanised steel wire.

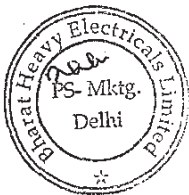


1.6 Outer Sheath

The extruded outer sheath shall be of special low smoke and very low halogen content (acid gas generation shall be less than 2% by weight) elastomeric HOFR compound comprising of synthetic rubber and shall generally conform to the type SE-3 of IS: 6380 latest revision.

Minimum value of 'Tensile Strength' and 'Percentage elongation at rupture' shall be 8 Newton/sq.mm. and 250% respectively.

The colour of outer sheath shall be black or any other colour agreed mutually between Owner & Contractor.

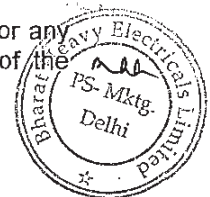


ANNEXURE-E

RATINGS AND REQUIREMENTS
(1.1KV GRADE COPPER CONDUCTOR FS CONTROL CABLES)

- 1.1 Conductor : It shall be of stranded construction, consisting of high conductivity annealed tinned copper conductors conforming to IS:8130 / 1984 amended upto date.
A suitable heat barrier tape, preferably glass mica tape shall be provided over conductor.
- 1.2 Insulation : The conductor insulation shall consist of heat resisting elastomeric material EPR (Ethelene Propylene rubber) and shall conform to type IE-2 of IS: 6380/1984 latest revision.
- 1.3 Laying up of cores
(For multicore cables only) : The core shall be suitably identified in accordance with IS: 9968 (Part-I)
The suitable fire retardant material fillers shall be used for filling in the interstices.
Two layers of plain glass fiber binder tape shall be applied over the laid up cores.
- 1.4 Inner Sheath : An inner sheath of extruded very low halogen (acid gas generation shall be less than 2% by weight) elastomeric HOFR compound of black colour or any other natural colour with prior approval from Owner conforming to Type SE3 of IS 6380 / 1984 amended upto date shall be provided over the laid up cores.
- 1.5 Armour : The armouring over inner sheath shall consist of single layer of wire / round galvanised steel wire as per IS 3975 amended upto date.
- 1.6 Outer Sheath : The outer sheath shall be of special low smoke and very low halogen content (acid gas generation shall be less than 2% by weight) elastomeric HOFR compound comprising of synthetic rubber and shall generally conform to the type SE-3 of IS:6380 latest revision.

The colour of outer sheath shall be black or any other natural colour with prior approval of the Owner.



ANNEXURE-F

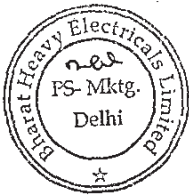
RATINGS AND REQUIREMENTS
FLEXIBLE TRAILING CABLES

i) 6600 V Unearthed Grade

Flexible trailing cable, annealed plain copper conductor, Class-5 of IS-8130, insulated with EPR, conductor and insulation shielded with EPR, cores screened with ATC wire braiding, cores laid up, HD CSP inner sheathed, proof cotton taped and FRLS HD CSP sheathed overall, conforming to IS:9968. Alternatively PCP sheathing may be acceptable.

ii) 1100 V Grade

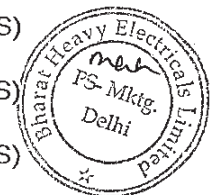
1100 V Grade trailing cable shall be plain copper of Class-5 of IS-8130, heat resistant elastomeric compound based on EPR insulation, inner sheath of heat resistant elastomeric compound PCP sheath, nylon cord reinforcement and heat resistant, oil resistant and flame retardant heavy duty elastomeric compound FRLS CSP outer sheath.



ANNEXURE-G

CABLE SIZES

Sl. No.	Cable Size	Conductor	Insulation
1.0	H. T. CABLES (11kV)		
1.1	1 core 630 Sq.mm	AL	XLPE (FRLS)
1.2	3 core 400 Sq.mm	AL	XLPE (FRLS)
1.3	3 core 240 Sq.mm	AL	XLPE (FRLS)
1.4	1 core 70 Sq.mm	AL	XLPE (FRLS)
1.0	H. T. CABLES (6.6kV & 3.3kV)		
1.1	1 core 630 Sq.mm	AL	XLPE (FRLS)
1.2	3 core 300 Sq.mm	AL	XLPE (FRLS)
1.3	3 core 240 Sq.mm	AL	XLPE (FRLS)
1.4	3 core 185 Sq.mm	AL	XLPE (FRLS)
1.5	1 core 70 Sq.mm	AL	XLPE (FRLS)
2.0	L. T. POWER CABLES		
2.1	3 core 2.5 Sq.mm	CU	XLPE (FRLS)
2.2	3 or 4 core 4.0 Sq. mm	CU	XLPE (FRLS)
2.3	3 or 4 core 10 Sq.mm	CU	XLPE (FRLS)
2.4	2 core 16 Sq.mm	AL	XLPE (FRLS)
2.5	3 core 16 Sq.mm	AL	XLPE (FRLS)
2.6	4 core 16 Sq.mm	AL	XLPE (FRLS)
2.7	2 core 35 Sq.mm	AL	XLPE (FRLS)
2.8	3 core 35 Sq.mm	AL	XLPE (FRLS)
2.9	4 core 35 Sq.mm	AL	XLPE (FRLS)
2.10	3 core 70 Sq.mm	AL	XLPE (FRLS)



Sl. No.	Cable Size	Conductor	Insulation
2.11	3.1/2 core 70 Sq.mm	AL	XLPE (FRLS)
2.12	3 core 95 Sq.mm	AL	XLPE (FRLS)
2.13	3.1/2 core 95 Sq.mm	AL	XLPE (FRLS)
2.14	3 core 185 Sq.mm	AL	XLPE (FRLS)
2.15	3.1/2 core 185 Sq.mm	AL	XLPE (FRLS)
2.16	3 core 240 Sq.mm	AL	XLPE (FRLS)
2.17	3.1/2 core 240 Sq.mm	AL	XLPE (FRLS)
2.18	3 core 300 Sq.mm	AL	XLPE (FRLS)
2.19	3.1/2 core 300 Sq.mm	AL	XLPE (FRLS)
2.20	1 core 630 Sq.mm	AL	XLPE (FRLS)
3.0	CONTROL CABLE		
3.1	2 core 2.5 Sq.mm	CU	HRPVC (FRLS)
3.2	3 core 2.5 Sq.mm	CU	HRPVC (FRLS)
3.3	5 core 2.5 Sq.mm	CU	HRPVC (FRLS)
3.4	7 core 2.5 Sq.mm	CU	HRPVC (FRLS)
3.5	9 core 2.5 Sq.mm	CU	HRPVC (FRLS)
3.6	12 core 2.5 Sq.mm	CU	HRPVC (FRLS)
3.7	20 core 2.5 Sq.mm	CU	HRPVC (FRLS)
4.0	FS POWER CABLES		
4.1	3 core 2.5 Sq.mm	CU	EPR
4.2	2 core 16 Sq.mm	CU	EPR
4.3	3 core 16 Sq.mm	CU	EPR
4.4	4 core 16 Sq.mm	CU	EPR
4.5	2 core 35 Sq.mm	CU	EPR

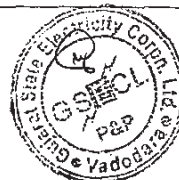
DEVELOPMENT CONSULTANTS

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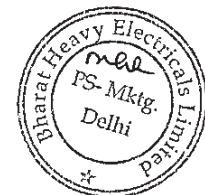
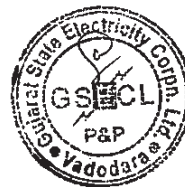
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Sl. No.	Cable Size	Conductor	Insulation
4.6	3 core 35 Sq.mm	CU	EPR
4.7	4 core 35 Sq.mm	CU	EPR
4.8	3 core 95 Sq.mm	CU	EPR
4.9	3.1/2 core 95 Sq.mm	CU	EPR
5.0	FS CONTROL CABLE		
5.1	2 core 2.5 Sq.mm	CU	EPR
5.2	3 core 2.5 Sq.mm	CU	EPR
5.3	5 core 2.5 Sq.mm	CU	EPR
5.4	7 core 2.5 Sq.mm	CU	EPR
5.5	9 core 2.5 Sq.mm	CU	EPR
5.6	12 core 2.5 Sq.mm	CU	EPR



SECTION: C-4
TECHNICAL SPECIFICATION (C&I PORTION)

	1X800 MW Wanakbori STPP	SECTION: C SUB SECTION : C&I
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	

TABLE OF CONTENTS

- A. General & Specific Technical requirement
- B. C&I deliverables list
- C. Specification for Motorized valve actuator
- D. Specification for field instruments
- E. PLC specification
- F. Control panels specification
- G. Drive control philosophy
- H. Applicable codes and standards
- I. Specification for Quality assurance & Testing
- J. Mandatory spares
- K. Drawings

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	1X800 MW Wanakbori STPP	SECTION: C SUB SECTION : C&I
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	

**GENERAL & SPECIFIC TECHNICAL
REQUIREMENT**

|

	1X800 MW Wanakbori STPP	SECTION: C SUB SECTION : C&I
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	

GENERAL REQUIREMENT

1.0 Bidder shall provide complete and independent control & instrumentation system with all accessories, auxiliaries and associated equipments for the safe, efficient and reliable operation of auxiliary systems.

2.0. The quantity of instruments for auxiliary system shall be as per tender P & ID, wherever provided, for the respective system as a minimum for bidding purpose. However, Bidder shall also include in his proposal all the instruments and devices that are needed for the completeness of the plant auxiliary system/ equipment supplied by the bidder, even if the same is not specifically appearing in the P & ID. During detail engineering if any additional instruments are required for safe & reliable operation of plant, bidder shall supply the same without any price implication.

3.0 Measuring instruments/equipment and subsystems offered by the bidder shall be from reputed experienced manufacturers of specified type and range of equipment, whose guaranteed and trouble free operation has been proven. Further all the instruments shall be of proven reliability, accuracy, and acceptable international standards and shall be subject to employer's approval. All instrumentation equipment and accessories under this specification shall be furnished as per technical specification, ranges, makes/ numbers as approved by the employer' during detail engineering.

4.0 The necessary root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifold and all the other accessories required for mounting/ erection of these local instruments shall be furnished, even if not specifically asked for, on as required basis. The contacts of equipment mounted instruments; sensors, switches etc for external connection including spare contacts shall be wired out to suitably located junction boxes.

5.0 In case of any contradiction most stringent clause/condition shall prevail.

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	1X800 MW Wanakbori STPP	SECTION: C SUB SECTION : C&I
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	

Specific Technical Requirements (C&I):

1) Operation and control of compressed air system shall be as per design philosophy given elsewhere in the specification. Integrated microprocessor based control system shall be provided for each Instrument Air compressor & Service air compressor. PLC based master controller for all compressors, driers shall be provided by Bidder. The PLC shall be located in the compressor control room. One(1) no. OWS (Operator Works Station) and one(1) no. OEWS(Operator cum Engineering Work Station) with 24” colour TFT monitor, one(01) no.A3 size color laser printer, keyboard, mouse, etc. shall be provided by the bidder. OWS/EWS shall be provided with anti-glare coating. In addition to OWS operation, hardware based monitoring / control / annunciation shall be provided for the systems where HMI workstations are not envisaged or need for such back up is strongly recommended by Bidder for the safe shutdown of the system. The Complete PLC based control system with OWS, Laptop, Printer, desk along with furniture shall be in Bidder’s scope. PC for OWS shall be of workstation grade. Additional laptop loaded with engineering software shall be provided.

All PT, DPT, TE (including winding and bearing temperature of compressor motor) outside the compressor skid shall also be hooked up to this system. Redundant MODBUS (on RS-485) link shall be provided between plant DCS & this microprocessor system for monitoring of all the parameters of compressed air system. In addition to the MODBUS link, provision for hardwired START, STOP, LOAD & UNLOAD commands from main plant DCS to all the compressors & their status feedbacks shall also be provided. All necessary hardware and software shall be under the bidder’s scope. Bidder to confirm all the above requirements stated above in their scope of supply. Bidder to furnish the configuration diagram of Microprocessor Based Control System showing communication with the PLC along with the bid. Group control is envisaged in PLC to clock more or less equal number of running hours for each Compressor. Bidder to furnish write-up & logics for group control of compressors.

2) All individual compressor and drier local panels shall be hardwired interfaced in addition to soft link connectivity with the PLC (master controller).

3) Compressors and driers shall be controlled from local control panel(microprocessor based/PLC) to be located on compressors and dryer units (non-air conditioned area). Control and protection logic will be implemented in the local panels.

4) Individual gauge board (as per manufacturer’s standard) shall be provided near each compressor where pressure, temperature and flow gauges are to be mounted for local indication of all important parameters such as pressure,temperature, flow related to the compressor.

	1X800 MW Wanakbori STPP	SECTION: C SUB SECTION : C&I
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	

5) Individual gauge board (as per manufacturer's standard) shall be provided near each Air Drying plant for local indication of all important parameters such as pressure, temperature, flow related to the driers.

6) Bidder shall provide all measuring instruments with required accessories for control, monitoring, protection and interlock of the compressors and driers.

Electronic analog signal transmission from field transmitters to area control rooms shall be 4-20 mA DC. All process switches, limit switches and drive feed back signals shall be provided with potential free contact. Temperature detector will be provided at each stage of the compressed air system and cooling water system of compressors for monitoring in the local control panel.

a) The control system shall meet the requirement of monitoring, sequential starting/stopping of drives, interlock and protection, individual/sequential control metering, annunciation and on-line and all other routine functions with minimum operator's intervention.

b) In line flow gauge & flow switch shall be provided on the cooling water line of the compressed air system.

7) Dew point measurement shall be provided for each Air drying plant of Compressed air system. The output of the instrument shall be 4-20 mA DC to be connected to the master controller panel.

8) PLC control system shall be time synchronized with the Master clock system of the main plant to ensure uniform time indication throughout the Plant. The required provision (IRIG-B) shall be made by the bidder at the PLC end to achieve the same.

9) The software and hardware for offered PLC system shall be of latest version and shall be upgradable. Bidder to ensure the availability of spares and service support for the offered PLC system for minimum 20 years after guarantee period. The software tool shall have facility to interface with third party software packages. Easy up gradation and future expansion facility shall be available. All softwares used shall be licensed versions only. All software user licenses shall be valid for entire life of power plant and shall be in the name of customer. User shall not have to pay any recurring license fee during the usage period of the system.

It shall be possible to upgrade the installed system with the latest available version of the software model during the plant life.

10) All electrical actuators shall be non-integral type.

11) The make/model of various instruments/items/systems shall be subject to approval of owner/purchaser during detailed engineering stage. No commercial implication in this regard shall be acceptable. In case of any conflict and repetition of clauses in the specification, the more stringent requirements among them are to be complied with.

	1X800 MW Wanakbori STPP	SECTION: C SUB SECTION : C&I
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	

12) The solenoid valves shall have limit switches for open/close feedback.

13) Interface of MCC, HT SWGR, Actuators etc. with PLC based control system shall be as per Drive Control Philosophy attached in the specification. The attached philosophy is for DCS based control system. However, the same is applicable for PLC/Microprocessor as well.

14) All the instruments/drives shall be terminated on JBs/Panels in field. JBs/Panels shall be in Bidder's scope. RTD's shall be of duplex type.

15) Scope of Instrumentation cables (Screened Control Cables), Fibre Optic cable & Control cables shall be as per Electrical Cable scope matrix in Electrical portion of specification. Any cable in Bidder's scope shall be as per specification.

16) Redundant 230 VAC UPS feeders shall be provided by BHEL at a single point. Further distribution to various instruments/PLC/OWS/ etc. shall be in Bidder's scope. Bidder to include necessary power distribution board (ACDB) (as per details attached elsewhere in this specification) in his scope. Any power supply other than the above, if required by any instrument/device, has to be derived by the Bidder from the above supply and all necessary hardware for the same shall be in bidder's scope. Bidder to furnish UPS power requirement along with the bid.

17) Bidder shall provide Customer training on the proper application and maintenance of PLC/Microprocessor Hardware & Software at Vendor's work or at Wanakbori site.

- 18) Following documents to be furnished by the bidder along with the bid:
- Proposed PLC/Microprocessor system configuration drawing with write-up
 - Duly stamped and signed copy of Quality Plan.
 - Product catalogues and specifications for PLC/Microprocessor as well as HMI application.
 - Requirement of electronic earthing, if any, for PLC based control system

19) Ergonomically & aesthetically designed furniture viz. control desks & Chairs shall be provided for workstations, programming stations, PCs and various peripherals at control room/computer room/equipment room. Furniture shall include documentation racks, tables for laydown etc. Control Desk profile shall be in line with drawing K9213R-DWG-I-0161.

20) Bidder to comply with codes and standards as mentioned in the specification.

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	1X800 MW Wanakbori STPP	SECTION: C SUB SECTION : C&I
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	

21) All local gauges, transmitters and switches shall be mounted on suitable enclosures, racks subject to owner's approval. All transmitters shall be HART compatible.

22) Bidder to delegate /depute their persons/experts as per owner/consultants' requirement.

23) Bidder must offer general tools and tackles and special calibration instruments required during start-up, trial run, operation and maintenance of the system.

24) The above given scope is indicative & minimum. Any item/ equipment not indicated above however required for the completeness of the system is to be supplied by bidder without any technical, commercial and delivery implication to BHEL.

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1.00.00 **GENERAL**

1.01.00 In conformity with the guidelines provided in the specification, the scope of works shall completely cover all Instrumentation & Control equipment, functions, activities and documentation specified under the accompanying Technical Specifications and shall not be limited to the following:

- a) Detailed design and engineering of the manufactured equipment; system integration and system engineering.
- b) Complete manufacture including shop testing before shipment.
- c) Specifying, procurement, quality inspection of bought-out items from sub-suppliers. Design co-ordination for and integration with bought-out items.
- d) Coordination, integration and interface between various BOP control systems such as Water Pretreatment plant, Demineralized Water plant, Coal Handling Plant, Ash Handling Plant, ETP etc. and the station DCS for centralized monitoring & selective operation.
- e) Providing engineering drawings, documents, licensed copy of software and developmental tools, data, instruction, operation and maintenance manual etc. for Owner's review / approval / record.
- f) Arranging for Owner's inspection and testing of manufactured as well as bought-out items at the respective works.
- g) Packaging and transportation of instruments, equipments, accessories and erection hardware from the manufacturer's works to the site, including transit insurance.
- h) Pre-assembly (if any), erection, testing and commissioning of all equipments and instruments supplied, in totality.
- i) Performing availability tests, Performance and Guarantee tests.
- j) Prepare and submit approved & as-built drawings and documents in hard and soft copies.
- k) Furnishing of spares, tools and tackle and test instruments.
- l) Fulfilling post-commissioning liabilities.
- m) Arranging for the training of Owner's personnel of different categories at manufacturer's works as well as plant site.
- n) Other activities detailed in subsequent sections of the Specification.
- o) Any other activity, not mentioned explicitly, but felt essential by Bidder for successful completion of work.

1.02.00 Requirements enumerated in this specification are qualitative in nature and are based on typical configuration of various BOP plants for the purpose of bidding. It shall be the responsibility of Bidder to offer Instrumentation &

- Control system to meet the actual functional requirements of the BOP systems offered.
- 1.03.00 Operation and control of various BOP systems like Water system, Coal Handling plant, Ash Handling plant, Compressed air system, Ventilation & AC system, DM plant, PT plant, CW treatment system, DG set, , Fuel unloading system etc. shall be carried out from redundant PLC / Microprocessor based control system. There may be other systems where control is not critical. In such cases hardwired / relay based interlock shall be envisaged.
- However, hardware based monitoring / control / annunciation shall be provided for the systems where HMI workstations are not envisaged or need for such back up is strongly recommended by Bidder for the safe shutdown of the BOP systems.
- 1.04.00 In case of any conflict or contradiction between any two or more sections of this specification the more stringent condition shall generally be applicable. Owner, however, reserves the right to relax this condition at his discretion.
- 1.05.00 Type of control vis-a vis the plant area are delineated below
- 1.05.01 Plant Auxiliaries System:
- a) DM Cooling Water System & process Heat exchangers
 - b) Condenser Cooling Water (CW system) with tube cleaning system.
 - c) Auxiliary Cooling Water System (ACW system) with self-cleaning strainers.
 - d) Condensate Transfer (CT) pump
 - e) DM Service Water (DMSW) pumps
 - f) Mill Reject Handling System
 - g) Fuel Oil Pressurizing & Heating System
 - h) Condensate On-line Polishing Unit
 - i) Chemical Feed system
- 1.05.02 Interface with Other Off site Plants under BOP Package
- Data acquisition / indication of selected parameters / selective operation (as required) from the following off site plants to station DCS are foreseen through MODBUS / OPC protocol:
- a) Pretreatment Plant;
 - b) Demineralization Plant;
 - c) Coal Handling plant;
 - d) Fuel Oil Unloading & Storage;

- e) Turbine Oil Purification system;
- f) ETP Plant;
- g) Ash Handling Plant;
- h) Fire sensing and protection system;
- i) Compressed air system;
- j) AC & Ventilation System.

1.05.03 Off Site Plants shall be operated from their local control stations located in the respective plant local control rooms. Some of the Plants shall have limited operational facility from Central Control Room as well.

1.05.04 All PLC based based control systems for plant auxiliaries and other offsite plants shall be powered from separate redundant UPS. Local control panels for such systems shall be kept in air condition environment.

1.05.05 Control matrix for the Auxiliaary system & off-site systems shall be in general as below:

SL. No.	AUX.SYSTEM / PLANT	CONTROL SYSTEM	CONTROL LOCATION	DCS INTERFACE
A.	Plant Auxiliaries System			
a)	DM Cooling Water System (Turbine)	DCS	DCS Monitoring & Operation from Central Control Room	
b)	DM Cooling Water System (Boiler)	DCS	DCS Monitoring & Operation from Central Control Room	
c)	CW system	Through Remote I/O Cabinet to DCS	DCS Monitoring & Operation from Central Control Room	
d)	ACW system	Through Remote I/O Cabinet to DCS	DCS Monitoring & Operation from Central Control Room	
e)	Condenser tube cleaning system	PLC	Local operating panel .	Hardware connectivity for alarm and monitoring.
f)	Mill Reject Handling	Redundant PLC	Operator stations in local	MODBUS Soft link for remote

SL. No.	AUX.SYSTEM / PLANT	CONTROL SYSTEM	CONTROL LOCATION	DCS INTERFACE
			Control Room	monitoring
f)	Instrument Air & Service Air Compressors & air drying plant	Microprocessor based control for each compressor with master controller	Individual unit with operator interface & PC based master Operating Staion with 24" TFT monitor in Compressor Room.	MODBUS Soft link for remote monitoring
g)	Fire sensing and protection system for Entire Plant.	Microprocessor based Intelligent Detectors & PLC based Fire Water Pump control System	Microprocessor based Main Fire Alarm Panel in Control Room & Local panel in Fire Water Pump House. One repeater Fire Alarm Panel in existing Fire Station and depending on distance cabling interface shall be decided by Bidder.	Hard wired interface to DCS for monitoring and status indication.
h)	Pretreatment Plant	Redundant PLC	Within the boundary limit of PTPlant	MODBUS Soft link for remote monitoring

NOTE: As per concept of integration of control system Bidder may consider propriatory control systems as integrated part of DCS.

1.05.06 Considering the high ambient noise and electromagnetic interference prevailing in power plant, communication links between off-site controls and plant DCS shall be based on Optical Fiber Communication (OFC) along with necessary hardware at both ends.

2.00.00 DESIGN PHILOSOPHY

2.01.00 General design philosophy outlined in Vol IIE Section 1 of the specification shall apply to plant auxiliaries as well.

2.02.00 PLC systems shall be time synchronized with the GPS Master Clock. Bidder shall arrange for the necessary ports and cable for the purpose as well.

3.00.00 INSTRUMENT & SYSTEM PHILOSOPHY

3.01.00 Fuel Oil Pressurising & Heating System

- button station will incorporate one lockable "STOP" push button and located near respective equipment.
- 3.11.15 Manual Override of solenoid Valve
- Local override operation knob to be provided on the solenoid valves.
- 3.11.16 Bidder shall provide necessary mimic diagram and other graphic displays depicting the entire bottom ash and fly ash evacuation system as part of the operator system.
- 3.11.17 Suitable alarm / annunciation system shall be provided for all local control panels to warn of any mal-functioning of the ash handling system.
- 3.11.18 Remote/Local selection of drives will be provided at MCC / Switch Gear. Local Start/Stop facility will be provided near each drive. During Local operation, safety protection interlocks shall not be bypassed.
- 3.11.19 All HT motors shall be provided with Duplex RTDs and current transducers, which shall be interfaced with the PLC for monitoring purpose.
- 3.11.20 Control & monitoring of Electrical distribution system, namely PCC, Bus coupler, Incomer, etc. for this plant shall be controlled from its monitoring station as well as from respective switchgear unit. Control system for the same shall be implemented in the local PLC envisaged in the AHP control room. Bidder shall consider all transducers for monitoring of voltage, current, KWh, power factor at respective monitor station.
- 3.12.00 Compressed Air Plant
- 3.12.01 Microprocessor based control system (preferably PLC based) with LCD colour graphic terminal has been envisaged for operation and control of air compressors and dryer unit.
- 3.12.02 There shall be one master controller for the compressor & dryer control system. This master controller (PLC or microprocessor based) shall be located in the compressor control room. One number operating cum programming station with 24" TFT PC monitor and printer shall be provided with this master controller.
- 3.12.03 All individual compressor and drier local panels shall be hardwired interfaced with this common PLC panel.
- 3.12.04 Required hardware/soft link interface between master controller and DCS shall be provided for remote, monitoring , alarm and selective operation as required.
- 3.12.05 Compressors and driers shall be controlled from local control panel to be located on compressors and dryer units (non-air conditioned area). Control and protection logic will be implemented in the local panels.
- 3.12.06 Individual gauge board (as per manufacturer's standard) shall be provided near each compressor where pressure, temperature and flow gauges are to be mounted for local indication of all important parameters such as pressure, temperature, flow related to the compressor.

- 3.12.07 Individual gauge board (as per manufacturer's standard) shall be provided near each Air Drying plant for local indication of all important parameters such as pressure, temperature, flow related to the driers.
- 3.12.08 Bidder shall provide all measuring instruments with required accessories for control, monitoring, protection and interlock of the compressors and driers. Electronic analog signal transmission from field transmitters to area control rooms shall be 4-20 mA DC. All process switches, limit switches and drive feed back signals shall be provided with potential free contact. Temperature detector will be provided at each stage of the compressed air system and cooling water system of compressors for monitoring in the local control panel.
- a) The control system shall meet the requirement of monitoring, sequential starting/stopping of drives, interlock and protection, individual/sequential control metering, annunciation and on-line and all other routine functions with minimum operator's intervention.
- b) In line flow gauge & flow switch shall be provided on the cooling water line of the compressed air system.
- 3.12.09 Dew point measurement shall be provided for each Air drying plant of compressed air system. The output of the instrument shall be 4-20 mA DC to be connected to the master controller panel.
- ~~3.13.00 Fuel Oil Unloading System~~
- 3.13.01 The Fuel Oil Unloading System shall be controlled from PLC based local control system or relay based system. No operator work station has been envisaged for this system. The system shall be operated from Lamp / Pushbuttons, selector switches etc located on the panel. Integral type hardware annunciation system shall be provided at the top of the panel for alarm monitoring. Important parameters i.e. tank levels, oil flow, oil temperature etc. from this panel shall be monitored in the station DCS via RIO considered for Fuel Oil Pressurising & Heating System. Facility shall be provided in the PLC for connecting laptop for programming.
- 3.13.02 Level signals from HFO/LDO day tank shall be connected to DCS via hardwired link for control of HFO/LDO transfer pumps. Bidder shall keep these signals terminated in suitable terminal blocks of the local panel.
- 3.14.00 Ventilation And AC System
- 3.14.01 For detail Instrumentation systems, operation & control philosophy refer Vol IIB.
- 4.00.00 **TECHNICAL SPECIFICATION – CONTROL SYSTEM**
- 4.01.00 Brief technical specification of the PLC based control systems are delineated below.
- 4.01.01 Programmable Logic Controller (PLC) based control system shall have 1:1 hot redundant configuration. Central Processing Units (CPUs) shall have word length of 32 bits minimum.

	1X800 MW Wanakbori STPP	SECTION: C SUB SECTION : C&I SHEET 8 of 17
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	

C&I DELIVERABLES LIST

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LIST OF DELIVERABLES OF PEM - C&I DEPARTMENT							
1X800 MW WANAKBORI TPP							
DOCUMENT NUMBER PE-GL-408-145-I100							
Sl.No.	DRAWING NO.	DRAWING/DOCUMENT TITLE	CATEGORY	CUSTOMER	FROM	USER	REMARKS
INSTRUMENTATION							
1	PE-V9-408-XXX-1901	INSTRUMENT DATA SHEETS	A	-	VENDOR	C&I	
2	PE-V9-408-XXX-1902	INSTRUMENT SCHEDULE	I	-	VENDOR	C&I	
3	PE-V9-408-XXX-1903	INSTRUMENT INSTALLATION/ HOOK UP DIAGRAMS	A	-	VENDOR	C&I	
4	PE-V9-408-XXX-1904	FIELD JB TERMINATIONS /GROUPING DOCUMENT	I	-	VENDOR	C&I	
5	PE-V9-408-XXX-1905	QUALITY PLANS (CV,FE, Tx and Analyser)	A	-	VENDOR	C&I	
PLC PANEL							
1	PE-V9-408-XXX-1906	PLC CONFIGURATION DRAWING	A	A	VENDOR	C&I	
2	PE-V9-408-XXX-1907	PLC PANEL GA (INTERNAL & EXTERNAL) DRAWING	A	-	VENDOR	C&I	
3	PE-V9-408-XXX-1908	CONTROL SCHEMES (BLOCK LOGIC)	A	-	VENDOR	C&I	
4	PE-V9-408-XXX-1909	PLC INPUT / OUTPUT SIGNAL LIST	I	-	VENDOR	C&I	
5	PE-V9-408-XXX-1910	UPS BATTERY CHARGER/ BATTERY DATASHEET & SLD	I	\$\$	VENDOR	C&I	
6	PE-V9-408-XXX-1911	UPS SIZING CALCULATIONS	I	-	VENDOR	C&I	
7	PE-V9-408-XXX-1912	BATTERY SIZING CALCULATIONS	I	-	VENDOR	C&I	
8	PE-V9-408-XXX-1913	CONTROL DESK LAYOUT / GA DRAWING	A	-	VENDOR	C&I	
9	PE-V9-408-XXX-1914	PLC-OWS/PRINTER FURNITURE BOM	A	-	VENDOR	C&I	
10	PE-V9-408-XXX-1915	PLC CONTROL ROOM LAYOUT DRAWING	A	-	VENDOR	C&I	
11	PE-V9-408-XXX-1916	PLC CATALOGUE	I	-	VENDOR	C&I	
12	PE-V9-408-XXX-1917	PLC QUALITY PLAN & FAT PROCEDURE	A	-	VENDOR	C&I	
13	PE-V9-408-XXX-1918	LIST OF SIGNAL EXCHANGE WITH DDCMIS (BOTH HARDWIRED & SERIAL INTERFACE IN BHEL FORMAT)	A	-	VENDOR	C&I	
14	PE-V9-408-XXX-1919	PROCESS GRAPHIC MANUSCRIPTS PLC	I	-	VENDOR	C&I	
15	PE-V9-408-XXX-1920	PROCESS GRAPHIC MANUSCRIPTS FOR DDCMIS	I	-	VENDOR	C&I	
16	PE-V9-408-XXX-1921	CABLE SCHEDULE (IN BHEL EXCEL FORMAT) & CABLE INTERCONNECTION DETAILS	I	-	VENDOR	C&I	
17	PE-V9-408-XXX-1923	PANEL & ELECTRONIC EARTHING REQUIREMENT	I	-	VENDOR	C&I	
18	PE-V9-408-XXX-1924	PANEL HEAT DISSIPATION DATA	I	-	VENDOR	C&I	
19	PE-V9-408-XXX-1925	MANDATORY SPARES BILL OF MATERIAL	A	A	VENDOR	C&I	
20	PE-V9-408-XXX-1926	PLC O & M MANUAL	I	-	VENDOR	C&I	
21	PE-V9-408-XXX-1927	PLC EARTHING SCHEME	I	-	VENDOR	C&I	
	Notes:	408 - Project No.					
		XXX -MAX Package Code					
		\$\$ -Approval by BHEL if Vendor BBU Item. Approval by Customer if Customer BBU Item					

	1X800 MW Wanakbori STPP	SECTION: C SUB SECTION : C&I SHEET 9 of 18
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	

**SPECIFICATION FOR MOTORISED VALVE
ACTUATOR**

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**SPECIFICATION
FOR
MOTORISED VALVE ACTUATOR**

SPECIFICATION NO.: PE-ID-408-145-I902

VOLUME II B

SECTION D

REV. NO. 00 DATE: 04.04.15

SHEET 1 OF 3

Data Sheet A & B

DATA SHEET-A
(TO BE FILLED BY PURCHASER)

DATA SHEET-B
(TO BE FILLED-UP BY BIDDER)

408

GENERAL*	* PROJECT		
	OFFER REFERENCE		
	* TAG NO. SERVICE		
	* DUTY	<input type="checkbox"/> ON / OFF <input type="checkbox"/> INCHING	
	* LINE SIZE (inlet/outlet): MATERIAL		
	* VALVE TYPE	<input type="checkbox"/> GLOBE <input type="checkbox"/> GATE <input type="checkbox"/> REG. GLOBE <input type="checkbox"/> BUTTERFLY	
	* OPENING / CLOSING TIME		
	* WORKING PRESSURE		
	AMBIENT CONDITION	SHALL BE SUITABLE FOR CONTINUOUS OPERATION UNDER AN AMBIENT TEMP. OF 0-55 DEG C AND RELATIVE HUMIDITY OF 0-95%	
	VALVE SEAT TEST PRESS	BIDDER TO SPECIFY	
REQUIRED VALVE TORQUE	BIDDER TO SPECIFY		
ACTUATOR RATED TORQUE	BIDDER TO SPECIFY		
CONSTRUCTION AND SIZING	CONSTRUCTION	TOTALLY ENCLOSED, WEATHER PROOF, IPW:55	
	MECHANICAL POSITION INDICATOR	TO BE PROVIDED FOR 0-100% TRAVEL	
	BEARINGS	DOUBLE SHIELDED, GREASE LUBRICATED ANTI-FRICTION.	
	GEAR TRAIN FOR LIMIT SWITCH/TORQUE SWITCH OPERATION	METAL (NOT FIBRE GEARS). SELF-LOCKING TO PREVENT DRIFT UNDER TORQUE SWITCH SPRING PRESSURE WHEN MOTOR IS DE-ENERGIZED.	
	SIZING	OPEN/CLOSE AT RATED SPEED AGAINST DESIGNED DIFFERENTIAL PRESSURE AT 85% OF RATED VOLTAGE. FOR ISOLATING SERVICE THREE SUCCESSIVE OPEN-CLOSE OPERATIONS OR 15 MINS. WHICHEVER IS HIGHER FOR INCHING SERVICE - 150 STARTS/HR MINIMUM & FOR REGULATING SERVICE - 600 STARTS/HR MINIMUM.	
HANDWHEEL	* REQUIRED	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	
	* ORIENTATION	<input type="checkbox"/> TOP MOUNTED <input type="checkbox"/> SIDE MOUNTED	
	*TO DISENGAGE AUTOMATICALLY DURING MOTOR OPERATION.		
ELECTRIC ACTUATOR	ACTUATOR MAKE/MODEL	BIDDER TO SPECIFY	
	MOTOR MAKE / MODEL / TYPE / RATING (KW)	BIDDER TO SPECIFY	
	@ MOTOR TYPE	SQUIRREL CAGE INDUCTION MOTOR, STARTING CURRENT LIMITED TO SIX TIMES THE RATED CURRENT- INCLUSIVE OF I.S. TOLERANCE	
	ACTUATOR APPLICABLE WIRING DIAGRAM	<input checked="" type="checkbox"/> ENCLOSED (BIDDER TO CONFIRM) A: <input type="checkbox"/> DRG. NO. 3-V-MISC-24227 R00 B: <input type="checkbox"/> DRG. NO. 3-V-MISC-24550 R00 C: <input type="checkbox"/> DRG. NO. 3-V-MISC-24283 R00 D: <input checked="" type="checkbox"/> DRG. NO. 4-V-MISC-90271 R11 E: <input type="checkbox"/> For Thyristor based Integral starter, Bidder/Vendor to furnish wiring diagram	
	COLOUR SHADE	<input type="checkbox"/> BLUE (RAL 5012) <input type="checkbox"/> (TO BE DECIDED BY BHEL DURING DETAIL ENGG.)	
	PAINT TYPE (## Refer Notes)	<input type="checkbox"/> ENAMEL <input type="checkbox"/> EPOXY <input type="checkbox"/> (TO BE DECIDED BY BHEL DURING DETAIL ENGG.)	
	SHAFT RPM	BIDDER TO SPECIFY	
	OLR SET VALUE	BIDDER TO SPECIFY	
	@ STARTING / FULL LOAD CURRENT	BIDDER TO SPECIFY	
	NO. OF REV FOR FULL TRAVEL	BIDDER TO SPECIFY	



**SPECIFICATION
FOR
MOTORISED VALVE ACTUATOR**

SPECIFICATION NO.: PE-ID-408-145-I902

VOLUME II B

SECTION D

REV. NO. 00

DATE: 04.04.15

SHEET 2

OF 3

Data Sheet A & B

DATA SHEET-A
(TO BE FILLED BY PURCHASER)

DATA SHEET-B
(TO BE FILLED-UP BY BIDDER)

408

	@ PWR SUPP TO MTR / STARTER	415V, 3PH, AC		
	@ CONTROL VOLTAGE REQUIREMENT	TO BE DERIVED FROM THE POWER SUPPLY TO THE STARTER <input type="checkbox"/> 230 V <input checked="" type="checkbox"/> 110 V		
	@ ENCLOSURE CLASS OF MOTOR	<input checked="" type="checkbox"/> IP 65 <input type="checkbox"/> FLAME PROOF		
	@ INSULATION CLASS	CLASS-F TEMP. RISE LIMITED TO CLASS-B		
	@ WINDING TEMP PROTECTION	<input checked="" type="checkbox"/> THERMOSTAT (3 Nos., 1 IN EACH PHASE) <input checked="" type="checkbox"/> ---THERMOSTAT- 1 NO+1 NC CONTACT -----		
	SINGLE PHASE / WRONG PHASE SEQUENCE PROTECTION	REQUIRED		
INTEGRAL STARTER	INTEGRAL STARTER	<input type="checkbox"/> REQUIRED <input checked="" type="checkbox"/> NOT REQUIRED		
	TYPE OF SWITCHING DEVICE	<input type="checkbox"/> CONTACTORS <input type="checkbox"/> THYRISTORS		
	TYPE	<input type="checkbox"/> CONVENTIONAL <input type="checkbox"/> SMART (NON-INTRUSIVE)		
	IF SMART			
	a) SERIAL LINK INTERFACE	<input type="checkbox"/> INTEGRAL <input type="checkbox"/> FIELD MOUNTED		
	b) SERIAL LINK PROTOCOL	<input type="checkbox"/> FOUNDATION FIELD-BUS <input type="checkbox"/> PROFI-BUS <input type="checkbox"/> DEVICE NET <input type="checkbox"/>		
	c) SERIAL LINK MEDIA	<input type="checkbox"/> TWISTED PAIR Cu-CBL <input type="checkbox"/> CO-AXIAL Cu-CBL <input type="checkbox"/> OFC		
	d) HAND HELD PROGRAMMER	<input type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED		
	e) TYPE OF HAND HELD PROGRAMMER	<input type="checkbox"/> BLUETOOTH <input type="checkbox"/> INFRARED <input type="checkbox"/>		
	f) MASTER STATION	<input type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED		
	g) MASTER STN INTRFACE WITH DCS	<input type="checkbox"/> MODBUS <input type="checkbox"/> TCP/IP		
	h) DETAILS OF SPECIAL CABLE	<input type="checkbox"/> ENCLOSED <input type="checkbox"/> NOT REQUIRED		
	STEP DOWN CONT. TRANSFORMER	<input type="checkbox"/> REQUIRED		
	OPEN / CLOSE PB	<input type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED		
	STOP PB	<input type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED		
	INDICATING LAMPS	<input type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED		
	LOCAL REMOTE S/S	<input type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED		
STATUS CONTACTS FOR MONITORING	<input type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED			
INTEGRAL STARTER DISTURBED SIGNAL	REQUIRED (O/L RELAY OPERATED, CONT./POWER SUPPLY FAILED, S/S IN LOCAL, TORQUE SWITCH OPTD. MID WAY)			
INTERPOSING RELAY/OPTO COUPLER (Applicable for integral Starter)	TYPE OF ISOLATING DEVICE	<input type="checkbox"/> INTERPOSING RELAY <input type="checkbox"/> OPTO COUPLER <input type="checkbox"/> EITHER		
	QUANTITY	<input type="checkbox"/> 2 NOs. <input type="checkbox"/> 3 NOs.		
	DRIVING VOLTAGE	<input checked="" type="checkbox"/> 20.5 – 24V DC <input type="checkbox"/> _____ V DC		
	DRIVING CURRENT	<input checked="" type="checkbox"/> 125mA MAX <input type="checkbox"/> _____ mA MAX		
	LOAD RESISTANCE	<input checked="" type="checkbox"/> > 192 ohms - <25 k ohms <input type="checkbox"/> > _____ ohms - < _____ ohms		
TORQUE SWITCH (Not Applicable for Smart Actuator) (\$\$ Refer Notes)	MFR & MODEL NO.	BIDDER TO SPECIFY		
	OPEN / CLOSE	<input checked="" type="checkbox"/> 1 No. <input type="checkbox"/> 2Nos. / <input checked="" type="checkbox"/> 1 No. <input type="checkbox"/> 2Nos		
	CONTACT TYPE	2 NO + 2 NC		
	RATING	5A 240V AC AND 0.5A 220V DC		
	CALIBRATED KNOBS(OPEN&CLOSE TS)	REQUIRED FOR SETTING DESIRED TORQUE		
	ACCURACY	+3% OF SET VALUE		



**SPECIFICATION
FOR
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SPECIFICATION NO.: PE-ID-408-145-I902

VOLUME II B

SECTION D

REV. NO. 00 DATE: 04.04.15

SHEET 3 OF 3

Data Sheet A & B

DATA SHEET-A
(TO BE FILLED BY PURCHASER)

DATA SHEET-B
(TO BE FILLED-UP BY BIDDER)

408

LIMIT SWITCH (Not Applicable for Smart Actuator) (\$\$ Refer Notes)	MFR & MODEL NO.	BIDDER TO SPECIFY		
	OPEN : INT : CLOSE	<input type="checkbox"/> 1 No. <input checked="" type="checkbox"/> 2 Nos.	2 Nos. (ADJ.)	<input type="checkbox"/> 1 No. <input checked="" type="checkbox"/> 2Nos.
	CONTACT TYPE	2 NO + 2 NC		
	RATING (AC / DC)	5A 240V AC AND 0.5A 220V DC		

POSITION TRANSMITTER	POSITION TRANSMITTER (For inching duty & other specific applications)	<input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED
	MFR & MODEL NO.	BIDDER TO SPECIFY
	TYPE	<input checked="" type="checkbox"/> ELECTRONIC (2 WIRE) R/I CONVERTER <input type="checkbox"/> ELECTRONIC (2 WIRE) CONTACTLESS
	SUPPLY	<input checked="" type="checkbox"/> 24V DC <input type="checkbox"/>
	OUTPUT	<input checked="" type="checkbox"/> 4-20mA
	ACCURACY	\pm 1% FS
SPACE HEATER	@SPACE HEATER	REQUIRED
	@ POWER SUPPLY (NON INTEGRAL)	230V AC, 1 PH., 50 Hz
	@ POWER SUPPLY (INTEGRAL)	BIDDER TO SPECIFY
	@ RATING	decided as per load data received tender stage
TERMINAL BOX	ACTUATOR/MOTOR TERMINAL BOX	REQUIRED
	ENCL CLASS ACTUATOR/MOTOR T.B.	@ <input type="checkbox"/> IP 68 @ <input type="checkbox"/>
	@ EARTHING TERMINAL	REQUIRED
	PLUG & SOCKET(9 PIN) (FOR COMMD, LS/TS FEED BACK, PoT)	<input type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED <input type="checkbox"/> 2 NOS. <input type="checkbox"/>
CABLE GLANDS	@ POWER CABLE GLAND	SIZE: decided as per load data received tender stage
	@ SPACE HEATER CABLE GLAND	SIZE: decided as per load data received tender stage
	OTHER CONTROL CABLE GLANDS-1	<input type="checkbox"/> 1No. for BFV of CW PUMP(Cable size 2Px1.5mm2)
	OTHER CONTROL CABLE GLANDS-2	QUANTITY & SIZE :-----



**SPECIFICATION
FOR
MOTORISED VALVE ACTUATOR**

SPECIFICATION NO.: PE-ID-408-145-I902	
VOLUME	II B
SECTION	D
REV. NO.	00
DATE:	04.04.15
SHEET	4 OF 3

Data Sheet A & B

DATA SHEET-A (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
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408

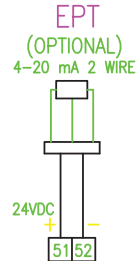
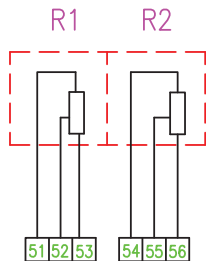
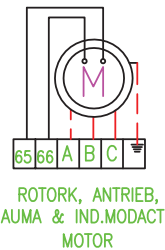
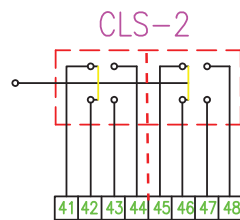
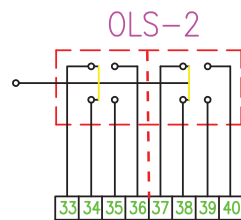
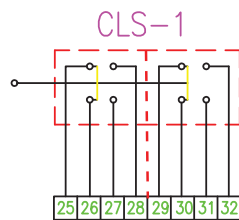
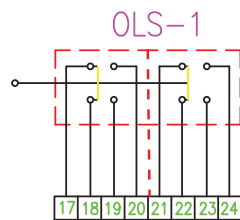
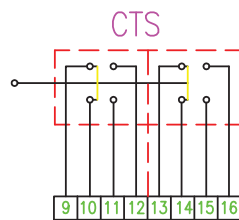
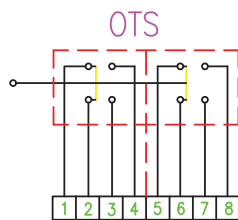
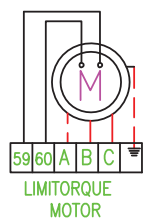
WEIGHT	TOTAL WEIGHT (ACTUATOR + ACCESSORIES)	BIDDER TO SPECIFY	_____ Kg.
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NOTES:

- SCOPE:** DESIGN, MANUFACTURE, INSPECTION, TESTING AND DELIVERY TO SITE OF ELECTRIC ACTUATOR FOR INCHING OR OPEN / CLOSE DUTY.
 - CODES & STANDARDS:** DESIGN AND MATERIALS USED SHALL COMPLY WITH THE RELEVANT LATEST NATIONAL AND INTERNATIONAL STANDARD. AS A MINIMUM, THE FOLLOWING STANDARDS SHALL BE COMPLIED WITH:
IS-9334, IS-2147, IS-2148, IS-325, IS-2959, IS-4691 AND IS-4722
 - TEMPERATURE RISE SHALL BE RESTRICTED TO 70 DEG. C FOR AMBIENT TEMPERATURE OF 50 DEG C.
 - CABLE GLANDS OF DOUBLE COMPRESSION TYPE, BRASS MATERIAL SHALL BE PROVIDED.
 - THE TORQUE SWITCHES SHALL BE PROVIDED WITH MECHANICAL LATCHING DEVICE TO PREVENT OPERATION WHEN UNSEATING FROM THE END POSITIONS. THE LATCHING DEVICE SHALL UNLATCH AS SOON AS THE VALVE LEAVES THE END POSITION. IF SUCH PROVISION IS NOT POSSIBLE, THE TORQUE SWITCHES SHALL BE BYPASSED BY END-POSITION LIMIT SWITCHES WHICH OPENS ON VALVE LEAVING END POSITION. THESE LIMIT SWITCHES ARE ADDITIONAL TO THE NUMBER OF LIMIT SWITCHES SPECIFIED ELSEWHERE.
 - THE MOTOR SHALL OPERATE SATISFACTORILY UNDER THE +/- 10% SUPPLY VOLTAGE VARIATION AT RATED FREQUENCY, -5% TO +3% VARIATION IN FREQUENCY AT RATED SUPPLY VOLTAGE, SIMULTANEOUS VARIATION IN VOLTAGE & FREQUENCY THE SUM OF ABSOLUTE PERCENTAGE NOT EXCEEDING 10%.
 - THE MOTOR SHALL BE SUITABLE FOR DIRECT ON LINE STARTING.
 - CANOPY FOR OUTDOOR SERVICES SHALL BE PROVIDED.
- \$\$ TORQUE SWITCH & LIMIT SWITCH SHALL ACT INDEPENDENT OF EACH OTHER. TANDEM OPERATION IS NOT ACCEPTABLE.**
- ## EPOXY PAINT IS RECOMMENDED FOR COASTAL AREAS.**

NAME SIGNATURE DATE	PREPARED BY	CHECKED BY	APPROVED BY	VENDOR COMPANY SEAL NAME SIGNATURE DATE

NOTES* = TO BE FILLED BY MPL (LEAD AGENCY). @= TO BE FILLED BY ES



* - SPARE FOR ROTORK, AUMA, ANTRIEB & IND.MODACT

SWITCHES - ALL ARE POTENTIAL FREE AND TWO PAIR OF CONTACTS CAN BE USED FOR DIFFERENT SUPPLY

THERMOSTAT - 65-66 (ROTORK, AUMA, ANTRIEB & IND.MODACT), 59-60 (LIMITORQUE).

EPT - ELECTRONIC POSITION TRANSMITTER (POTENTIOMETRIC TYPE, FOR INCHING DUTY)

THERMOSTAT TERMINALS - TERMINATED IN MOTOR TB IN ANTRIEB & IND.MODACT AND IN MAIN TB IN OTHER MAKES

CTS - TORQUE SWITCHES FOR CW ROTATION (CLOSE) - 2 NO+2 NC

OTS - TORQUE SWITCHES FOR CCW ROTATION (OPEN) - 2 NO+2 NC

OLS-1, OLS-2 - LIMITSWITCHES FOR POSITION OPEN - 2 NO+2 NC

CLS-1, CLS-2 - LIMITSWITCHES FOR POSITION CLOSE - 2 NO+2 NC

OTS, CTS - TWO INDEPENDENT SWITCHES IN ANTRIEB & LIMITORQUE

OLS-2 & CLS-2 - CAM DISC IN ROTORK & ANTRIEB

R1-R2- POTENTIOMETER 2 x 100 OHMS

H - SPACE HEATER 1ϕ 240V AC SUPPLY

M - MOTOR 3ϕ 415V 50 Hz AC SUPPLY

SETTING PROCEDURE OF POSITION LIMIT AND TORQUE SWITCH

VALVES	OPEN		CLOSE	
	MAIN	BACK UP	MAIN	BACK UP
GATE VALVE OF 100 mm AND ABOVE IN 1500 CL AND ABOVE RATINGS	OLS	OTS	CLS	CTS
ALL OTHER GATE & GLOBE VALVES	OLS	OTS	CTS	⊙

⊙ - CLS NOT TO BE CONNECTED IN TRIP CIRCUIT

NOTE:

1. BYPASS OTS FOR INITIAL 5% OF TRAVEL (FOR GATE VALVES ONLY)
2. CONNECT THERMOSTAT WITHOUT FAIL IN THE STARTER CIRCUIT

CONTACT DEVELOPMENT DIAGRAM					
OTS	1-2	OFF AT OVER TORQUE DURING OPENING TRAVEL			
	5-6				
	3-4	ON AT OVER TORQUE DURING OPENING TRAVEL			
CTS	7-8				
	9-10	OFF AT OVER TORQUE DURING CLOSING TRAVEL			
	13-14				
	11-12	ON AT OVER TORQUE DURING CLOSING TRAVEL			
OLS-1	15-16				
	17-18				
	21-22				
	19-20				
CLS-1	23-24				
	25-26				
	29-30				
	27-28				
OLS-2	31-32				
	33-34				
	37-38				
	35-36				
CLS-2	39-40				
	41-42				
	45-46				
	43-44				
SWITCH	47-48				
	TERMINAL NO.	FULL OPEN	a	INTERMEDIATE	b
VALVE POSITION					
<p>— INDICATES CONTACT CLOSED</p> <p>- - - INDICATES CONTACT OPEN</p>					

CONTACT RATING: 5A AT 250V AC & 0.5A AT 220V DC

					BHARAT HEAVY ELECTRICALS LTD. UNIT: HIGH PRESSURE BOILER PLANT. TIRUCHIRAPALLI 620014.	
					365-139	
				DRAWN	N.P.ESWAR	TITLE
				CHECKED	K.ARUNACHALAM	INTERNAL WIRING DIAGRAM FOR ELECTRICAL VALVE ACTUATORS (AC) (DRAWN FOR INTERMEDIATE POSITION OF VALVES)
				APPROVED	P.LOGANATHAN	
11	09.09.2000			CONTACT DEV. FIG.ADDED.	DATE	
REV	DATE	CHD	APPD	DESCRIPTION	DRAWING No.	4-V-MISC-90271
						REV 11

VOLUME : IIF/1

SECTION-III

TECHNICAL SPECIFICATION
FOR
ELECTRIC MOTOR ACTUATORS

1.00.00 **SCOPE**

1.01.00 This Section covers the general requirements of Electric Motor Actuators for valves, dampers and gates.

1.02.00 All electric motor actuators shall be furnished in accordance with this general specification and the accompanying driven equipment specification.

2.00.00 **STANDARDS**

2.01.00 All electrical equipment shall conform to the latest applicable IS, ANSI and NEMA Standards, except when stated otherwise herein or in driven equipment specification.

2.02.00 Major standards, which shall be followed, are listed below. Other applicable Indian Standards for any component part even if not covered in the listed standards shall also be followed

i) IS-9334

ii) IS-325

3.00.00 **SERVICE CONDITIONS**

3.01.00 The actuator shall be suitable for operation in hot, humid and tropical atmosphere, highly polluted at places with coal dust and/or fly ash.

3.02.00 Unless otherwise noted, electrical equipment/system design shall be based on the service conditions and auxiliary power supply given in the general specification.

3.03.00 For actuator motor installed outdoor and exposed to direct sun rays , the effect of solar heat [manufacturer to decide] shall be considered or overhead shed shall be provided locally to avoid direct sun rays.

4.00.00 **RATING**

4.01.00 For isolating service, the actuator shall be rated for three successive open-close operation of the valve/damper or 15 minutes, whichever is longer.

4.02.00 For regulating service, the actuator shall be suitably time-rated for the duty cycle involved with necessary number of starts per hour, but in no case less than 150 starts per hour.

5.00.00 **PERFORMANCE**

The actuator shall meet the following performance requirements:

5.01.00 Open and close the valve completely and make leak-tight valve closure without jamming.

5.02.00 Attain full speed operation before valve load is encountered and impart an unseating blow to start the valve in motion (hammer blow effect).

5.03.00 Operate the valve stem at standard stem speed and shall function against design differential pressure across the valve seat.

5.04.00 The motor reduction gearing shall be sufficient to lock the shaft when the motor is de-energised and prevent drift from torque switch spring pressure.

5.05.00 The entire mechanism shall withstand shock resulting from closing with improper setting of limit switches or from lodging of foreign matter under the valve seat.

6.00.00 **SPECIFIC REQUIREMENT**

6.01.00 **Construction**

6.01.01 The actuator shall essentially comprise the drive motor, torque/ limit switches, gear train, clutch, hand wheel, position indicator/ transmitter, in-built thermostat for over load protection, space heater and internal wiring. Actuator shall be non integral type.

6.01.02 The actuator enclosure shall be totally enclosed, dust tight, weather-proof suitable for outdoor use without necessity of any canopy.

6.01.03 All electrical equipment, accessories and wiring shall be provided with tropical finish to prevent fungus growth.

6.01.04 The actuator shall be designed for mounting in any position without any lubricant leakage or operating difficulty.

6.02.00 **Motor**

6.02.01 The drive motor shall be three phase, squirrel cage, induction machine with minimum class B insulation and IPW-55 enclosure, designed for high torque and reversing service. Canopy shall be provided for outdoor service.

6.02.02 The motor shall be designed for full voltage direct on-line start, with starting current limited to 6 times full-load current.

6.02.03 The motor shall be capable of starting at 85 percent of rated voltage and running at 80 percent of rated voltage at rated torque and 85 percent rated voltage at 33 percent excess rated torque for a period of 5 minutes each.

- 6.02.04 Motor leads shall be terminated in the limit switch compartment.
- 6.02.05 Motor actuators for valves/dampers shall be non-integral type with separate starter units and operable from remote.
- 6.02.06 Earthing terminals shall be provided on either side of the motor.
- 6.03.00 **Limit Switches**
- Each actuator shall be provided with following limit switches: -
- 6.03.01 2 torque limit switches, one for each direction of travel, self-locking, adjustable torque type.
- 6.03.02 4 end-of-travel limit switches, two for each direction of travel.
- 6.03.03 2 position limit switches, one for each direction of travel, each adjustable at any position from fully open to fully closed positions of the valve/damper.
- 6.03.04 Each limit switch shall have 2 NO + 2 NC potential free contacts. Contact rating shall be 5A at 240V A.C. or 0.5A at 220V D.C.
- 6.04.00 **Hand Wheel**
- Each actuator shall be provided with a hand wheel for emergency manual operation. The hand wheel shall declutch automatically when the motor is energized.
- 6.05.00 Position Indicator/Transmitter
- The actuator shall have:
- 6.05.01 One (1) built-in local position indicator for 0-100% travel.
- 6.05.02 One (1) position transmitter, potentiometer type, for remote indicator.
- 6.06.00 **Space Heater**
- A space heater shall be included in the limit switch compartment suitable for 240V, 1 phase, 50 Hz supply.
- 6.07.00 **Wiring**
- All electrical devices shall be wired up to and terminated in a terminal box. The internal wiring shall be of sufficient size for the power rating involved but in no case less than 1.5 Sq.mm copper. All wiring shall be identified at both ends with ferrules. All wires shall be fire resistance type.
- 6.08.00 **Terminal Box**
- The terminal box shall be weather proof, with removable front cover and cable glands for cable connection. The terminal shall be suitable for connection of 2.5 Sq.mm copper conductor.

7.00.00 **ACCESSORIES**

As required for the driven equipment, the actuator shall be furnished with starting equipment mounted on the actuator. This shall include:

- 7.01.00 One (1) triple pole MCCB for local isolation near the actuator
- 7.02.00 One (1) reversing starter with mechanically interlocked contactors, 3 thermal overload relays, 2 NO + 2 NC auxiliary contacts for each contactor.
- 7.03.00 One (1) remote-local selector switch.
- 7.04.00 CLOSE-STOP-OPEN oil tight push buttons with indication lights.
- 7.05.00 415/240 V or 415/110V control transformer with primary protected by fuse & secondary protected by Miniature Circuit Breaker (MCB).

8.00.00 **TEST**

The actuator and all components thereof shall be subject to tests as per relevant Standards. In addition, if any special test is called for in equipment specification, the same shall be performed.

9.00.00 **DRAWINGS, DATA & MANUALS**

9.01.01 To be Submitted with Bid

Data sheet for each type of actuator shall be furnished along with internal wiring diagram, suggested control schematic and torque limit switch contact development and manufacturer's catalogues.

9.01.02 To be Submitted after Award of Contract

- a) Actuator Data Sheet
- b) Internal wiring diagram and suggested control schematic
- c) Torque switch and limit switch contact development
- d) Manufacturer's Catalogue
- e) Instruction manual indicating clearly the installation methods, check ups and tests to be carried out before commissioning of the equipment.
- f) Any other relevant drawings, documents or data necessary for satisfactory installation , operation and manufacturing.

9.02.00 The Bidder may note that the drawings, data and manuals listed herein are minimum requirements only. The Bidder shall ensure that all other necessary write-ups, curves and information required to fully describe the equipment are submitted with his bid.

	1X800 MW Wanakbori STPP	SECTION: C SUB SECTION : C&I SHEET 10 of 18
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	

SPECIFICATION FOR FIELD INSTRUMENTS

|

1.00.00 **FIELD INSTRUMENTS**

This section provides general hardware guidelines for field instruments and equipment to be supplied under this specification.

1.01.00 Pressure Transmitter

01. Working Principle : Smart (HART Compatible)
02. Type : 2 - Wire
03. Output Signal : 4-20 mA DC.
04. Signal Processing : Silicon solid state electronic circuitry
05. Measuring Element : Capsule / Diaphragm
06. Element material : AISI-316 (Stainless Steel) or better
07. Static Pressure : 150 % of maximum span continuously, without affecting the calibration.
08. Turn-down ratio : 60: 1.
09. Span and Zero : Locally adjustable non-interacting. Facility for elevation and suppression by 100% of span
10. Enclosure Class : IP-65
11. Output Indicator : LCD
12. Nameplate : Tag number, service engraved in SS tag plate
13. Body : Forged Carbon Steel for air and flue gas application and SS for other application.
14. Operating Voltage : 16 - 48 Volts D.C.
15. Load : 600 Ohms (min.) at 24 Volts D.C.
16. Ambient Temperature : 0 - 50 °C
17. Performance:
 - i) Accuracy : $\pm 0.1\%$ of Span or better
 - ii) Repeatability : $\pm 0.05\%$ of Span or better
 - iii) Response time : 100 msec or better
18. Sealing/Isolation : Extended diaphragm with 5 meters SS armoured capillary for viscous fluid applications.
19. Accessories :
 - a) Universal mounting bracket suitable for 2" pipe mounting.
 - b) High tensile carbon steel U- bolts.
 - c) Siphon for steam and hot water services.
 - d) 1/2" NPT 2-valve stainless steel manifold, constructed from SS316 bar stock.
 - e) Companion flange with nuts, bolts and gaskets.

- f) ½" NPT cable gland
- 1.02.00 Differential Pressure Transmitter / Flow transmitter
01. Working Principle : Smart (HART compatible)
 02. Type : 2-Wire
 03. Output signal : 4-20 mA DC.
 04. Signal Processing Unit : Silicon solid-state electronic circuitry
 05. Measuring element : Capsule/Diaphragm
 06. Element material : AISI-316 (Stainless Steel) or better
 07. Static Pressure/
Overload Pressure : Maximum line (or static) pressure on either side without permanent deformation or loss of accuracy
 08. Turn-down ratio : 60 : 1 minimum
 09. Span and Zero : Locally adjustable, non-interacting
 10. Enclosure class : IP-65
 11. Zero suppression /
elevation : At least 100% of Span
 12. Output Indicator : LCD type
 13. Nameplate : Tag number and Service engraved in SS tag plate
 14. Body : Forged Carbon Steel for air and flue gas application and SS for other application
 15. Ambient temperature : 0 - 50 °C
 16. Operating Voltage : 16 - 48 Volts DC
 17. Load : 600 Ohms (min.) at 24 Volts DC
 18. Performance:-
 - i) Accuracy : ±0.1 % of span or better
 - ii) Repeatability : ± 0.05 % of span or better
 - iii) Response time : 100 msec or better
 19. Sealing / Isolation : Extended diaphragm with 5 meters SS armoured capillary for viscous fluid applications.
 20. Accessories :
 - a) Universal mounting bracket suitable for 2" pipe mounting.
 - b) High tensile carbon steel U-bolts.
 - c) Siphon for steam and hot water services.
 - d) Companion flange with nuts, bolts and gaskets.
 - e) ½" NPT cable gland

- f) ½" NPT generally 5-valve stainless steel manifold, constructed from SS316 bar stock. 3 valve manifold for DP application in flue gas and air.

1.03.00 Displacer Type Level Transmitters

01. Type : Smart (HART compatible)
02. Stages of operation : Continuous
03. Material -
- i) Displacer : AISI 316 SS
 - ii) Suspension wire : AISI 316 SS
 - iii) Torque tube housing : Carbon steel or SS as per application
 - iv) Torque tube : Inconel
 - v) Displacer chamber : CS or SS as per process application
 - vi) Transmitter Housing : Die cast aluminium or better
04. Operating Voltage : 16-48 Volts D.C.
05. Transmission : 2-wire
06. Output Signal : 4-20 mA DC.
07. Signal processing : Solid-state electronic circuitry
08. Static / overload pressure : Maximum static pressure without permanent deformation or loss of accuracy.
09. Turn-down ratio : 10 : 1 or better
10. Zero & Span : Easily accessible (local zero & span adjustment and non-interactive type)
11. Enclosure Class : IP-65
12. Output Indicator : LCD type
13. Nameplate : Tag number and Service engraved in stainless steel tag plate
14. Ambient Temperature : 0 - 50 °C
15. Load Impedance : 600 Ohms at 24 Volts (minimum)
16. Process Connection : 2" Companion flange with nuts, bolts and gaskets
17. Performance -
- Accuracy : ± 0.5 % of span or better
18. Accessories :
- a) Counter Flange, nuts, bolts, gaskets etc.
 - b) Weights for 5 point calibration of instruments.
 - c) Vent and drain plugs
 - d) Special calibration tool/configurator, if any.
 - e) ½"NPT cable gland

19. Preferred Features : a) Test plug connection and cutout terminals physically separated from other electronics.
b) Electronic Damping facility (adjustable).
- 1.04.00 Mass Flow meter
- 1.04.01 Sensor
01. Measuring Principle : Coriolis Mass flow.
02. Primary Element : Flow Tube of 316SS or better
03. Heating Arrangement : Integral.
04. Temperature Control : For heavy fuel oil application.
05. Process Connection : Flanged of rating as per process requirement.
06. Drain : Self-draining facility
07. Enclosure : Stainless steel
08. Accessories : Counter flanges, Mounting nuts, bolts, gaskets etc.
- 1.04.02 Transmitter
01. Measured quantities : Mass Flow rate, Total Mass Flow, Density.
02. Input Signal Processing : Digital Processing.
03. Display : Digital Display (LCD).
04. Output : 2 off. isolated 4-20mA DC output.
05. Load : < 750 ohms.
06. Power supply : 240V AC, 50 Hz.
07. Turn Down : 100:1
08. Accuracy : ± 0.2 % of measured value
09. Housing : IP 65
10. Nameplate : Tag number, service engraved in stainless steel tag plate
11. Accessories : a) Handheld configurator
b) Mounting U-bolts, nuts, bolts, prefab cable etc.
c) $\frac{1}{2}$ "NPT cable gland
- 1.05.00 Pressure Gauge and Differential Pressure Gauge
01. Type : Bourdon/Bellows/Diaphragm
02. Sensing & Socket : AISI-316 SS
03. Movement Material : AISI-304 SS
04. Case Material : Stainless steel. IP-65.
05. Dial Size : Generally 150 mm
06. Scale : Black lettering on white in 270° arc.

- | | | | |
|-----|-----------------------|---|---|
| 07. | Window | : | Shatterproof glass |
| 08. | Range Selection | : | Normal process pressure: 50~70 % of range |
| 09. | Over-range Protection | : | 125% of maximum range by internal stop. External stop at zero. |
| 10. | Adjustment | : | Micrometer screw for zero. Internal micrometer screw for range. |
| 11. | Element Connection | : | Argon welding |
| 12. | Process Connection | : | 1/2" NPT (M) Bottom for local, back for panel mounting. |
| 13. | Performance | : | Accuracy of ± 1.0 % of span or better. |
| 14. | Operating ambient | : | 0 - 50 °C |
| 15. | Safety Feature | : | Blow out disc /diaphragm at the back |
| 16. | Accessories | : | a) Snubbers and Glycerin filled for pulsating fluid applications and at pump discharge.
b) Stainless steel Diaphragm seals for viscous fluids.
c) 3-Way SS316 Gauge cock for pressure gauges.
d) 5-valve SS316 manifold from barstock for differential pressure gauge.
e) Siphons for steam and hot water services. |
| 17. | Applicable standard | : | IS-3624 / 1996 |
| 18. | Nameplate | : | Tag number, service engraved in stainless steel tag plate |

1.06.00 Temperature Gauge

- | | | | |
|-----|--------------------------|---|--|
| 01. | Type | : | Bimetallic or gas filled. |
| 02. | Sensing Element Material | : | Bourdon - AISI-316 SS |
| 03. | Capillary Armoring | : | Stainless steel flexible |
| 04. | Movement Material | : | AISI 304 SS |
| 05. | Bulb / Stem Diameter | : | 12 mm |
| 06. | Bulb / Stem Material | : | AISI 316 |
| 07. | Capillary | : | Stainless Steel |
| 08. | Connection to well | : | 1/2" NPT |
| 09. | Case Material | : | Stainless steel |
| 10. | Dial Size | : | 150 mm in general |
| 11. | Scale | : | Black lettering on white in 270 ° arc. |
| 12. | Mounting | : | Surface/Panel |
| 13. | Over range Protection | : | 125 % of range or more |

14. Instrument connection : Bottom for local and back for panel mounting.
15. Range : Normal temperature–50~70% of range.
16. Zero adjuster : Micrometer screw adjustable from front.
17. Window : Shatterproof glass.
18. Accuracy : $\pm 1\%$ or better
19. Enclosure Class : IP-65
20. Capillary : 5 meters (local surface)/15.0 meters (local panel) - armoured stainless steel
21. Compensation : Capillary and Case Compensation
22. Accessories : a) Forged barstock thermowell screwed as per ASME PTC code. Process connection M 33X2 (M).
Material of construction of Thermowell:
- SS 316: In general
- Inconel: For flue gas application
- Tungsten carbide: For coal mill application.
23. Nameplate : Tag number, service engraved in stainless steel tag plate
- 1.07.00 Thermocouples
01. Type : a) Type-J (Iron Constantan) / Type-K (Chromel Alumel) / Type-R (Pt.-Rhodium Pt.) / Type-S (90% Pt – 10% Rhodium). [As per application]
b) Duplex
c) Ungrounded
02. Wire gauge : 16 AWG for Type-K, 24 AWG for Type-R
03. Standard : ANSI-MC 96.1.
04. Protecting Tube :-
i) O.D. : 8 mm
ii) Material : 316-SS Seamless
iii) Filling : Magnesium Oxide (Purity above 99.4%)
05. Response time : a) < 20 seconds for measurement.
b) < 10 seconds for control.
06. Accuracy : $\pm 1.1^{\circ}\text{C}$ up to 300°C & 0.4% of measured temperature range above 300°C .
07. Head:
i) Type : IP-65 universal screwed type.
ii) Material : Die cast aluminum or better
iii) Terminal blocks : Nickel plated Brass - screw type/ silver plated

- iv) Instrument connection : ½" NPT
to well
 - v) Cable connection : ½" NPT gland and grommet.
 - vi) Others : Terminal head cover with SS chain and suitable gasket. All thermowells in the high velocity steam service shall be checked for Strouhal's frequency limit to arrive at a safe size and design of thermowells.
08. Accessories : a) Adjustable nipple-union-nipple [1/2" Sch 80 X ½" NPT (M)] with thermowell connection
- b) Compression fittings/unions
 - c) Flanges etc. (for flanged connections only)
 - d) Forged barstock thermowell as per ASME PTC code. Process connection M 33X2 (M) in general or 1½" Flanged for Flue gas/Furnace/Air etc. application.

Material of construction of Thermowell:

SS 316: In general

Inconel: For flue gas application

Tungsten carbide: For coal mill application.

09. Nameplate : Tag number, service engraved in stainless steel tag plate

1.08.00 Resistance Temperature Detector

- 01. Type : Platinum (Duplex), Ungrounded
- 02. Resistance : 100 ohm at 0 °C
- 03. Base : Wound on ceramic (anti-inductive)
- 04. Wiring : 3 /4 Wire
- 05. Protecting Tube :-
 - i) O.D. : 8 mm
 - ii) Material : SS-316, Seamless
 - iii) Filling : Magnesium oxide (Purity above 99.4%).
- 06. Response time : a) < 20 seconds for measurement.
b) < 10 seconds for control.
- 07. Calibration : DIN 43760
- 08. Accuracy : ± 0.5%
- 09. Head :

- | | | | |
|---------|--------------------------|---|--|
| | i) Type | : | IP-65 universal screwed type. |
| | ii) Material | : | Die cast aluminum or better |
| | iii) Terminal blocks | : | Nickel plated Brass-screw type / silver plated |
| | iv) Cable connection | : | ½" NPT gland and grommet. |
| | v) Others | : | Terminal head cover with SS chain and suitable gasket. All thermowells in the high velocity steam service shall be checked for Strouhal's frequency limit to arrive at a safe size and design of thermowells |
| 10. | Accessories | : | <p>a) Adjustable nipple-union-nipple [1/2" Sch 80 X ½" NPT (M)] with thermowell connection</p> <p>b) Compression fittings/unions</p> <p>c) Flanges etc. (for flanged connections only)</p> <p>d) Forged/barstock thermowell as per ASME PTC code. Process connection M33X2 (M).</p> <p>Material of construction of Thermowell:
SS 316: In general
Inconel: For flue gas application
Tungsten carbide: For coal mill application.</p> |
| 11. | Nameplate | : | Tag number, service engraved in stainless steel tag plate |
| 1.09.00 | Pressure Switch | | |
| 01. | Type | : | <p>i) Piston for high pressure application</p> <p>ii) Bellow / Diaphragm for low pressure application</p> |
| 02. | Sensing element material | : | AISI SS-316. All other wetted part SS316. |
| 03. | Case Material | : | Die-cast aluminum alloy, neoprene gasket. |
| 04. | Setter Scale | : | Black graduation on white linear scale. Graduation 0-100% with red pointer for set points. |
| 05. | Over range | : | 150 % of maximum pressure |
| 06. | Adjustments | : | <p>a) Internal Set Point</p> <p>b) Differential adjustment</p> |
| 07. | End Connection | : | 1/2" NPT (M) bottom connected |
| 08. | Switch configuration | : | Two SPDT |
| 09. | Switch Rating | : | 240V, 5A AC/220V, 0.5A DC |

10. Switch Type : Snap acting, shock & vibration proof
11. Terminal Block : Suitable for full ring lugs.
12. Cable connection : ½" NPT conduit connection.
13. Enclosure Class : IP-65.
14. Performance : a) Repeat accuracy $\pm 1.0\%$
b) Accuracy of Setting Indication of $\pm 1.5\%$
15. Ambient temperature : 0 – 50 Deg.C
16. Nameplate : Tag number, service engraved in SS tag plate
17. Accessories : a) Remote diaphragm seal with SS-316 capillary for viscous & corrosive application.
b) Siphons for steam and hot water services.
c) Retention ring and screws for surface mounting.
d) ½" NPT 2 Valve SS-316 barstock manifold
e) ½" NPT cable gland
- 1.10.00 Differential Pressure Switch
01. Type : Bellows / Diaphragm / Piston actuated
02. Sensing element material : AISI SS-316. For all other wetted part SS 316
03. Case Material : Die-cast aluminum alloy with neoprene gasket.
04. Setter Scale : Black graduation on white scale with 0-100% graduation and provided with red pointer for set point adjustment
05. Over range : Static pressure on any one side, the other side being open to atmosphere.
06. Adjustments : a) Internal set point adjustment
b) Differential adjustment
07. Process Connection : ½" NPT (M) bottom / back connected.
08. Switch configuration : Two SPDT
09. Switch rating : 240V, 5A AC/220V, 0.5A DC.
10. Switch type : Snap acting type contacts, shock and vibration proof.
11. Terminal Blocks : Suitable for full ring lugs for cable connection.
12. Cable Connection : ½" NPT conduit connection or compression gland.
13. Performance : a) Repeat accuracy $\pm 1.0\%$
b) Accuracy of set point Indication: $\pm 1.5\%$

14. Operating Ambient : 0 - 50 °C (Maximum Continuous)
15. Enclosure : IP-65
16. Accessories : a) Snubbers for pulsating fluid application.
b) Syphons for steam and hot water services.
c) Retention ring and screws for surface mounting.
d) 1/2" NPT 3-Valve SS-316 manifold constructed from barstock
e) 1/2" NPT Cable gland
17. Nameplate : Tag number, service engraved in stainless steel tag plate
18. Remote Seal type for special application : a) Silicone oil / fluorolube filled remote diaphragm seal for dirty / viscous / corrosive fluid.
b) SS armoured capillary at least 3 meters each.
c) Adapter flanges with nuts, bolts and gaskets for instrument and process side.
- 1.11.00 Level Switch
01. Type : External cage float operated. Magnetically coupled.
02. Float Material : AISI-316 stainless steel or better
03. Other wetted parts : AISI-316 stainless steel or better
04. External Cage : Carbon steel / Stainless steel as per process requirements, welded type / flanged construction. Cage pressure rating shall equal or exceed the rating of the main vessel.
05. External cage mounting : Side-Side.
06. External cage connection : 25 NB socket welded.
07. Switch housing : Epoxy coated die-cast aluminum alloy with neoprene gasket conforming to IP-65.
08. Type of switch configuration : 2 SPDT (two nos.)
09. Contact rating : 5A, 240V/AC, 0.25A, 220V DC
10. Accessories : a) Counter flange, nuts & bolts, suitable gasket etc.

- b) Steel globe type drain valve.
- c) ½"NPT cable gland
- d) Stainless steel nameplate with alpha-numeric engraved for service and tag.
11. Preferred feature : Switch operating point marked on cage
12. Mounting : On standpipe
- 1.12.00 Conductivity Type Level Switch
01. Type : Conductivity discrimination.
02. Application : Drain pots viz. on CRH line
03. Mounting : Flanged – on external cage.
04. Probe MOC : Stainless steel with high purity ceramic.
05. Probe rating : > Maximum design pressure of vessel.
06. Input : Four independent channel with selectable switching threshold for water conductivity.
07. Relay Output : Four isolated output relays for Hi, Lo, Hi-Hi, Lo-Lo.
08. Contact type & rating : 2SPDT or 1 DPDT @ 5A 30V DC.
09. Local Display : Coloured LEDs for Hi, Lo, Hi-Hi, Lo-Lo, Power & fault.
10. Power supply : Dual 240V AC, 50 Hz, 1Ph.
11. Enclosure : IP-65, corrosion resistant & wall mounting type (Explosion proof for NEC Class-1, Division-1 area).
12. Accessories : a) PTFE cable from probe to electronics
b) Mounting accessories
c) External cage
d) Washer & gasket
- 13 Test pressure : Two times rated pressure
14. Cable connection : ½" NPT with cable gland
- 1.13.00 Orifice Plate
01. Application : Low fluid velocity flow measurement
02. Design Standard : BS-1042, Part-I
03. Number of Tapings : As required plus one additional pair of taps
04. Diameter Ratio : Between 0.4 to 0.7
05. Thickness : 3 mm for main pipe diameter up to 250 mm, 6 mm for main pipe diameter above 250 mm and 10 mm for main pipe diameter of 500 mm and above.

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|---------|-----------------------------|---|---|
| | 06. Document | : | Beta ratio calculation, assembly drawing and Flow vs. DP curve. |
| | 07. Meter run pipe | : | Same as pipe material |
| | 08. Accessories | : | Flanges, gaskets, nuts & bolts, root valves jack screw, meter run pipe, Drain & vent hole as per application etc.. |
| 1.14.00 | Flow Nozzle | | |
| | 01. Application | : | High fluid velocity flow measurement |
| | 02. Design Standard | : | ASME PTC 19.5 |
| | 03. Number of Tapings | : | As required plus one additional pair of taps |
| | 04. Diameter Ratio | : | Between 0.4 and 0.7 |
| | 05. Thickness | : | Suitable for the application |
| | 06. Document | : | Beta ratio calculation, assembly drawing and Flow vs. DP curve. |
| | 07. Meter run pipe | : | Same as pipe material |
| | 08. Accessories | : | Meter run pipe, nipples and root valves.

(Inspection port assembly for nozzles used in plant performance purpose) |
| 1.15.00 | Gauge Glass | | |
| | 01. Type | : | Reflex |
| | 02. Glass | : | Toughened borosilicate. Resistant to mechanical and thermal shocks. |
| | 03. Body material | : | Carbon steel / stainless steel- As per process requirements (Flanged Connection) |
| | 04. Pressure rating | : | Twice the maximum working pressure |
| | 05. Temperature rating | : | As required |
| | 06. Bolts and nuts | : | Rust proof alloy steel |
| | 07. Accessories | : | Suitable ball check valves of SS-304/316 body, gaskets, companion flange etc. |
| 1.16.00 | Power Cylinders (Pneumatic) | | |
| | 01. Mounting Type | : | a) Fixed position mounting (End mounting).

b) Trunnion mounting |
| | 02. Control Signal | : | 4-20 mA DC to electro-pneumatic positioner. 24V DC operated solenoid valve operating on pneumatic line for open & closing purpose of on & off drive. |
| | 03. Supply Air | : | 0-7 Kg / Cm ² . |
| | 04. Selection | : | Based upon thrust / torque, stroke length, angular movement, full-scale travel time, repeatability, space factor etc. Provision for air-to-open and air-to-close operation. |

05. Casing : IP-65.
06. Accessories : a) Air lock relay
b) Hand wheel.
c) Air filter regulator with gauge.
d) Volume Booster.
e) Limit Switches.
f) Positioner with Input and Output pressure gauges, local keypad & display.
g) Solenoid Valve
h) Integral non contact type position Transmitter (4-20 mA DC linear output).
i) Junction box with cable gland
07. Fail-safe operation : For regulating duty- stay put against power & air fail.
08. Repeatability : Better than 0.5% of full travel.
09. Hysterisis : Less than $\pm 1\%$ of full travel
10. Operating Temp. limit : 50 Deg. C (min.)
- 1.17.00 Smoke Density Analyzer
01. Type : In-situ infra red
02. Principle of measurement : Transmission & absorption (Dual beam type)
03. Light source : Modulated high intensity LED
04. Display : Back Lit LCD
05. Measurement range : 0-999 mg/m³, 0-999 mg/Nm³, 0-100% opacity
06. Measurement averaging : Selectable 10 sec to 60 minutes
07. Accuracy : 0.2% opacity
08. Resolution : 0.1% opacity
09. Linearity : 0.1% opacity
10. Repeatability : 0.1% opacity
11. Flue gas temperature : 350 °C (max 600 °C)
12. Ambient temperature : 0 - 60 °C
13. Operating temperature : Transmitter & receiver- 0-90 °C, Electronic unit - 70 °C
14. Mounting : Transceiver on opposite side of the duct
15. Analog output : 4-20mA DC (in 500 ohm resistance) to
16. Alarm output : 2 SPCO potential free rated at 230 VAC, 5A
17. Power Supply : 240V AC, 50 Hz, 1 Phase
18. Automatic misalignment detection : Required

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| 19. | Automatic compensation of lens contamination | : | Required |
| 20. | Purge air Failure | : | Purge air to be provided from Blower unit and to be monitored for failure. |
| 21. | Span and Zero Check | : | Automatic periodic with manual override |
| 22. | Housing | : | Corrosion resistant painted aluminium rated at IP-65 |
| 23. | Fail safe shutter | : | Automatic fail safe shutter against power and air failure |
| 24. | Input normalisation | : | Correction for temperature, pressure, oxygen and water vapour to be provided. |
| 25. | Preferred Features | : | “Power Supply On” LED visible from front |
| 26. | Accessories | : | a) Mounting pads suitable for mounting projector and receiver units on duct, flanges, etc.
b) Blower unit (Purging System) with purge fail alarm at CCR
c) Enclosure for electronic units & indicators
d) Control unit for interface with PC based data logger |
| 27. | Application | : | At chimney
At each ESP outlet |
| 1.18.00 | SO _x , NO _x , CO, CO ₂ , O ₂ & Moisture Analyzer | | |
| 01. | Type | : | In-situ Probe type combined analyser / Sampling extraction type. |
| 02. | Gases to be measured | : | SO _x , NO _x , CO, CO ₂ , O ₂ and Moisture |
| 03. | Principle of measurement | : | Infrared absorption |
| 04. | Flue gas Temperature | : | 350 ° C |
| 05. | Ambient temperature | : | 60 ° C |
| 06. | Mounting | : | On chimney |
| 07. | Measurement range | : | 0-3000 ppm / mg/Nm ³ for SO _x , NO _x , CO, O ₂ and 0-25% for CO ₂ and Moisture - fully selectable |
| 08. | Units of measurement | : | PPM, mg / Nm ³ and % |
| 09. | Power Supply | : | 240V, 50 Hz, 1 Phase |
| 10. | Local Display | : | Back lit LCD / LED |
| 11. | Measurement averaging | : | 10 sec to 60minutes (selectable) |
| 12. | Accuracy | : | 2% of measured value |
| 13. | Repeatability | : | 2% of full scale |
| 14. | Response time | : | 5 seconds or better for 95% of full scale |

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|---------|------------------------------|---|---|
| | 15. Zero & Span drift | : | 2% per month |
| | 16. Calibration | : | Zero and Span calibration in manual and automatic mode. Automatic calibration interval shall be fully selectable. |
| | 17. Analog output | : | 4-20 mA DC (in 500 ohm resistor) to for each channel |
| | 18. Alarm output | : | 1NO + 1NC rated at 230V AC, 5A |
| | 19. Input normalisation | : | Required—online with pressure and temperature sensor and also provision for key pad entry of inputs |
| | 20. Probe material | : | Stainless Steel 316L |
| | 21. Enclosure | : | Corrosion resistant epoxy painted aluminium housing & enclosure rated to IP-65. |
| | 22. Accessories | : | a) Blower unit, tubes & fittings for calibration and purging, purge fail alarm in CCR
b) Calibration gas cylinders for SO ₂ , NO _x , CO ₂ , O ₂ and CO filled in 10 Ltrs. Of WC carbon cylinder with necessary SS regulators with pressure & flow gauges, solenoid valve & SS tubings and SS fittings etc. as required.
c) Mounting flanges, gasket etc.
d) Control unit for interface with PC based data logger |
| | 23. Application | : | On flue gas stack. |
| 1.19.00 | Stack Gas Velocity Monitor | | |
| | 01. Type | : | Non contact type |
| | 02. Measurement | : | Flue gas velocity |
| | 03. Principle of measurement | : | Time delay correlation of flue gas Infrared emission received by two detectors located at a distance apart on the chimney. |
| | 04. Flue gas Temperature | : | Up to 350 ° C |
| | 05. Ambient temperature | : | 60 ° C |
| | 06. Mounting | : | On chimney |
| | 07. Measurement range | : | As required |
| | 08. Units of measurement | : | velocity- m/sec, flow- m ³ /sec |
| | 09. Power Supply | : | 240V, 50 Hz, 1 Phase |
| | 10. Local Display | : | Back lit LCD / LED |
| | 11. Measurement averaging | : | 10 sec to 60minutes (selectable) |
| | 12. Accuracy | : | 2% of measured value |
| | 13. Linearity | : | 2% of full scale |

14. Response time : 5 seconds or better for 95% of full scale
15. Zero & Span drift : 2% per month
16. Calibration : Zero and Span adjustment
17. Analog output : 4-20 mA DC (in 500 ohm resistor) to for each channel
18. Probe material : Stainless Steel 316L
19. Enclosure : Corrosion resistant epoxy painted aluminium housing & enclosure rated to IP-65.
20. Accessories : a) Blower unit, tubes & fittings for calibration and purging, purge fail alarm in CCR
b) Mounting flanges, gasket etc.
c) Control unit for interface with PC based data logger
21. Application : On chimney
- 1.20.00 Oxygen Analyzer
01. Type : In-situ, Zirconium sensor, micro-processor-based transmitter, field repairable.
02. Range : 0.1-10% / 0.25-25% by volume
03. Output : 4-20 mA DC linear
04. Probe Length : 1800 mm (approximate depending on duct size)
05. Process Temperature : 850 ° C approx.
06. Measurement Reference : Instrument Air
07. Accuracy : ±1% of F.S.
08. Response Time : Less than 5 (five) seconds
09. Amplifier Housing : IP-65
10. Calibration : Automatic periodic
11. Calibration Frequency : Once every 24 hours
12. Power Supply : 240V, 50 Hz, 1 Phase
13. Material for Gas Carrying Components : Stainless Steel
14. Read Out : LED/LCD Local indicating meter
15. Protection : Automatic cell protection against reducing atmosphere
16. Alarm Facility : 1 HI and 1 LO independently adjustable over span. Contact rating 500 mA at 220 V DC (minimum).
17. Preferred Features : a) HI and LO alarm LED visible from front.
b) Power Supply On/Failure LED visible from front

18. Accessories : a) Mounting flanges, adaptor plate and protection shield
b) Gasket, nuts and bolts
c) Cable with conduit from cell to amplifier (as required) and other special cables (if any)
d) Automatic calibration kit (complete with all accessories and standard Gas Cylinders)
19. Application : a) At each economizer outlet
b) At each air preheater outlet
- 1.21.00 CO, NOx & Moisture Analyzer
01. Type : In-situ Probe type combined analyser
02. Gases to be measured : CO, NOx and Moisture
03. Principle of measurement : Infrared absorption
04. Flue gas Temperature : 850 ° C (max)
05. Ambient temperature : 60 ° C
06. Mounting : On duct
07. Measurement range : 0-3000 fully selectable
08. Units of measurement : PPM and mg / Nm³
09. Power Supply : 240V, 50 Hz, 1 Phase
10. Display : Back lit LCD / LED
11. Measurement averaging : 10 sec to 60minutes (selectable)
12. Accuracy : 2% of measured value
13. Repeatability : 2% of full scale
14. Response time : 5 seconds or better for 95% of full scale
15. Zero & Span drift : 2% per month
16. Calibration : Zero and Span calibration in manual and automatic mode. Automatic calibration interval shall be fully selectable.
17. Analog output : 4-20 mA DC (in 500 ohm resistor) to for each channel
18. Alarm output : 1NO + 1NC rated at 230V AC, 5A
19. Input normalisation : Required – online with pressure and temperature sensor and also provision for keypad entry of inputs
20. Probe material : Stainless Steel 316L
21. Enclosure : Corrosion resistant epoxy coated aluminium housing & enclosure rated to IP-65.

22. Accessories : a) Blower unit, tubes & fittings for calibration and purging, purge fail alarm in CCR
b) Calibration gas cylinders for NO_x and CO filled in 10 Ltrs. of WC carbon cylinder with necessary SS regulator, SS gauges, SS tubings and SS fittings etc. as required.
c) Mounting flanges, gasket etc.
23. Application : At economizer outlet
- 1.22.00 H2 + CO2 + Air Analyzer
01. Type : Thermal Conductivity
02. Range Selection : 3 ranges (H₂ in CO₂, H₂ in air and CO₂ in air)
03. Range : As required
04. Output : 4-20mA DC (Isolated)
05. Operating ambient temp. : 10 ° C to 50 Deg. C
06. Power Supply : 240V AC, 50Hz
07. Sample gas flow control : Required
08. Reference gas flow : Required
09. Reference gas pressure regulator : Required
10. Cell response : 95% of change in 30 Sec.(Appox.)
11. Accuracy : 2% of full scale
12. Repeatability : 1% of full scale
13. Local Indicator : Indicating meter of 1% accuracy
14. Alarm facility : Dual (High & Low) independently adjustable.
15. Contact rating : 0.5A at 220 V AC
16. Enclosure : Flame Proof
17. Accessories : Calibration gas, mounting accessories and others as required to be provided
18. Application : Generator Gas Purity.
- 1.23.00 Radar Type Level Measurement
01. Type : Radar based on Time Domain Reflectometry
02. Antenna : Co axial / single rod type guided wave or Horn type as required for the application
03. Communication : Two wire 4-20mA DC, HART or Field Bus protocol.
04. Environmental temperature : 0 – 50 °C
05. Enclosure : Explosion proof /IP 65 as per application
06. Cable Entry : ½" NPT

07. Calibration : a) Self calibration with internal reference
b) Zero & Span calibration
08. Programming : Handheld programmer & Local keypad
09. Process Connection : Flanged /screwed
10. Electronic Housing : Epoxy painted Die-Cast aluminium alloy
11. Antenna / Flange assembly : 316 SS or Hest alloy (as required)
12. Output Indicator : Digital Integral Display
13. Accuracy : 5 mm or 0.1% of probe length
14. Accessories : a) Programming tool kit
b) Gasket
- 1.24.00 Temperature Switch
01. Type : Bimetallic or gas filled.
02. Sensing Element Material : Bellow / Bourdon AISI SS-316
03. Bulb Material : AISI SS-316
04. Capillary : Stainless steel armored
05. Movement Material : AISI SS-304
06. Case material : Epoxy coated steel plate or die-cast aluminum alloy with neoprene gasket and clear glass where applicable cover conforming to IP-65. (Explosion proof for NEC Class-1, Division 1 area).
07. Scale : Black lettering on white background
08. Over range Protection : 120 %
09. Instrument connection : Bottom
10. Switch configuration : Two SPDT
11. Switch rating : 240V, 5A AC/220V, 0.5A DC
12. Switch type : Snap acting, shock and vibration-proof.
13. Adjustability : Internal Set point adjustable over span range
14. Cable connection : 3/4" ET conduit connection or compression gland.
15. Compensation : a) Capillary compensation with invar wire throughout the capillary length.
b) Case compensation
16. Performance :
- i) Scale Accuracy : ± 1.0 % of full scale
- i) Repeatability : < 0.5 % of full range
- ii) Response time : Less than 40 seconds with thermowell
17. Capillary length : 5 meters (minimum) for local mounting/15 meters for local panel mounting.

	18. Nameplate	:	Tag number, service engraved in stainless steel tag plate
	19. Accessories	:	Mounting accessories, 3/4"ETcable gland.
1.25.00	Rotameter		
	01. Type	:	On-line up to 2". By-pass above 2"
	02. Metering tube	:	Borosilicate glass
	03. Float	:	AISI 316-SS unless the process fluid demands some other material.
	04. Body MOC	:	AISI 316-SS
	05. Scale	:	Graduated- Engraved black on white background.
	06. Process connection	:	Flanged
	07. Accuracy	:	± 2% of full scale detection or better for on-line type and ±4% of full-scale detection or better for by-pass type.
	08. Nameplate	:	Tag number, service engraved in stainless steel tag plate
	09. Accessories	:	Slip-on orifice plate of 316-SS and taps of Stainless Steel as per application requirements. Applicable SS Isolation valves and SS Range Orifice - for bypass type rotameters.
1.26.00	I/P Converter		
	01. Type	:	Electro-pneumatic (Outdoor Type)
	02. Input level	:	4-20 mA DC
	03. Output range	:	0.2 to 1.0 Kg/Sq. cm With 'Fail Freeze' feature. (i.e in case of wire snapping the last good value of pneumatic signal out put will hold for at least six hours)
	04. Split range	:	For typical application wherever required.
	05. Control Action	:	Selectable air to close, air to open and fail freeze application
	06. Supply pressure	:	1.2 to 1.6 Kg/cm ² (1.4 typical)
	07. Max. supply pressure	:	7 Kg/ sq.cm.
	08. Response Time	:	5 Seconds for 0 to 90% output pressure
	09. Housing	:	IP 55
	10. Repeatability	:	±0.1% of span
	11. Accuracy	:	± 0.25% of span
	12. Supply pressure effect	:	Less than 1%
	13. Span and Zero adjustments	:	Screw
	14. Pneumatic connection	:	¼" NPT

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|---------|-------------------------|---|---|
| | 15. Stability | : | Less than 0.25% of Span / Zero for six months. |
| | 16. Cable connection | : | ¾" ET |
| | 17. Mounting | : | Field (pipe/wall mounting) |
| | 18. Accessories | : | Air filter regulator, mounting accessories, cable gland etc. |
| 1.27.00 | Air Filter Regulator | | |
| | 01. Filter Element | : | Sintered Bronze |
| | 02. Filter Size | : | 5 microns |
| | 03. Input Air | : | 10.0 Kg/Sq. cm (maximum) |
| | 04. Output | : | Adjustable from 0-2.0 Kg / Sq. cm or 0-7.0 Kg / Sq. cm (continuous) as applicable for I/P converter, control drives and control valve |
| | 05. Effect of Supply | : | Maximum 0.02 Kg/Sq. cm for a change pressure variation in supply pressure of 4 Kg/Sq. cm |
| | 06. Bowl Material | : | Metallic cover around high temperature area / clear transparent polycarbonate with metallic cover for ordinary applications. |
| | 07. Accessories | : | 2" dial size output pressure gauge |
| | 08. Desirable Feature | : | No perceptible drop of pressure on opening the drain port. |
| 1.28.00 | Solenoid Valve | | |
| | 01. Operating Principle | : | Electromagnetic (noiseless) |
| | 02. Coil voltage rating | : | 240 V AC / 220 V DC/24 V DC/110 V (as required) |
| | 03. Ways | : | Generally 3-ways other depending on requirement |
| | 04. Port size | : | 1/4" NPT all ports |
| | 05. Body | : | SS bar stock |
| | 06. Trim | : | SS-316 |
| | 07. Duty | : | Suitable for continuous energization |
| | 08. Sealing | : | Airtight and leak proof |
| | 09. Ambient Temperature | : | 0 - 50 ° C |
| | 10. Fluid Temperature | : | 0-150 ° C (approx.) |
| | 11. Coil Enclosure | : | Stainless Steel |
| | 12. Insulation | : | Class-H |
| | 13. Coil Casing | : | IP-65 (Explosion proof for NEC Class-1, Division-1 area) |
| | 14. Mounting | : | On pipe or on panel |
| | 15. Cable Connection | : | ¾" ET |
| | 16. Accessories | : | Mounting brackets, nuts and bolts |

17. Preferred feature : a) Solenoid valve directly integral to actuator body shall have NAMOOR interface for uniformity
b) Local indication for power
- 1.29.00 Sight Glass
01. Type : Flap-type
02. End connection : Screwed / Flanged
03. Material:
- a) Body : CS/SS as per process medium
- b) Indicator : Stainless steel
04. Sight Glass : Toughened Borosilicate
05. Gasket : Neoprene
06. Bolts & Nuts : High tensile steel
07. Hydraulic Test Pressure : 1.5 times maximum working pressure
08. Accessories : As required
- 1.30.00 Flow Indicating Switch
01. Type : On line metal tube Rotameter
02. End connection : Flanged
03. Material:
- a) Body : CS/SS as per process medium
- b) Float : Stainless steel
- c) End fittings/flange : Stainless steel
- d) Other wetted part : Stainless steel
- b) Casing : Di cast Alluminium
04. Accuracy : +/- 2.0% of FSR
05. Rangeability : 10:1
06. Electrical connection : ¾" ET
07. Switch type : Snap acting hermitically sealed 2 nos. SPDT
08. Contact rating : 5A, 240V AC
09. Protection class : IP-65
10. Accessories : As required

~~2.00.00 **CLOSED CIRCUIT TELEVISION SYSTEM**~~

~~2.01.00 Closed Circuit Television System~~

~~2.01.01 Closed Circuit Television System (CCTV) with all equipment and accessories shall be installed for the purpose of surveillance of major plant areas. Also, cameras shall be installed at the Main plant (TG Hall, Boiler ESP) and other common auxiliary plants.~~

~~2.01.02 The CCTV system shall meet the specific functional & design requirements towards collecting live video information from the various areas of the plant and displaying that information at monitors.~~

CCTV network configuration shall be built on the Stackable Managed Ethernet switches for better control of data traffic & performance and future expansion. Switch configuration shall be redundant with seamless changeover without any upset in the CCTV operation. MTBF of the switch shall be more than 20 Years. Configuration shall be automatic.

3.00.00 CONTROL PANEL/DESK MOUNTED INSTRUMENTS AND ELECTRICAL SYSTEM ACCESSORIES

3.01.00 Coupling Relay

01. Type : Octal base plug-in type/ DIN rail Mounting
02. Coil voltage : 24 V D.C. in general / other as required
03. Contact : 2 NO & 2 NC (Minimum)
04. Contact rating : 250 V/5A (A.C)/220V/2A (D.C)
05. Operating range : 70 to 110% of rated voltage.
06. Insulation : 2 KV for 1 minutes between terminal & earth.
07. Mechanical life : 20 million operations
08. Coil protection : Diode
09. Indication : Coil on LED
10. Enclosure : Transparent cover
11. Connection : Screw terminals.
12. Mounting : Projection mounting inside panel / DIN rail mounting

3.02.00 Bar graph Indicator

01. Type : Bar graph
02. Number of channels : One / Two (as required)
03. Input : 4-20 mA/1-5 V/Thermocouple/RTD
04. Indication : Green LED / LCD
05. Scale : 100 mm vertical one for each channel graduated in engineering unit (linear scale)
06. Readable Distance : 3 meters (minimum)
07. Mounting : Flush panel
08. Face Dimension : 36(W) x 144(H) mm (approx) / 72 x 144 (H) mm
09. Resolution : 1% of scale or better
10. Power Supply : 240V, 1 Phase, 50 Hz AC
11. Operating Conditions :-
 - a) Temperature : 0-50 ° C
 - b) Relative Humidity : 5%-95%
 - c) Supply Voltage : -15% to +10%
12. Connection between

- | | | | |
|---------|---------------------------------|---|--|
| | Indicator and Tray | : | Prefab Cable |
| 13. | Accessories | : | i) Mounting Tray
ii) Engraved phenolic nameplate affixed to front flange to identify each indicator by tag number and each point by measured variables. |
| 14. | Alarm Facility | : | 1 HI and 1 LO for each channel independently adjustable over span. Voltage free outputs |
| 15. | Reference Junction Compensation | : | Built-in cold junction compensation for thermocouple inputs |
| 16. | Feature | : | i) Alarm level indication by flashing cursor
ii) Green Digital display of parameter value in front panel with a 3.1/2 digit display. |
| 3.03.00 | Valve Position Indicator | | |
| 01. | Input | : | 4-20 mA DC/1-5 Volts DC |
| 02. | Indication | : | Pointer and Scale. Moving Coil Meter |
| 03. | Readable Distance | : | 3 meters (minimum) |
| 04. | Pointer Deflection | : | 90 Deg Sector or linear |
| 05. | Mounting | : | Flush Panel (Horizontal/vertical) |
| 06. | Accuracy | : | ±1% or better |
| 07. | Protection Class | : | IP-42 |
| 08. | Operating Ambient Temp. | : | 0-50 °C |
| 09. | Scale | : | 0-100% |
| 10. | Bezel Size | : | DIN Standard |
| 3.04.00 | Digital Indicator | | |
| 01. | Type | : | Four and half digit LED seven-segment display with sign. |
| 02. | Face Dimension | : | 72 x 144 mm / 48 x 96 mm (as applicable) |
| 03. | Display Character | : | 13.8 mm, Green (LED) |
| 04. | Accuracy | : | 0.1% of reading, ±2 digit |
| 05. | Input | : | 4-20mA DC/1-5 V DC/RTD/Thermocouple |
| 06. | Mounting | : | Flush Panel |
| 07. | Power Supply | : | 240V ±10%, 50 ±2.5 Hz |
| 08. | Output Contact | : | 2 nos SPDT, contact rating 5A at 240V AC/
0.25A at 220V DC |
| 09. | Power/Signal Connection | : | Screwed |
- Large Display (150x300 mm) indicators shall be provided for MW, MVAR and frequency indications.

- 3.05.00 Push Button
- 01. Type : Shrouded square format
 - 02. Face Dimension : 32 x 32 mm (maximum)
 - 03. Contact Configuration : 2 NO + 2 NC
 - 04. Contact Addition : Add-on block up to 4 each with 2 pairs of contacts
 - 05. Contact Material : Hard Silver Alloy
 - 06. Contact Rating : 500V / 10 A
 - 07. Utilization Category : AC11 / DC11
 - 08. Insulation Voltage : 2 KV for 1 minute between terminals and earth
 - 09. Mechanical Life : 1 million operation
 - 10. Construction : Aluminum shrouding with plastic lens
 - 11. Colors : Red, Green, Yellow, Black, etc.
 - 12. Connection ; Screw terminals
 - 13. Enclosure Class : IP-52
 - 14. Legend : Engraving
- 3.06.00 Illuminated Push Button
- 01. Type : Square format
 - 02. Face Dimension : 32 x 32 mm (maximum)
 - 03. Contact Configuration : 2 NO + 2 NC (minimum)
 - 04. Contact Addition : Add-on-Block up to 4 each with 2 pairs of contacts
 - 05. Contact Material : Hard Silver Alloy
 - 06. Contact Rating : 500 V/ 10A
 - 07. Utilization Category : A C11 / DC11
 - 08. Insulation Voltage : 2 KV for 1 minute between terminals and earth
 - 09. Mechanical Life : 1 Million Operation
 - 10. Lamp : LED with built-in resistors as required
 - 11. Lamp Rating :-
 - a) Voltage : 240 V AC
 - b) Watt : 2 Watt (approx.)
 - 12. Lamp and Lens Replacement : From front
 - 13. Construction : Transparent Plastic Lens
 - 14. Color : Red, Green, Amber, Yellow etc.
 - 15. Connection : Screw terminals

- | | | | |
|---------|-------------------------------|---|---|
| | 16. Enclosure Class | : | IP-52 |
| | 17. Legend | : | Engraving |
| 3.07.00 | Selector Switch | | |
| | 01. Type | : | 2/3/4 position stay put type with rotary lever actuator. |
| | 02. Face Dimension | : | 32 x 32 mm (maximum) |
| | 03. Contact Configuration | : | 4 pair of contacts |
| | 04. Contact Addition | : | Add-on-Block up to 4 each with 2 pairs of contact |
| | 05. Contact Material | : | Hard silver Alloy |
| | 06. Contact Rating | : | 500 V/10 A |
| | 07. Utilization Category | : | AC11 / DC11 |
| | 08. Insulation Voltage | : | 2 KV for 1 minute between terminals and earth |
| | 09. Mechanical Life | : | 1 million operation |
| | 10. Construction | : | Aluminum shrouding |
| | 11. Connection | : | Screw terminals |
| | 12. Enclosure Class | : | IP-52 |
| 3.08.00 | Indicating Lamp | | |
| | 01. Type | : | LED with built-in resistor |
| | 02. Face Dimension | : | 32 x 32 mm (maximum) |
| | 03. Voltage | : | 240 V AC |
| | 04. Watt | : | 2.5 Watt (approximate) |
| | 05. Lamp and Lens Replacement | : | From front |
| | 06. Construction | : | Transparent Plastic lens |
| | 07. Color | : | Red, Green, Amber, Yellow etc. |
| | 08. Connection | : | Screw terminals |
| | 09. Legend | : | Engraving |
| 3.09.00 | Indicating Meters (A.C) | | |
| | 01. Type | : | Rectifier type |
| | 02. Face Dimension | : | 96 x 96 mm |
| | 03. Scale | : | Radial arc of 240 Deg. |
| | 04. Accuracy | : | 1.5% of full scale.
±0.5 Hz for frequency meter |
| | 05. Input | : | 0-1/0-5A for current measurement, 0-240V, 50 ± 2.5 Hz for voltage / frequency measurement |
| | 06. Zero Adjustment | : | Screw on meter face |

- 07. Enclosure : Shielded Case
- 08. Mounting : Flush Panel
- 09. End Scale Suppression : 6 times the measuring range only for motor ammeters

3.10.00 Indicating Meters (D.C)

- 01. Type : Taut band moving coil
- 02. Face Dimension : 96 x 96 mm
- 03. Scale : Radial arc of 240 Deg.
- 04. Accuracy : 1.5% of full scale
- 05. Input : 0-75 mA for current measurement. Direct reading for voltage measurement.
- 06. Zero Adjustment : Screw on meter face
- 07. Enclosure : Shielded case
- 08. Mounting : Flush Panel
- 09. End Scale Suppression : 2 times the measuring range only for motor ammeters.

For electrical system's meter and for synchronization, Bidder shall refer to electrical volume of the specification

3.11.00 Auxiliary Relay

- 01. Type : Electromagnetic
- 02. Coil voltage : 240 V A.C / 220V DC. For any other voltage bidder to make his own arrangement.
- 03. Contact Configuration : 2 NO & 2 NC (Minimum), additional contacts as per requirement with provision for additional contact block expansion
- 04. Contact rating : 250V/5A (A.C/D.C.)
- 05. Operating range : 80 to 110% of rated voltage
- 06. Insulation : 2 KV for 1 minute between terminals & earth.
- 07. Mechanical life : 20 million operations
- 08. Coil protection : Diode/surge suppressor
- 09. Connection : Screw terminals.
- 10. Mounting : Projection mounting inside panel

3.12.00 Electrical Transducer

Transducers shall be provided for conversion of AC electrical quantities such as voltage, current and power. Transducer shall be suitable for 220V DC auxiliary supply. Transducers shall be of low burden type having 4 – 20 mA DC linear galvanically isolated output compatible with secondary indicating instrument. Transducer shall be dual channel type. Accuracy class of Transducers shall be as per IS14570:1998 or IEC688:992

3.13.00 Synchroscope

Synchroscope shall be designed to provide an illuminate and indication of phase and frequency difference between bus voltage and Generator voltage. It shall denote the actual frequency difference corresponding to the inverse of time taken for one rotation of the illuminated vector spot. The instrument shall be designed for industrial applications, which require precise, reliable and robust instruments for the display range and indication. Synchroscope shall be designed as per the DIN / IEC / BS standards.

4.00.00 **CONTROL VALVES, ACTUATORS & ACCESSORIES**

General Technical Guidelines for the Control Valves shall be as follows :

- a) Bidder shall exercise caution in selecting severe service control valves like BFP recirculation valves, HP & LP bypass valves, superheater & reheater attemperator valves, PRDS valves for Boiler & Turbine, Soot blower steam pressure control valve, control valves whose down stream are connected to vacuum such as HP/LP heater emergency level control, condenser make up water control valve, separator level control and CEP minimum flow control valve. For such critical applications, Bidder shall offer valves which are proven for similar application. Above valves shall have leakage class equal or better than class-V with metal-to-metal seating.
- b) Wherever, steam conditioning calls for Pressure reducing & desuperheating, combined PRDS type valves shall be offered.
- c) Bidder shall provide redundant control valves for Main condensate flow control, Superheat attemperation control and Reheat attemperation control as a minimum for high availability. For other application, if the availability criteria for the plant cannot be met even with the best established product, redundant control valves shall be provided.
- d) Control valves shall be located near floor or platform for ease of access and with adequate clearances for maintenance and lay-down and shall be placed as station with upstream motorized isolating valve, down-stream isolating valve, inching duty motorized bypass valve and manual drain valves. Each redundant control valve shall have its upstream motorized and down-stream manual isolating valves. Where quick shut off requirement is foreseen such as in case of SH & RH attemperation valves, upstream isolation valve shall be pneumatic type.

4.01.00 General

4.01.01 Control valves for regulating service shall normally be globe body, preferably cage guided, metal-to-metal seated, pneumatically operated and shall be provided with characterized plugs having ANSI leakage class-IV except for the control valves indicated above.

4.01.02 Where the operating time is critical for the operation of the plant, as in case of HP or LP bypass valves, hydraulic actuators with electro-hydraulic interface shall be offered.

4.01.03 Bonnet joints for all control valves shall be of flanged and bolted type.

4.01.04 Flanged valve shall be rated at no less than class 300 lbs.

4.01.05 Valve Body / End Connections

- 4.01.06 Valve end to end dimension and connection shall be according to ANSI standard, straight through pattern. However, Bidder may offer angle body valve for high pressure drop applications. For high pressure drop applications, construction of the valve shall be such that the gland is not exposed to inlet pressure.
- 4.01.07 Control valves of 40 mm. size and above with line pressure up to 50 Kg / Sq. cm may have flanged or welded end connections.
- 4.01.08 Control valves, used in high pressure services shall have butt welded end connections for size 65mm and above and socket weld end connection for size 50 mm or below.
- 4.01.09 Control valve body shall be selected as per the ISA guideline. Generally control valve body shall be cast and machined for pressure rating up to 1500 lbs. Above 1500 lbs, valve body shall be of forged steel. For Demineralized Water application, valve body shall be Stainless Steel.
- 4.01.10 The direction of flow shall be clearly engraved on the body .
- 4.02.00 Valve Body Material (material shall match the process condition for super critical boiler)

SR. NO.	SERVICE	MATERIAL
1.	Non corrosive, non-flashing and non cavitating service for fluid temperature up to 275°C	Cast carbon steel ASTM A216 Gr. WCB
2.	Non corrosive, non-flashing and non cavitating service for fluid temperature above 275°C	Cast alloy steel ASTM A217 Gr. WC9
3.	Severe flashing / cavitating services	Cast alloy steel ASTM A217 Gr. WC9
4.	Low flashing / cavitating services	Cast alloy steel ASTM A217 Gr. WC6
5.	DM water application (condenser hotwell normal, emergency make up etc.)	Cast type 316 stainless steel ASTM A351 Gr. CF8M

4.03.00 Valve Size

The control valve sizing (Cv / Kv) shall be based on following guidelines :

- The valves shall pass normal flow (MCR condition) with 60 to 70 percent opening for linear characterised valves and between 70 to 80 percent opening for equal percentage characterised valves.
- The valves shall have adequate rangeability to pass the minimum and maximum flows at 10% and 85% of the valve opening respectively. Valve stem travel range from minimum to maximum flow condition shall not be less than 50% of the total valve stem travel.

- c) Valve Cv shall be selected in such a way that the valve shall be capable of handling at least 120% of required maximum flow.
- d) The valve selection shall be based on the highest size dictated by the above considerations unless noise, flashing or other factors dictate the final selection.
- e) Trim outlet velocity for the control valves shall be no more than 7 m/sec for water service and Mach number less than 1/3 for steam and air service application.
- f) The sizing procedure followed shall be as per latest edition of ANSI/ISA or equivalent standard.

4.04.00 Valve Top work

4.04.01 Top work shall be sized so that the valve shall operate properly when upstream pressure is 10 percent above maximum inlet pressure and downstream pressure is atmospheric.

4.04.02 Extended bonnet/Finned bonnet and high temperature packing shall be used for high temperature application.

4.04.03 The gland material shall be chosen to suit the operating temperature. PTFE may be chosen for lower temperature application (232°C maximum) and for high temperature application graphited asbestos glands are to be provided. For vacuum services, the glands shall be of dry seal type.

4.05.00 Valve Trim

4.05.01 Valve trim for applications up to leakage class-V shall be stainless steel 316 SS for pressure drop up to 7 Kg/ Sq. cm. For pressure drops above 7 Kg/Sq. cm hard trim (stelliting or equivalent) shall be used. Other alloys or treatment such as nitride shall be used if severe erosion is expected.

4.05.02 Balanced trim valves shall be offered for high shut-off pressure or high pressure drop condition to reduce the size of the actuators.

4.05.03 For flashing services and two stage mixtures, the trim material shall be 17-4 PH SS or equivalent.

4.05.04 If cavitating condition is foreseen, Bidder shall offer multistage or labyrinth trims valves. Trim of severe service valves shall be of multistage and multipath design with number of discrete pressure drop stages to eliminate the chances of erosion, cavitation, noise and vibration throughout the control range of the valve.

4.05.05 Quick replacement type trim shall be considered for easy maintenance.

4.05.06 Trim Material

SR. No.	SERVICE	MATERIAL
1.	Non corrosive, non-flashing and non cavitating service for fluid temperature up to 275°C.	SS 316 stellited
2.	Non corrosive, non-flashing and non cavitating service for fluid temperature above 275°C.	SS 316 stellited

SR. No.	SERVICE	MATERIAL
3.	Severe flashing /cavitating services	: 440 C
4.	Low flashing /cavitating services	: 17-4 PH SS
5.	DM water application (condenser hotwell normal, emergency make up etc.)	: 17-4 PH SS

4.06.00 Noise Level

The equivalent sound level measured at 1.5M above nearest floor level in elevation and 1 M horizontally from the control valve expressed in decibels to a reference of 0.0002 microbar shall not exceed 85 dBA. If the calculated noise is more than the above limit, even with low noise trim design, diffusers shall be included. Diffusers shall be made of stainless steel and shall be integrally connected to the control valve with spool piece. The spool piece shall be in conformity with the main line piping specification.

4.07.00 Valve Actuators

Spring-diaphragm type actuators shall generally be used. Piston type actuators shall be offered in case of high shut-off pressure & quick response requirement.

4.07.01 The actuator shall be designed for 150% thrust required for the valve (at shut-off pressure) at an air line supply pressure of 5.5 Kg/Sq. cm.

4.07.02 Diaphragms shall be designed for 200% maximum operating pressure.

4.07.03 Nylon reinforced neoprene is preferred as diaphragm material.

4.07.04 Valve actuators shall be capable of operating at 80O C ambient, continuously.

4.07.05 Entire actuator assembly shall be painted with corrosion inhibiting paint.

4.07.06 Air connection size shall be 1/4" NPT (F) unless otherwise dictated by process response time. Integral tubing shall be stainless steel.

4.07.07 Bidder shall indicate the stroking time of the valve assemblies with positioner and ensure that the stroke time shall meet the process and equipment dynamics and shall be better than 20 seconds.

4.07.08 All actuators shall be of fail safe design signifying that the spring direction will tend to move the valve (open or close) in a direction safe for the process. "Failure to Open" or "Failure to Close" shall be marked on the actuator.

4.08.00 Valve Positioners

4.08.01 Regulating duty valves shall be offered with Electro Pneumatic Positioners to ensure accuracy and repeatability of response.

4.08.02 Positioners shall have integral non contact (LVDT) type position transmitter, input and output gauges, local keypad & display.

4.08.03 Positioners shall be capable of functioning under hot, humid and vibrating conditions.

4.08.04 Positioner casings shall be dust tight, corrosion resistant and weatherproof.

4.08.05 In general, positioner shall operate at signal range 4 - 20 mA DC for the full travel of the valve.

- 4.09.00 Valve Accessories
Accessories shall include side mounted hand wheels, limit switches, junction boxes, airlock relays etc.. Solenoid valve wherever required shall be furnished.
- 5.00.00 **CONTROL DESK / PANEL / RACK**
- 5.01.00 Convenient and logical approach to operational interfaces and aesthetics in the overall view of the panel /desk shall be considered.
- 5.02.00 For items susceptible to vibration, suitable anti-vibration padding shall be provided to prevent damage or malfunction.
- 5.03.00 All items inside the panels/cabinets shall be neatly arranged with easy access/maintenance approach.
- 5.04.00 Incoming power supply feeders shall be duplicated. Alarm shall be provided for failure of a power supply feed.
- 5.05.00 Desk / panel shall be provided with interior illumination, utility receptacles with plug and cooling fan.
- 5.06.00 Panel / Desk shall have gland plate at cable entry to panel. Thickness of gland plate shall not be less than 3 mm.
- 5.07.00 Wire shall be routed / laid through covered trough.
- 5.08.00 Crating of the panels and desks shall be suitable for protection against shock, vibration, inappropriate handling and inclement weather conditions during transportation and warehousing. Mounted equipment shall have adequate protection against damage during handling, transit and storage. Suitable desiccant shall be used inside the packing case.
- 5.09.00 Nameplate
- a) Nameplate shall be provided for instrument or device mounted on the panel.
 - b) Nameplates for panels shall be provided both in front and rear.
- 5.10.00 Control Desks
- 5.10.01 Devices mounted on the desks shall be flush type. Devices shall be so mounted that their removal and replacement can be accomplished without interruption of services to others.
- 5.10.02 Desk shall be ergonomically designed to suit working on a 24 X 7 basis. Aesthetics, ergonomics and illumination shall be considered while positioning of the desk, large video screen and panels in control room.
- 5.10.03 Control desk shall be free standing floor mounting type of table-top design with compartments for locating the hardware. Desk shall be constructed from aluminum extrusion with high pressure laminate MDF board for work surface of approved colour. Aluminium structure shall be anodized or powder coated paint finish.
- 5.10.04 Monitors with retractable keyboard, emergency push buttons shall be provided on the desk. Desk shall be arranged in arc-like shape without any sharp edges. Edges shall be extruded PVC or rounded post-formed laminate..
- 5.10.05 Desks shall be of modular, scalable and industrially ruggedized design and shall have Telephones and Intercom connections.
- 5.10.06 Desks shall have concealed cable trays for wire dressing.

- 5.10.07 Design shall include Earthing bolts.
- 5.10.08 Back installed items shall be suitably concealed from front view.
- 5.11.00 Back Up Panel
- 5.11.01 Construction shall be from sheet steel of thickness not less than 3mm.
- 5.11.02 Electrical upright Panel construction & design shall be similar to back up panel. Control switches, meters, indicators, synchronizer, excitation control switch, annunciation window etc. along with associated mimic diagram, as recommended, shall be provided for manual synchronization of generator.
- 5.12.00 Cabinets / Enclosure / Panels
01. Material of construction : Cold rolled steel sheet
 02. Thickness of Sheet :
 - a) 3.0 mm for faces supporting instruments / terminals.
 - b) 2 mm for other sides and top.
 03. Construction : Welded throughout as per approved National Standards.
 04. Panel height : 2300 mm (approx)
 05. i) Corners : 7 mm inner radius
 - ii) Dimensional Tolerances :
 - a) In height & length - 3 mm
 - b) In height between adjacent sections - 2 mm.
 - c) Total for a group - 6 mm
 06. Doors : Double, recessed, turned back edges
 - i) Thickness of Sheet : 2 mm
 - ii) Hinges : Stainless steel
 - iii) Door latches : Three point type
 - iv) Door gaskets : Neoprene rubber on fixed frame to result dust proof/weatherproof enclosure.
 - v) Opening of the doors : Outward
 - vi) Louvers : With removable wire mesh to ensure dust and vermin proof.
 07. Color of interior : Brilliant white
 08. Colour external : RAL 7032
 09. Painting : Epoxy powder coated or better
 10. Gland plates : Removable 4 mm thick (bottom)
 11. Cable entry : Bottom
 12. Hardware :
 - a) Anti vibration pad- 15 mm
 - b) Predrilled base channel ISMC - 100 or equivalent for all sides.

- c) Stainless steel buff- finished 2 mm thick kick plate for all sides.
- d) Stainless steel scratch strips along desk edges fixed with pan-head recessed screws.
- e) Rubber strips to ensure air tightness between kick plate and finished floor.
- f) Lifting hook / Eye bolt
- g) Drawing pocket
- h) Door switch, lamps, thermostat, heaters and fans

13. Enclosure Protection : As per environment condition of the area of installation. Refer section-I of this vol.

5.13.00 Local Instrument Racks & Enclosure

5.13.01 General Requirements

- a) Devices located in the field shall be grouped and installed in the enclosure (Open / Closed Rack) in Boiler and TG Building.
- b) Racks and enclosure shall be factory prefabricated & painted and shall complete with internal piping, tubing, manifold, isolation valves, blowdown valves, integral junction box, illumination etc.
- c) No more than six instruments shall be grouped in a single rack / enclosure.
- d) Racks shall be installed above the tapping points for air, flue gas and coal air mixture application whereas for applications such as for water and steam, racks to be installed below the source point.
- e) Attention shall be paid in the layout to avoid air traps in liquid piping and water accumulation in air /gas piping.
- f) Welding of impulse lines shall comply with the provisions of the latest applicable ANSI Code for Pressure Piping.
- g) Instrument piping and tubing shall be hydrostatically tested at one and one-half times the maximum system pressure except for low pressure and vacuum measurement for which the test pressure will be as per piping standard.
- h) Service air connection shall be provided for continuous and intermittent purging of impulse pipe in dusty medium. Continuous purging shall be adopted for differential pressure measurement such as flue gas and coal air mixture application. Pressure measurement shall have only intermittent purging whenever required. In case of continuous purging, an air header shall be formed this shall receive service air through isolation valve and air filter regulator. Air shall be fed from the air header to both the impulse pipes near to take off points through isolation valves and flow regulators. Air header shall be constructed from stainless steel. Impulse pipe for such applications shall have a four-way valve. One port of the valve shall have an adaptor to connect flexible stainless steel braided nylon hose to the service air. Rating of the hose shall not be less than 10 Kg/sq.cm.

Four way valve shall have two position operations. One position for service and other one for purging. Required pressure gauges shall be provided for monitoring of air pressure. Complete purging arrangement shall be integral to the enclosure and racks.

- i) Gate or ball type (full ported) instrument isolation valve and globe type blow down drain valve adequate for duty requirement and for withstanding continuous design pressure and temperature of main process medium shall be provided in the hook up plumbing. For process pressure equal or above 40 kg / sq.cm single instrument isolation valve and double blowdown valves shall be used before connecting to blowdown header. Whereas for line pressure less than 40 kg/ sq.cm, single instrument isolation valve and single blow down valves can be used before connecting to blow down header. Instrument manifolds shall be non integral and shall be installed close to the instrument.
- j) Drawing K9213R-DWG-I-0200 shall be referred for typical arrangement of Local instrument enclosure and rack.

5.13.02 Closed Instrument Rack

- a) Enclosure shall be free standing type. Racks shall be adequately reinforced to ensure true surfaces and to provide support. Major load-bearing posts shall be suitably supported by gusset plates or moment members.
- b) Enclosure outer shall be constructed from at least 3 mm thick steel plate and epoxy painted to shade gray. Base frame shall be made of ISMC 100 and black colour finish.
- c) 2" NB galvanized pipes shall be laid horizontally and supported at two end channels to mount transmitters at accessible height. Center posts or any member, which would reduce access, shall be avoided.
- d) Double leaf interlocking front opening doors with three point locking shall be provided and shall be arranged for maximum possible access to the interior. Key shall be of identical for all enclosures.
- e) Doors shall have concealed quick removal type pinned stainless steel hinges and locking handles. Gaskets shall be used between all mating sections to achieve dust and weather proof enclosure rated for IP-65 including the internal junction box.
- f) Removable type bulkhead plates of thickness not less than 6 mm shall be mounted at the racks with suitable high temperature gasket. Impulse lines within the enclosures shall be properly clamped.
- g) All internal wirings between the instruments and junction box shall run through flexible conduits.
- h) Racks shall have a common blowdown drain header, which will connect individual instrument blowdown line after suitable pressure breaking through regulating globe type blowdown valves. Header shall be of 2" NB ASTM A 106, Sch-80 Gr. C installed at a slope of 1:25 and extended beyond the rack for connection to plant drain header.
- i) Each rack shall be provided with one receptacle, light fixtures each at instrument & Junction box compartments with wire guard.

5.13.03 Open Instrument Rack

- a) Rack shall be free standing type constructed from 6 mm thick steel channel frame provided with a canopy to protect the instrument from dripping water or falling objects and shall be epoxy painted. Rack Major load-bearing posts shall be suitably supported by gusset plates or moment members. Suitable protective grill shall be welded to the end-posts of the rack to outline a boundary beyond which no mounted equipment shall project. Canopy shall be of CRCA steel sheet of at least 3 mm thickness. Center posts or any member, which would reduce access, shall be avoided.
- b) 2" NB galvanized pipes laid horizontally and supported at two end channels shall be employed at working accessible height for mounting of instruments.
- c) All internal wirings between the instruments and junction box shall run through flexible conduits. No exposed wirings are admissible.
- d) All racks shall have a common blowdown drain header, which will connect individual instrument blowdown line after suitable pressure breaking through regulating globe type blowdown valves. Header shall be of 2" NB ASTM A 106, Sch-80 Gr. C installed at a slope of 1:25 and extended beyond the rack for connection to plant drain header.

5.13.04 Junction Box

Junction boxes of FRP construction with protection class conforming to IP 55.

- a) Junction box shall be provided at a dry compartment at one side of the enclosure / rack with front opening type door. Earth stud shall be furnished at rack for safety grounding.
- b) Terminals shall be screwless cage clamp type of reputed make and 20% spare terminals shall be furnished in the junction box.

~~6.00.00 **DISTRIBUTED CONTROL SYSTEM (DCS)**~~

~~6.01.00 System Functional Description~~

~~6.01.01 Integrated functionally distributed and hierarchically structured real time control (both binary and modulating), Data acquisition, Man machine interface, Historization units and Management Information System (MIS) system synthesized from one general family of identical interchangeable multifunction hardware has been envisaged.~~

~~6.01.02 System shall be highly reliable with the availability of not less than 99.7% with adequate redundancy and fault tolerant configuration.~~

~~6.01.03 The system shall be unitized and connectivity with other plant control system.~~

~~6.01.04 Remote input output stations as a data concentrator for acquisition and monitoring of Boiler metal temperature are foreseen. RIO shall be industrially ruggedized and shall be provided with integral air conditioner considering the harsh environment.~~

~~6.01.05 For Power supply to system refer Volume IIE Section I.~~

~~6.01.06 Controls of some plant auxiliaries for CW & ACW Pumps and Fuel oil heating & pressurizing system controls shall be realized in DCS through Remote I/O (RIO) cabinets.~~

~~6.01.07 Off-site & BOP plants such as Coal Handling Plant, Ash Handling Plant, Raw water & Pretreatment plant, Compressed Air System, Mill Reject System and Demineralized water plant etc. having microprocessor based or PLC based~~

- 14. Indication : Processor status and fault display
- 15. Features : Power fail hold, Automatic restoration on power

7.03.07 Operator's & Engineering Station:

The specification shall be as below or the latest available at the market at the time of contract:

- a) Operator's Station / Engineering Station (PC Based)
 - 1. Intel Pentium Core 2 Duo processor with latest available speed;
 - 2. Windows XP Professional preloaded with CD media;
 - 3. 2 GB RAM;
 - 4. 320 GB HDD;
 - 5. 64 MB SVGA graphics card;
 - 6. 2 MB L2 Cache;
 - 7. 1 DVD Read / write;
 - 8. Antivirus protection software with license;
 - 9. 1 PCI Express x 1 slot 3 PCI 2.2 slot (5v, 32 bit) on Mini Tower, one PCI Express x 16 graphics slot;
 - 10. 4 x USB ports, 1 Serial Port, 1 Parallel Port, PS/2 Port for Mouse & Keyboard;
 - 11. 1 x 104 keyboard;
 - 12. Integrated sound Blaster Compatible Audio Controller 16-bit along with internal speaker;
 - 13. 10 / 100 / 1000 Mbps embedded Network Interface Card. Additional NIC with 2 nos. Intel Pro / 100S PCI Network Adapter Card;
 - 14. Minitower Chassis;
 - 15. 240 VAC 50 Hz power supply
- b) Client Server
 - In case of Client Server Architecture this shall be of the latest model / version and shall have the following minimum requirements:
 - 1. Two Intel Xeon up to 3.4 GHz Processors, 800 MHz FSB;
 - 2. Windows 2008 Server 10 user license preloaded with CD media;
 - 3. Interaction with at least 10 Clients;
 - 4. 2 GB ECC DDR (1GB Installed in two slots and two slots free) SDRAM;
 - 5. Dual 73 GB Ultra 320 SCSI internal storage; HDD partitioning C: 36 & D: 36;
 - 6. 64 MB SVGA graphics card;
 - 7. 2 MB L2 Cache;

8. DVD Read/Write;
9. Antivirus protection software with license;
10. 20 / 40 GB Internal DAT Drive;
11. 4 x 64 bit and 2 x 32 bit PCI slots;
12. 4 x USB ports, 1 Serial Port, 1 Parallel Port, PS/2 Port for Mouse & Keyboard;
13. 1 x 104 keyboard;
14. Integrated sound Blaster Compatible Audio Controller 16-bit along with internal speaker;
15. 10 / 100 / 1000 Mbps embedded Network Interface Card. Additional NIC with 2 nos. Intel Pro / 100S PCI Network Adapter Card;
16. 240 VAC 50 Hz power supply;
17. Tower Chassis;
18. 1 x 24" SVGA High Resolution TFT Monitor.

c) Monitor

1. Type : TFT monitor
2. Screen diagonal : 24" flat
3. Display : XGA or better
4. Resolution : 1680x1050 or better
5. Degree of protection : IP-30
6. External Controls : Brightness, contrast, Horizontal / Vertical amplification & shift
7. Power supply : 240 V, 50 Hz, 1 phase
8. Ambient temperature : 0-50 ° C
9. Humidity : 95% non-condensing
10. Version : To suit industrial application

d) Key Board

1. Type : Flat spill proof membrane type or Positive depression type
2. Different keys
 - a) Soft and user defined function keys for software/ programming including text correction, scan rate alteration, zooming/ flashing color selection etc.
 - b) Panel select keys for alarm summary, control loop display, overview, trend,

- graphic, operator guide message etc.
 - c) Standard Alphanumeric keys
 - d) Alarm acknowledge keys
 - e) Cursor keys
 - f) Mode/loop status switching keys
 - g) Setting change keys
 - h) Print-out command keys
 - i) Other keys as required to operate the system
3. Key lock : Lockable type push button mounted on keyboard
4. Life Expectancy 50 million cycles per key
5. Version : To suit industrial application
- e) Laser Printer
- 1. Type : Electro-photographic laser, tabletop
 - 2. Printer Memory : 256 MB (min.)
 - 3. Speed : Monochrome 24 ppm - A4, Color 6 ppm - A4
 - 4. Resolution : 1200 x 1200 DPI in color
 - 5. No. of color (Basic) : 4 (four) minimum
 - 6. Duty cycle : Monochrome 75000 pages / month
 - 7. Power supply : 240 V, 50 Hz, 1 phase
 - 8. Ambient temperature : 0-50 Deg C
 - 9. Humidity : 95% non-condensing
 - 10. Size of paper : Letter, A4, Legal, Ledger, A3
 - 11. Print media : Plain paper, transparencies, thick stock, glossy stock, envelopes
 - 12. Accessories : Adapters, Connector Cable, Multiplexer switch (4 point)

7.03.08 Stackable Managed Switch

Data highway shall be of high speed Ethernet and full duplex configuration. Network shall be built on the Stackable Managed Ethernet switches for better control of data traffic & performance and future expansion. Switch configuration shall be redundant with seamless changeover without any upset in the process or equipment. Failure reporting shall be available at HMI. MTBF of the switch shall be more than 20 Years. Configuration shall be automatic.

7.03.09 Furniture

Bidder shall include a complete set of furniture for the Control Room and computer Room of ergonomic design from reputed manufacturer especially designed for computer peripherals. The set of furniture shall include but not be limited to control desk, chair, printer table, computer tables etc, all necessary furniture for Computer Room peripherals, cabinets for storage of manuals / booklets/recorder charts, storage racks for special tools/ diskettes and Shift Charge Engineer's desk/chair/side rack etc.

7.04.00 Software Specification

7.04.01 General

The system shall utilize a readily upgradeable, public domain software platform proven for real-time operation environment at the control and monitoring level overlaid with a relational database program. The desirable features are enumerated below.

- a) The operating system shall be suitable for real-time operation both at process as well as HMI end.
- b) The software system shall be fully modular.
- c) The software shall meet the following general requirements.
 - i) Simple, easy-to-learn language for editing and on-line operation.
 - ii) Wide range of peripheral support.
 - iii) Effective task scheduling and support of multiple priority structure including event based interrupt etc.
 - iv) Effective debugging.
 - v) Provision for on-line editing and program development without interrupting on-line functions.
 - vi) Self-diagnostic routines.
 - vii) Efficient memory management and effective utilization of system time.
 - viii) Quick start-up and loading.
 - ix) Support of multiprogramming and multi-user operation.

7.05.00 Memory Management / Operating System

- a) The main memory capacity shall be adequate to minimize swapping.
- b) Individual task shall reside in partitions, which can be split into sub-partition for parallel task handling.
- c) The operating system shall automatically perform housekeeping functions including file management.
- d) Task swapping shall be dynamic.

8.18.01 A Portable data collector shall be provided for taking periodic collection of non critical machine data. Machine condition monitoring system shall be capable to analyze the data. Instrument shall be microprocessor based and ready for use in harsh environment. Integral LCD display shall provide the necessary display of readings & spectral data. Minimum 02 channels along with additional input for phase reference measurement shall be available with the instrument.

8.18.02 Instrument shall include necessary accelerometers and other devices with accessories for collection of machine parameters. A long life Ni-Cd battery pack shall be used. Replacement of battery shall not lead to loss of stored data.

8.18.03 Shaker table shall be provided for testing & calibration.

9.00.00 **INSTRUMENTATION & CONTROL CABLE**

9.01.00 Cables shall be flame retardant low smoke (FRLS) type. In hazardous areas cables of suitable R/L ratio shall be provided for intrinsic safety.

9.02.00 Durable marking shall be provided on the surface of the cable at intervals not exceeding 5 mtrs. Marking shall include Manufacturer's name, Year of manufacture, Voltage grade, Type of cables (Conductor size & no. of pairs / triads / type of compensating /extension cable), Insulation material, FRLS etc.

9.03.00 Sequential length marking shall also be provided at every meter interval on outer sheath of cable.

9.04.00 Standard seasoned wooden drum containing minimum 500 /1000 M \pm 5% length. Drum shall be anti rodent, anti termite and smooth finish. Both end of cable shall be capped by means of non hygroscopic sealing material.

9.05.00 Thermocouple Extension & Compensating Cable

- | | | |
|-----------------------------|---|--|
| 01. Conductor | : | Solid conductor |
| 02. Conductor size | : | 0.75 sq.mm |
| 03. Type | : | KX (Extension) (Chromel Alumel)
RX (Compensating) (Copper-Copper alloy)
JX (Extension) (Iron Constantan) |
| 04. Conductor Insulation | : | HR PVC Type-C (IS-5831,1984) 0.6 mm thick |
| 05. Operating Voltage | : | 300V /500V RMS (Core to earth / core to core) |
| 06. Twisting | : | Pair twisted with lay of 60 mm (max) |
| 07. Twisting Direction | : | All pairs in the same direction. Lapped to form bunch with mylar tape. |
| 08. Screen (Pair & Overall) | : | Aluminium mylar tape with a thickness of 28 μ m (min.) for individual pair screen and 60 μ m (min.) for overall screen with 100% coverage and 25% overlapped edges. Over the individual pair screening tape two laps of 0.05 mm thick (min.) polyester tape shall be applied with minimum overlap of 25%. Metallic side of the screen shall be in contact with drain wire. |

09. Drain wire : Annealed tinned copper wire, stranded. Size 0.5 Sq. mm. (No. of strands / size:- 7 / 0.3mm)
10. Inner Sheath : Extruded FRLS PVC (anti rodent, anti termite & moisture resistant properties)
HR PVC Type ST2 of IS-5831,1984
Thickness as per IS-1554Part-I 1976
11. Rip Cord : Non metallic under sheath
12. Armouring : GI wire / strip as per IS 3975
13. Outer Sheath : Extruded FRLS PVC (anti rodent, anti termite & moisture resistant properties)
HR PVC Type ST2 of IS-5831,1984
Thickness as per IS-1554Part-I 1976
14. Filler : Non hygroscopic with FRLS property
15. Temperature Range : Up to 85 °C
16. Insulation at 20⁰ C : 100 MOhms/Km [Min]
17. Capacitance at 800 Hz : 120 nf/km
18. Cross talk : 60 dB
19. Attenuation : 1.2 dB/Km
20. Codes & Standards : a) IEC 332-1
b) ANSI MC 96.1
c) IS-8784-1987
21. Tests : a) Oxygen Index: Min.29 at room temp. (ASTM-D-2863)
b) Acid Gas Gen.: Max.20% by weight as per IEC 754 Part-I
c) Temp Index : Min 250 DEG C at 21Oxy. Ind. (ASTM-D-2863)
d) Smoke Density Rating : Max.60% (ASTM-D-2843).
e) Flammability Test : as per IEC 332 Part-I /IEEE-383
Swedish Chimney Test - SS-424-1475 F3
f) High voltage test
Core to core- 1.5 KV for 1 min.
Core to screen- 1.0 KV for 1 min.
g) Insulation Resistance 100 M Ohm / Km Min

- h) Rodent & Termite repulsion test
(Presence of lead shall be confirmed)

22. Conductor material & sheath color for thermocouple cable as per ANSI MC 96.1

CABLE TYPE	OVERALL SHEATH COLOR	WIRE	SHEATH COLOR	CONDUCTOR MATERIAL
KX	Yellow	Positive	Yellow	Nickel / Chromium
		Negative	Red	Nickel / Aluminum
JX	Black	Positive	White	Iron
		Negative	Red	Constantan
RX	Green	Positive	Black	Copper
		Negative	Red	Copper Nickel Alloy

23. Durable printed or embossed numbering at regular interval of 50mm shall be provided for identification of pairs.

9.06.00 Instrumentation multi Paired Signal Cable

01. Conductor type : Stranded (7) annealed tinned copper
02. Conductor size : 0.5 / 1.0 / 1.5 Sq.mm (as required)
03. Conductor resistance : 39 Ω/Km/18 Ω/Km/12 Ω/Km
04. Conductor Insulation : HR PVC Type-C (IS-5831,1984) 0.6 mm thick
05. Operating Voltage : 300 / 500V RMS (Core to earth / core to core)
06. Twisting : Twin twisted with lay of 60 mm
07. Twisting Direction : All pairs in the same direction. Lapped to form bunch with mylar tape.
08. Screen (Pair & Overall) : Aluminium mylar tape with a thickness of 28 μm (min.) for individual pair screen and 60 μm (min.) for overall screen with 100% coverage and 25% overlapped edges. Over the individual pair screening tape two laps of 0.05 mm thick (min.) polyester tape shall be applied with minimum overlap of 25%. Metallic side of the screen shall be in contact with drain wire.
 - * Analog signals- Individual pair & overall shield to be considered.
 - * Binary signals- overall shield to be considered.

09. Drain wire : Annealed tinned copper wire, stranded. Size 0.5 Sq. mm. (No. of strands / size:- 7 / 0.3mm)
10. Inner Sheath : Extruded FRLS PVC (anti rodent, anti termite & moisture resistant properties)
HR PVC Type ST2 of IS-5831,1984
Thickness as per IS-1554, Part-I 1976
11. Rip Cord : Non metallic under sheath
12. Armouring : GI wire / strip as per IS 3975
13. Outer Sheath : Extruded FRLS PVC (anti rodent, anti termite & moisture resistant properties)
HR PVC Type ST2 of IS-5831,1984
Thickness as per IS-1554, Part-I 1976
14. Filler : Non hygroscopic with FRLS property.
15. Temperature Range : 85 °C
16. Insulation at 20 Deg.C : 100 MOhms/Km [Min]
17. Capacitance at 800 Hz : 120 nf/km
18. Cross talk : 60 dB
19. Attenuation : 1.2 dB/Km
20. Codes & Standards : a) IPCEA-S-61-402
b) BS 5308
c) IEC 332-1
d) ASTM-B-33
e) IS-8130-1984
f) IS 1554 Part-1
g) IS 10810
21. Sheath colour : Inner- Black and Outer- Gray
22. Tests : a) Oxygen Index: Min.29 at room temp. (ASTM-D-2863)
b) Acid Gas Gen.: Max.20% by weight as per IEC 754 Part-I
c) Temp Index : Min 250 ° C at 21Oxy. Ind. (ASTM-D-2863)
d) Smoke Density Rating : Max.60% (ASTM-D-2843).
e) Flammability Test : as per IEC 332 Part-I
f) Swedish Chimney Test-SS-424-1475 F3
g) Insulation Resistance 100 M Ohm / Km Min

- h) High voltage test
 - Core to core- 1.5 KV for 1 min.
 - Core to screen- 1.0 KV for 1 min.
- i) Rodent & Termite repulsion test
(Presence of lead shall be confirmed)

23. Colour of core for Instrumentation Cable (As per IS-9938)

PAIR	CORE	COLOR
1st	1st	Blue
1st	2nd	Red
2nd	1st	Gray
2nd	2nd	Yellow
3rd	1st	Green
3rd	2nd	Brown
4th	1st	White
4th	2nd	Black

Above 4 Pairs, 4 Pairs making a unit shall have indelible printed colour coded bands like Pink for 1st unit, Orange for 2nd unit and Violet for 3rd unit and so on. In addition band marking, for example single band for 1st. unit, double band for 2nd. unit and so on, shall be provided on each conductor for identification of unit. Band marking on individual core shall be provided at regular intervals not exceeding 50 mm.

9.07.00 Cables near high temperature zone shall be capable of withstanding high temperature and terminated in junction box / panel in normal temperature zone. Teflon insulated and sheathed thermocouple extension cables and copper conductor cables shall be used in high temperature zone. Conductor and sheath shall be extruded FEP (Teflon) as per VDE 0207 Part 6 and ASTM D 2116. These cables shall be pair, multipair, triad, multitriad and twisted & shielded.

9.08.00 Control & power Cable

Bidder shall refer to Volume IIF of the electrical specification for detail.

10.00.00 **ERECTION HARDWARE**

This section provides the general technical guidelines for the erection materials for instruments. All erection materials shall be of good quality and conform to the operating environment of the corresponding instrument.

10.01.00 Electrical Accessories

Electrical conduit and associated materials shall conform to the requirements of the articles which follow :

- a) Rigid Steel Conduit
 - i) Conduits up to and including 25 mm shall be of 16 SWG and conduits above 25 mm shall be of 14 SWG. Minimum size of conduits shall be 19 mm.

- ii) Each piece of conduit shall be straight, free from blister and other defects and covered with capped bushing at both ends.
- iii) All rigid conduit couplings and elbows shall be hot dip galvanized rigid mild steel in accordance with ANSI C 80.1 and UL6. The conduit interior and exterior surfaces shall have a continuous zinc coating with an over coat of transparent enamel or zinc chromate. Conduits shall be furnished in standard length of 3 meters, threaded at both ends.
- iv) All conduit fittings shall conform to the requirements of ANSI C 80.4 and UL-514 where these standards apply.
- b) Flexible Conduit
 - i) Flexible conduit shall be of three layer construction of very high quality of lead coated steel. Outside and inside layer shall be reinforced with heat resistant material.
 - ii) Lead coating outside and inside of the conduit steel surface shall provide a non-corrosive characteristic particularly in acidic atmosphere. Besides flexibility, this shall be strong enough to stay at the desired profile without support and shall be durable and strong so as to offer sufficient mechanical protection. It shall also be fully liquid dust and air tight and shall withstand a continuous hydraulic pressure up to 2 Kg/Sq. cm and temperature up to 200 °C.
- c) Special Fittings
 - i) Conduit sealing and fittings shall be provided as required and shall be consistent with the area and equipment with which they are installed.
 - ii) Double locknuts shall be provided on all conduit terminations not provided with threaded lugs and couplings. Locknuts shall be designed to securely bond the conduit to the enclosure when tightened. Locknuts shall not loosen due to vibration.

10.02.00

Electrical Junction Box

1.	Type of Enclosure	: Dust tight & weatherproof conforming to IP 65
2.	Material	: 3 mm sheet steel
3.	Type of Cover	: Solid unhinged with retention chain
4.	Paint	: RAL 7032
5.	Mounting	: Surface
6.	Cable Entry	: 3 mm (min) Gland plate
7.	Gasket	: Neoprene
8.	Grounding	: Brass earth lug with green screw head External-2 nos , Internal-1no.M6
9.	Number of Drain Holes	: Two at bottom capped
10.	Identification	: Label for JB and Tags for cable

11.	Accessories	: Rail mounted cage clamp type screwless terminals with markers, Cable gland, Ferrules, Canopy at top
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10.03.00 Cable Gland

1.	Type	: Double compression
2.	Entry Thread	: NPT
3.	Material	: Brass
4.	Finish	: Cadmium Plated.
5.	Protection	: IP 54 or better
6.	Accessories	: Neoprene gasket, locknuts, reducers etc

10.04.00 Cable Tray

1. Material : Mild steel, slotted
2. Thickness : not less than 2.0 mm
3. Finish : Hot dip galvanized
4. Perforation : As per MFR standard
5. Cover : Suitable for tray

10.05.00 Process Hook Up Accessories & specification

Material and rating of the hook up items shall suit the piping and fluid condition. Hook up materials shall be IBR certified for applicable cases. Bidder shall furnish hook up drawings and the drawings for open racks & closed racks for owner's approval.

10.05.01 Seamless Stainless Steel Pipe

1. Reference : ASTM A-312 TP 316
2. Material Grade : TP 316
3. Type : Seamless /Plain end
4. Size : ½" NB
5. Schedule : 40
6. Standard Length : 5 meter

10.05.02 Stainless Steel Pipe Fittings

1. Reference : ASTM A-182 F 316 / ANSI B16.11

2. Type : Forged
3. Rating : 3000 lbs / 6000 lbs / 9000 lbs
4. Size : ½" NB
5. End connection : Generally socket weld
6. Type of Fittings : Reducing coupling, male-female reducer, straight coupling, equal tee, three piece union, elbow, cap etc.

10.05.03 Seamless Stainless Steel Tube

1. Reference : ASTM A-213 TP 316
2. Material Grade : TP 316
3. Size : ½" OD X 2.1 MM Thick
4. Type : Cold drawn annealed, pickled, passivated, de-scaled, hydraulically cleaned seamless tube.
5. Properties : The tube shall be free from scratches and suitable for bending and capable of being flared by hardened and tapered steel pin. The expanded tube shall show no crack or rupture. Hardness shall be RB 80.
6. Test Pressure : 400 Kg/Sq. cm (minimum)
7. Tolerance : ± 0.13 mm for outside diameter
: ± 15 % for wall thickness
8. Standard Length : 5 meter
9. Test : Flare, Hardness, Ball and Bubble Test

10.05.04 Stainless Steel Tube Fittings

1. Reference : ASTM-A-182
2. Type : Double ferrule double compression
3. Material : 316 Stainless steel forged
4. Ferrule : 316 Stainless Steel
5. Type of Fittings : Male / female connector, elbow, cross /equal tee, straight connector, bulkhead union, ferrule etc. as required to suit installation.
6. Size : To suit SS tubing and NPT end connection

- 10.05.05 C.S. Pipe
1. Reference : ASTM-A 106 Gr. C
 2. Material : Cold drawn seamless black C.S.
 3. Type : Seamless / Plain ends
 4. Size : ½" NB
 5. Schedule : 80, 160, XXS as required
 6. Standard Length : 5 meter
- 10.05.06 C.S. Pipe Fittings
1. Reference : ASTM-A 105 / ANSI B16.11
 2. Type : Forged
 3. Rating : 3000 lbs / 6000 lbs / 9000 lbs
 4. Size : ½" NB
 5. End connection : Generally socket weld
 6. Type of Fittings : Reducing coupling, male-female reducer, straight coupling, equal tee, three piece union, elbow, cap etc.
- 10.05.07 A.S. Pipe
1. Reference : ASTM-A 335 P22 AS PER ANSI B 36.10
 2. Material : Cold drawn seamless A.S.
 3. Type : Seamless / Plain ends
 4. Size : ½" NB
 5. Schedule : XXS
 6. Standard Length : 5 meter
- 10.05.08 A.S. Pipe Fittings
1. Reference : ASTM-A 182 F22 AS PER ANSI B 16.11
 2. Type : Forged
 3. Rating : 9000 lbs
 4. Size : ½" NB
 5. End connection : Generally socket weld

6. Type of Fittings : Reducing coupling, male-female reducer, straight coupling, equal tee, three piece union, elbow, cap etc.
- 10.05.09 Carbon Steel Globe Valve
1. Reference : ASTM A-105
 2. Type : Globe
 3. Construction : Forged Body Cadmium Plated
 4. End Connection : ½" Socket Weld
 5. Rating : Cl. 800 / CL. 2500
 6. Material : Body - Carbon steel
: Stem - Hardened Steel
: Plug - AISI 316 SS
: Seat- Stainless steel stellited
 7. Packing : Teflon / Grafoil as required
 8. Yoke : ASTM A105
 9. Hand wheel : Carbon steel
 10. Design standard : As per ANSI B 16.34
- 10.05.10 Stainless Steel Globe Valve
1. Reference : ASTM A-182 F316
 2. Type : Globe
 3. Construction : Forged Body
 4. End Connection : Socket Weld
 5. Proof Pressure : 400 Kg/Cm2
 6. Material : Body - Stainless steel
: Stem - Hardened Steel
: Plug - AISI 316 SS
: Seat- Stainless steel stellited
 7. Packing : Teflon as required
 8. Yoke : ASTM A182 F316

9. Handwheel : Carbon steel
10. Design standard : As per ANSI B 16.34
- 10.05.11 Alloy Steel Globe Valve
1. Reference : ASTM A-182 F22
2. Type : Globe
3. Construction : Forged Body
4. End Connection : ½" Socket Weld
5. Rating : CL. 2500
6. Material : Body - Alloy steel
: Stem - Hardened Steel
: Plug - AISI 316 SS
: Seat- Stainless steel stellited
7. Packing : Grafoil as required
8. Yoke : ASTM A182 F22
9. Handwheel : Carbon steel
10. Design standard : As per ANSI B 16.34
- 10.05.12 Condensate Pot
1. Reference : ASTM A182 F22 /ASTM A105
2. Material : Alloy steel / carbon steel as per application
3. Construction : Drilled from barstock
4. End connection : 3 nos. ½" socket weld end
5. Accessories : Vent valves
- 10.05.13 Instrument Valve Manifold
1. Type : Two valve manifold
: Five valve manifold
2. Mounting : Remote 2" Pipe Mounting
3. Construction : Single block (bar stock)
4. Material : Forged body and bonnet AISI 316 stainless

- steel
5. Ports : 1/2 " NPT (F)
 6. Rating : 420 Kg/Sq. cm at ambient
 7. Operating Temperature : (-)30 to (+)170 Deg C
 8. Packing : PTFE Wafer
 9. Seat & Stem : AISI 316 SS
 10. Plug : AISI 316 SS free to turn on stem / 17-4 PH
 11. Handle Bar : AISI 316 SS
 12. Connection : Straight
 13. Accessories : Plugs for all ports, Mounting Bracket , bolts , nuts

10.06.00 Pneumatic Hook Up Accessories

10.06.01 Air Header

Technical Particulars	For Panel	For Field
Material of Construction	: Stainless steel	: Stainless steel
Inlet Connection	: 2" NPT (M)	: 1" NPT (M)
Header Take-off Material	: Stainless steel	: Stainless steel
Take off connection	: 1 / 2" NPT (M)	: 1/ 2" NPT (M)
Take-off Valves Material	: stainless steel	: stainless steel
Tube Take-off	: Tube adapter on valve	: Tube adapter on valve
Drain	: SS drain valve at lowest point	: SS drain valves at lowest point

10.06.02 Seamless Stainless Steel Tube

1. Reference : ASTM A-269 TP 316
2. Material Grade : TP 316
3. Size : ¼" OD X 0.049" wall thickness

4. Type : Cold drawn annealed, pickled, passivated, de-scaled, hydraulically cleaned seamless tube.
5. Properties : The tube shall be free from scratches and suitable for bending and capable of being flared by hardened and tapered steel pin. The expanded tube shall show no crack or rupture. Hardness shall be RB 80.
6. Test Pressure : 400 Kg/Sq. cm
7. Tolerance : ± 0.13 mm for outside diameter
: ± 15 % for wall thickness
8. Standard Length : 5 meter
9. Test : Flare, Hardness, Ball and Bubble Test

11.00.00 **SPECIAL TOOLS & TACKLE AND TEST EQUIPMENT FOR AND OTHER SYSTEMS**

- 11.01.00 Bidder shall supply a complete set of new, unused and reliable type of special tools and tackle and test equipment which are necessary or convenient for erection, commissioning, maintenance and overhaul of the plant and equipment provided under this specification.
- 11.02.00 The tools & tackle and Test Equipment shall be shipped in separate container, clearly marked with names of the equipment for which they are intended.
- 11.03.00 Bidder shall furnish list of tools & tackle and test equipment proposed to be supplied along with the bid.

material with suitably colored lettering engraved on the back.

- c) The nameplates shall be held by self-tapping screws. The size of nameplate shall be approximately 20 mm x 75 mm for equipment and 40 mm x 150 mm for the panels.
- d) Items of plant such as valves, which are subject to handling, are to be provided with an engraved chromium plated nameplate or label with engraving filled with enamel, suitably mounted or affixed with strong rustproof chain.
- e) All such nameplates, instruction plates, lubrication charts etc. shall be with English inscriptions.

8.00.00 **METERING BASES AND CHART UNITS**

The following system of units shall be followed for various displays and scales unless otherwise mentioned:

- i) Pressure : Kg/cm²
Differential Pressure : mm of H₂O column / Kg/cm²
- ii) Draught : mm of H₂O column
- iii) Vacuum : Kg/cm² (abs)/mm of Hg column
- iv) Temperature : Degree Celsius (° C)
- v) Flow (Steam, Water) : Tonnes / hr, M³/Hr
- vi) Flow (Oil) : M³ / Hr, Litter/Hr
- vii) Flow Air : Tonnes / hr / M³ / Hr.
- viii) Density : gms / c.c.
- ix) Level : mm /%
- x) Conductivity : μS / cm or mS/cm
- xi) Gas Analyzer : Percentage by weight or as specified in respective case.
- xii) Dissolved Oxygen / Silica / Sodium : ppm /ppb

9.00.00 **PROCESS CONNECTION & INSTRUMENT HOOK UP**

9.01.00 Instrument connection to the process system (piping, vessel etc.) shall be according to the process & piping specification upto and including the root valves. Root valves shall be installed as close as possible to the piping or vessel.

- 9.02.00 Each instrument shall have its own independent connection to the process except for instruments located on standpipe. Each instrument shall be connected independently to the standpipe through isolation valve.
- 9.03.00 Isolation and blowdown drain valves adequate for duty and capable of withstanding continuous design condition of main process shall be provided. Instrument blow down valve near to the instrument shall be of gradual opening type. For process pressure equal or above 40 kg/ sq.cm double blowdown valves shall be used connecting to blowdown header. Instrument manifold / gauge valve shall be installed close to the instrument.
- 9.04.00 The nominal size of the takeoff connections on line shall not be less than NPS ½" for source conditions not in excess of either 900 psi or 425OC and NPS ¾" (for adequate physical strength) for design conditions exceed either of these limits. Where the size of the main is smaller than the limits given above, the takeoff connections shall not be less than the size of the main line.
- 9.05.00 Process connection for instruments lines and vessels shall be in accordance to standards such as ASME or other recognized international standards. Table below indicates the type of connection generally to be used.

INSTRUMENTS	EQUIPMENT / PIPE SIDE	INSTRUMENT SIDE
Level Instruments		
Internal Displacer	4" - Flanged	4" - Flanged
External Displacer	2" - Flanged	2" - Flanged
Level gauge	¾" -Flanged	¾" - Flanged
DP Type	½" (min.)-welded	½"- NPT
	1" – welded for vessel like HP heaters, LP heaters, De-aerator etc. application	
External cage Level switch	1"- welded	1"- welded
Flow Instruments		
DP Type	½" - welded in general	½" - NPT
	1" – welded for high pressure / temperature main steam, feed water, PRDS etc. application	
Pressure Instruments		
Conventional	½" (min.)-welded	½" - NPT
	1"- welded for high pressure/	

INSTRUMENTS	EQUIPMENT / PIPE SIDE	INSTRUMENT SIDE
	temperature main steam, feed water, PRDS etc. application	
Diaphragm type-HFO application	3"- Flanged	3"- Flanged
Temperature Instruments		
Thermowell	Generally - M 33 X2 (M); 1½" Flanged- For air/FG path application	½" NPT
Analyzer		
Liquid analyzer	½"- 1" - welded	½"

- 9.06.00 Size of impulse pipe for pressure measurement in air and flue gas duct path of boiler shall not be less than ¾" NB.
- 9.07.00 Separate stubs and take-off points with thermo well / root vlves shall be provided for performance guarantee test.
- 9.08.00 Impulse pipes shall be clamped at suitable interval not exceeding 1.5 meter. Process pipe shall not be used for supporting the impulse pipe.
- 9.09.00 Fittings shall conform to ANSI B 16.11. Threads of piping component shall be of tapered construction.
- 9.10.00 Instrument blowdown header shall in no case be lower than the material grade ASTM A 106 Gr. C.
- 9.11.00 Impulse pipe shall be laid at least with slope of gradient 1:10 to avoid any air pocket or water accumulation.
- 9.12.00 Expansion loop shall be provided at least at every 2.5 meter interval without affecting the gradient of slope in long run impulse pipe to avoid stress on the piping.
- 9.13.00 Siphon shall be provided in the impulse pipe or tube to protect the instruments where fluid temperature is 100 OC or more.
- 9.14.00 Orientation of tapplings shall be as follows :
- For liquid service within 45 ° at lower half of the pipe horizontal plane.
 - For gas service within 90 ° at upper half of the pipe horizontal plane.
 - For steam service within 45 ° at upper half of the pipe horizontal plane.

As a rule tap orientation of high and low pressure side should be parallel and symmetrical.

9.15.00 Pressure & Differential pressure instruments in steam and liquid services shall be located below the taps and the piping shall be sloped to avoid formation of air pocket.

9.16.00 Pressure & Differential pressure instruments in air and flue gas service shall be located above the taps and the piping shall be sloped back to process to avoid formation of any liquid.

9.17.00 Impulse pipe including taps for furnace, flue gas and coal mill application shall be provided with air purge connection. Differential instruments for such application shall have continuous and as well as intermittent purging. Whereas, pressure measurement shall have only intermittent purging.

9.18.00 Material of impulse pipe for the instruments mounted on rack and enclosure shall be same as that of main process pipe except stainless steel tube of Gr. 316 or better shall be provided for connection in between impulse pipe (from tee connection on impulse pipe) and instrument manifold valve & instruments. Impulse pipe, tubes, fittings and accessories shall have the same design pressure and temperature applicable for the related main pipe.

~~10.00.00 **POWER SUPPLY SYSTEMS**~~

~~10.01.00 Instrumentation power supply system shall include all conditioning equipment required to accommodate normal variations in the electrical supply. All panels and cabinets shall accept redundant power feeds from two different sources.~~

~~10.02.00 Type of power supply systems envisaged for the various I & C system including DCS are as follows:~~

~~a) 240V AC Redundant UPS system HMIs, Main Plant Field devices / equipment, CCTV, EWLI, CEMS, SWAS etc. and PLC of package System~~

~~b) 24V / 48 VDC Supply for DCS~~

~~11.00.00 **ENVIRONMENTAL CONSIDERATIONS**~~

~~I & C components should operate properly with no degradation in expected lifetime or in operation parameter in the normal power plant environment. I & C system shall be designed considering all the operating conditions which may be encountered during installation and operation.~~

~~11.01.00 Temperature~~

~~11.01.01 Where the environmental extreme exceeds the capabilities of the selected system, Bidder should take appropriate steps to control the environment.~~

~~11.02.00 Humidity~~

~~11.02.01 I & C system shall be designed to withstand the humidity limits specified for the project. Condensation shall not be allowed to form in the cabinets nor~~

For Other details as given in sub-section of Battery & Battery charger specification

4.07.00 **Step-down transformer and voltage stabilizer**

- a) A three phase to single phase transformer along with associated voltage stabilizer shall be furnished with the UPS system.
- b) The transformer and stabilizer shall be sized for 100% UPS load and shall coordinate with the largest branch circuit protection device for feeder short circuit current without sacrificing voltage regulation.
- c) The voltage stabilizer shall employ silicon solid state circuitry and shall maintain the specified output voltage for 0 to 100% load with maximum input voltage variation as indicated in the annexure.
- d) Provision shall be kept for dead closing of static transfer switch from stabilizer circuit to inverter when the output of the stabilizer is zero, but at that time the inverters are running.

4.08.00 **A.C. Distribution Boards**

- a) The distribution boards shall be fixed type, of modular design in freestanding gasketed sheet steel enclosure conforming to IP-52. Sheet steel thickness shall be 2 mm minimum for load bearing members and 1.6mm for non-load bearing members.
- b) Each module shall be housed in a separate compartment complete with individual front access door. Working height shall be limited to 1800 mm from floor level.
- c) A full height vertical cable alley shall be provided in each panel to facilitate module wiring. The alley shall be liberally sized and shall have removable cover at the front. Removable back covers shall be provided at the back of the panels.
- d) Incomer shall be provided with Moulded Case Circuit Breaker (MCCB) and outgoing feeders shall be provided with Switch-fuse units.

MCCB shall be suitable to make & break rated short-circuit current (25kA minimum) having in-built short circuit & over-load (adjustable type) protections.
- e) Switches shall be double pole, air break, heavy duty (AC 22) type, capable of safely making and breaking the full load current of associate circuit.
- f) Switch handle shall have position indicator and provision of padlocking in ON & OFF positions. Further it shall be interlocked with access door for safety.
- g) Fuses shall be HRC, preferably link type, design to permit easy & safe replacement. Visible indication shall be provided for indication of fuse.

- h) Incomer feeder shall be provided with Ammeter, Voltmeter, Power factor meter & bus energizes indicating lamp with fuse and outgoing feeders with feeder energizes indicating lamp with fuse.
- i) All indicating meters are 96 mm sq. digital type with LED display and all indicating lamps are clustered LED type so that lamp can be replaceable from front of the panel.

4.09.00

UPS Cabinets/Enclosures

- a) The UPS system components shall be housed in a sheet steel freestanding IP-42 enclosure with all access from the front. Sheet steel thickness shall be 2 mm minimum.
- b) The enclosure shall consist of vertical cabinets housing modules in rack type sub-assemblies, connected mechanically and electrically to form a rigid, self-supporting, metal enclosed structure.
- c) The modular units shall be mounted in pull out and/or swing trays. Each module shall be capable of being easily removed to provide for the ready inspection of major solid-state devices.
- d) Vertical wiring trough shall be provided for the entire height of the UPS cabinet. Cable entry shall be from bottom only.
- e) Adequate ventilating louvers and screens shall be provided. The top of the panel shall be protected by a suitable drip cover to prevent entrance of falling liquid and foreign material.
- f) If the equipment supplied requires forced air cooling, the cooling system furnished shall meet the following requirement :
 - i) Two (2) nos. 100% cooling fans shall be provided for each vertical panel.
 - ii) Completely independent duplicate protection, control and wiring systems shall be provided for the cooling fans for redundancy.
 - iii) The cooling fans shall be powered from the output of the associated inverter. Normally one fan will be running while the other is on stand-by.
 - iv) Each cooling fan shall be equipped with an airflow switch having an alarm contact that closes upon failure of airflow.

4.10.00

Alarms

- a) Solid state audio-visual annunciation system shall be provided for inverters, static transfer switch, battery charger.
- b) Alarm facia shall be provided on each charger and inverter panel, complete with proper actuating devices, circuitry and legends.

- 5.05.00 Cooling : Natural convection or forced cooling using redundant fans.
- 5.06.00 Design Ambient Temperature : 50 Deg.C
- 5.07.00 A.C. input :
- a) Supply : 415V, 3-phase, 50 Hz
 - b) Voltage variation : $\pm 10\%$
 - c) Frequency variation : $\pm 5\%$
 - d) Combined volt frequency variation : 10% (absolute sum)
 - e) Short-circuit level : 50 KA
 - f) System earthing : Solidly grounded
- 5.08.00 D.C. output : 100% UPS load plus restoring fully discharged battery to full charge condition in 8 hours.
- 5.09.00 Blocking Diode, Peak inverse voltage : 800 V (minimum)
- 5.10.00 Performance Requirement
- a) The output voltage of the charger shall be regulated within $\pm 1\%$ of the set value for any load variation from 0 to 100% and A.C input voltage and frequency variation as indicated above in 4.06.00
 - b) The ripple content in charger D.C. output shall be limited to less than $\pm 1\%$ with battery and less than $\pm 2\%$ without battery.
- 6.00.00 DISTRIBUTION BOARDS
- 6.01.00 Type : Fixed, Modular construction.
- 6.02.00 Enclosure : Sheet Steel, IP52
- 6.03.00 Mounting : Free standing
(can be attended from both front & back)



STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR PRESSURE SWITCH

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks		
				M	C	B			
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	V	V			
	1.1 MODEL NO/TAG NO								
	1.2 RANGE								
	1.3 END CONN								
1.4 NO. OF CONTACT									
2	CALIBRATION					P	V	V	
	2.1 REPEATABILITY								
	2.2 SET POINT ADJUSTMENT								
	2.3 DIFFERENTIAL								
3	OVER PR & LEAK TEST			P	V	V			
4	ELECT. INSULATION/HV TEST	ONE			P	V	V		
5	REVIEW OF TC FOR MATERIALS OF	FOR LOT			V	V	V		
	5.1 SENSOR								
	5.2 MOVEMENT								
	5.3 PROCESS CONNECTION								
6	REVIEW OF TC FOR DEGREE OF PROTECTION	TYPE TEST			V	V	V		
	REVIEW OF TC OF MICROSWITCH	FOR LOT			V	V	V		

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, P = Perform, W = Witness, V = Verification

Note :

- Quantum of check shall be as below :
100 % - By Manufacturer
- Manufacturer to carry out ROUTINE TEST on 100 %.
- Contractor to provide compliance certificate for tests/checks verified by contractor and the same alongwith test certificates to be verified by BHEL



STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR TRANSMITTER

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECKS FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	VISUAL.						
	MODEL/TAG No						
2	PROCESS CONNECTION			P	W	V	
3	ACCURACY			P	W	V	
4	REPEATABILITY			P	W	V	
5	HYSTERESIS	P		W	V		
6	EFFECT OF TEMP VARIATION ON ACCURACY	P		W	V		
7	SPAN / ZERO ADJUSTMENT	ONE / TYPE		P	W	V	
8	EFFECT OF SUPPLY VOLTAGE VARIATION			P	W	V	
9	EFFECT OF LOADING (500 OHM METERS)			P	W	V	
10	HIGH PRESSURE TEST	SEE NOTE-1 BELOW		P	W	V	
11	BURN-IN TEST	ONE / TYPE		P	W	V	
12	DEGREE OF PROTECTION		P	W	V		
13	ACCESSORIES AS APPLICABLE	SEE NOTE-1 BELOW	V	V	V		

Legend :

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, P = Perform, W = Witness, V = Verification

Note :

1. Quantum of check shall be as below :
100 % - By Manufacturer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
3. When material corelation are not available manufacturer's compliance to be provided.
4. Contractor to provide compliance certificate for tests/checks verified by contractor and submit the same alongwith test certificates to be verified by BHEL.



STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR PRESSURE & DP GAUGE

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	SENSOR TYPE						
	DIAL SIZE						
	MODEL NO/TAG NO						
	RANGE/SCALE						
	SWITCH CONTACT RATING & NOS.						
	END CONNECTION						
2	CALIBRATION	ONE	APPROVED SPEC./ DATA SHEETS	P	W	V	
	ACCURACY						
	REPEATABILITY						
	SET POINT ADJUSTMENT						
3	OVER PRESSURE & LEAK TEST			P	W	V	
4	OPERATION OF PRESSURE. RELIEF DEVICE	ONE		P	W	V	
5	REVIEW OF TC FOR	FOR LOT	APPROVED SPEC./ DATA SHEETS	V	V	V	
	MATERIALS OF SENSOR						
	MOVEMENT						
	PROCESS CONNECTION						
	HOUSING						
6	REVIEW OF TC FOR DEGREE OF PROTECTION	TYPE TEST		V	V	V	
7	ACCESSORIES AS APPLICABLE	SEE NOTE-1 BELOW		V	V	V	

Legend :

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, P = Perform, W = Witness, V = Verification

Note :

1. Quantum of check shall be as below :
100 % - By Manufacturer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
3. Manufacturer to carry out ROUTINE TEST on 100 %.
4. When material correlation is not available, MFR's compliance to be provided
5. Contractor to provide compliance certificate for tests/checks verified by contractor and submit the same alongwith test certificates to be verified by BHEL.



STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR LEVEL GAUGE

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS / DRWGS	P	W	V	
	TYPE						
	MODEL/ TAG NO.						
	DAIL SIZE						
	RANGE/SCALE						
END CONNECTION							
2	DIMENSIONS, PROCESS CONNECTION	ONE / LOT		P	W	V	
3	ACCURACY			P	W	V	
4	MATERIAL TC FOR			P	V	V	
	BODY ISO.						
	VALVE						
	GAUGE GLASS						
5	HYD. TEST	SEE NOTE-1 BELOW	P	W	V		
6	ACCESSORIES AS APPLICABLE		P	W	V		

Legend :

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Note :

- Quantum of check shall be as below :
100 % - By Manufacturer
- Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
- Manufacturer to carry out ROUTINE TEST on 100 %.
- Contractor to provide compliance certificate for tests/checks verifid by contractor and submit the same alongwith test certificates to be verified by BHEL.



STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR ANNUNCIATORS

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	TYPE/ MODEL						
	DIMENSIONS OF HARDWARE						
	MODULARITY						
	SEQUENCE						
FACIA DETAILS							
2	FUNCTIONAL TEST	100%		P	W	V	
3	IMMUNE TO STEP VARIATIONS IN THE POWER SUPPLY	SEE NOTE-1 BELOW		P	W	V	
4	DEGREE OF PROTECTION FOR ENCLOSURE	TYPE TEST		P	W	V	
5	I/R CHECK	SEE NOTE-1 BELOW		P	W	V	
6	RESPONSE		P	W	V		

Legend :

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Note :

- Quantum of check shall be as below :
100 % - By Manufacturer
- Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
- Manufacturer to carry out ROUTINE TEST on 100 %.
- Contractor to provide compliance certificate for tests/checks verified by contractor and submit the same alongwith test certificates to be verified by BHEL.

	1X800 MW Wanakbori STPP	SECTION: C SUB SECTION : C&I SHEET 11 of 18
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	

PLC SPECIFICATION

|

- 3.12.07 Individual gauge board (as per manufacturer's standard) shall be provided near each Air Drying plant for local indication of all important parameters such as pressure, temperature, flow related to the driers.
- 3.12.08 Bidder shall provide all measuring instruments with required accessories for control, monitoring, protection and interlock of the compressors and driers. Electronic analog signal transmission from field transmitters to area control rooms shall be 4-20 mA DC. All process switches, limit switches and drive feed back signals shall be provided with potential free contact. Temperature detector will be provided at each stage of the compressed air system and cooling water system of compressors for monitoring in the local control panel.
- a) The control system shall meet the requirement of monitoring, sequential starting/stopping of drives, interlock and protection, individual/sequential control metering, annunciation and on-line and all other routine functions with minimum operator's intervention.
- b) In line flow gauge & flow switch shall be provided on the cooling water line of the compressed air system.
- 3.12.09 Dew point measurement shall be provided for each Air drying plant of compressed air system. The output of the instrument shall be 4-20 mA DC to be connected to the master controller panel.
- 3.13.00 Fuel Oil Unloading System
- 3.13.01 The Fuel Oil Unloading System shall be controlled from PLC based local control system or relay based system. No operator work station has been envisaged for this system. The system shall be operated from Lamp / Pushbuttons, selector switches etc located on the panel. Integral type hardware annunciation system shall be provided at the top of the panel for alarm monitoring. Important parameters i.e. tank levels, oil flow, oil temperature etc. from this panel shall be monitored in the station DCS via RIO considered for Fuel Oil Pressurising & Heating System. Facility shall be provided in the PLC for connecting laptop for programming.
- 3.13.02 Level signals from HFO/LDO day tank shall be connected to DCS via hardwired link for control of HFO/LDO transfer pumps. Bidder shall keep these signals terminated in suitable terminal blocks of the local panel.
- 3.14.00 Ventilation And AC System
- 3.14.01 For detail Instrumentation systems, operation & control philosophy refer Vol IIB.
- 4.00.00 **TECHNICAL SPECIFICATION – CONTROL SYSTEM**
- 4.01.00 Brief technical specification of the PLC based control systems are delineated below.
- 4.01.01 Programmable Logic Controller (PLC) based control system shall have 1:1 hot redundant configuration. Central Processing Units (CPUs) shall have word length of 32 bits minimum.

- 4.01.02 Following components shall be redundant as well : communication processors, memory modules, rack power supply units, bulk IO power supply units, IO communication modules, data highway and high speed (100Mbps) data network connecting the operator stations.
- 4.01.03 Two CPUs shall operate on fault tolerant mode with continuous self and cross-monitoring. Failure of the active CPU shall not affect the operation of the plant. In the event of failure of active CPU, tasks shall be transferred to the standby CPU within fastest possible transfer time (< 5m sec.) without causing any relays to drop out during the transfer.
- 4.01.04 CPUs shall not be loaded to over 60% of their capacity even under worst data loading conditions. It shall be possible to make a manual transfer from the active to the back-up CPU from engineering station and as well as from the front panel of CPU module.
- 4.01.05 Modules shall have adequate status and diagnostic indication on the front panel.
- 4.01.06 System shall be of modular construction and expandable by adding hardware modules. Bidder shall provide at least 20% or a minimum of one off, spare channels as hot-on-rail spares in each configured cards / modules. In addition to this, 10% or minimum of one off, extra assigned complete spare modules mounted on rails in racks for each type of I / O modules shall also to be provided. The spare channel and cards shall be fully wired and terminated.
- 4.01.07 Memory unit of the CPU shall be field expandable at least by 25%. Operating system / application program / sequence logic etc. shall be stored in nonvolatile memory for automatic re-booting. Dynamic memories shall be provided with battery back up at least for 360 hours.
- 4.01.08 Number of input / output points per card shall not exceed 16 (sixteen) for digital and 8 (eight) for analog / thermocouple / RTD signals. Individual input and Output channels shall have galvanic / optical isolation. Merely fusing of individual or a group of channels is not acceptable.
- 4.01.09 Data communication system of the PLC shall not be limited to the following:
- a) Internal bus and external data network loading shall in no case be more than 60% of its capacity.
 - b) Disrupted message shall be automatically retransmitted when the system is restored.
 - c) Failure or physical removal of any module connected on the system bus shall not lead to any loss of communication.
 - d) Diagnostics message shall be issued on fault detection.
 - e) Bus change over from active bus to stand by bus, during failure of active bus, shall be performed automatically and bumplessly. Such event shall be suitably logged or alarmed.

- f) Noise immunized and reliable highspeed dual fault tolerant optic fiber cable communication with standard communication protocol shall be provided between PLC s and remote or extended I/O modules.
 - g) Main data network shall comply with the International Standard IEEE-802.3 (Ethernet) for data exchange and communication.
- 4.02.00 Operator workstation shall be complete with latest user friendly operating system, 24" colour LCD monitor, membrane KB, mouse, colour laser printer and dot matrix printer. In addition, a laptop unit loaded with engineering software shall be furnished.
- 4.02.01 The functions performed from the HMIs shall not be limited to the following:
- a) Selection of auto/Manual, open/close, sequence auto, start/stop operation.
 - b) Dynamic Mimic display depicting the process.
 - c) Alarm monitoring, report & log generation, printing of trends etc.
 - d) On line / historical trending, historical storage and retrieval of data.
- 4.03.00 Software
- a) Necessary software for implementation of the control logics, operational displays & logs, data storage, retrieval and other functional requirements, shall be provided.
 - b) Licensed version of required software including operating system, configuration and HMI software shall be provided.
 - c) Detail documentation on the programming softwares as part of the O&M manual.
- 4.04.00 Power Supply
- a) Power supply to the PLC system shall be provided from solid-state 240V AC \pm 1% packaged UPS (Uninterruptible Power Supply) units to be placed local to the control systems. UPS system shall be complete Ni-Cd type battery & battery chargers. UPS shall have adequate capacity to cater 100% load without overloading. UPS system shall be adequate to provide back up power for not less than 30 minutes.
 - b) UPS shall be complete with AC Distribution board. Two feeders shall be extended from ACDB to PLC.
 - c) Bulk power supply units for interrogation, relay and solenoid voltage shall be separate from system power supply units and shall be redundant.
- 4.05.00 System shall have MTBF better than 99.7% and shall be hot maintainable. System hardware shall be designed to be 'fault avoidant' by selecting high-grade components of proven quality and properly thermally de-rated design. The network shall have extensive fault monitoring, self-surveillance & on-line self-diagnostic capability so that failure is immediately detected.

- 4.06.00 System shall automatically check & correct gain & drift for ADCs on-line.
- 4.07.00 Data exchange in a bus shall be fully monitored and checked for validity.
- 4.08.00 Response time consisting of IO scan time, data communication time, processing time etc. shall be equal to or less than the following :
- a) OLCS & sequence control inputs : 100 ms.
 - b) CLCS inputs : 250 ms.
 - c) Monitoring analog parameters : 500 ms.
 - d) Monitoring digital parameters : 100 ms.
- 4.09.00 Following operations will be performed on I/Os, as required:
- a) Square root extraction
 - b) Pressure & temperature compensation
 - c) Reasonability check of all inputs, validation and quality tagging like good, bad, suspect etc.
 - d) Channel wise engineering unit conversion
 - e) Contact bounce filtering with adjustable time constant.
- 4.10.00 The controllers shall be time synchronized to GPS master clock via IRIG-B or Ethernet port. Software capability shall be provided to implement closed loop control functions as follows:
- a) PID control and their variations.
 - b) On-off control
 - c) Cascade control
 - d) Ratio and bias control
- 4.11.00 Features for Open Loop Control shall not be limited to following:
- a) Logic functions like AND/OR/NOT gates, timers (on-delay, off-delay), shift registers, counters, latches, flip-flops, mono-shots etc.
 - b) Automatic sequence control for start up and shutdown of auxiliaries / equipment in functional groups initiated by command from operator's console. A sequence shall be made of steps executed in predetermined order according to logic criteria. For each step there shall be a provision for 'waiting time' and 'monitoring time'. System shall have the capability to bypass a step, if desired, from the operator's station. Such action however shall be registered as an exception.
 - c) Inputs for protection system shall be of high priority. In the event of either loss of control power or control signal input to the drive, the drive shall remain in its last position unless specifically required otherwise. The

system shall be designed such that no upset occurs either to process or to the drive when the power is restored.

4.12.00 Interface of the system with M.C.C / Switchgears shall be in the form of potential free contacts via interposing relay modules mounted in the respective switchgear or MCC unit. Other interfacing relays shall be mounted in a cabinet separate from the system cabinet. 10% wired additional interposing relay modules shall be provided as installed spare. Freewheeling diodes shall be provided across the coil of DC solenoid and contactors / relays. For AC solenoids and contactors directly driven from output cards, arc suppressors shall be provided across the coil.

Each I / O rack shall have 10% spare rack space for future upgradation.

4.13.00 Single programming instruction / command shall be sufficient to delete a program rung from memory. Similarly, any rung can be inserted into the existing program. The active and the stand-by CPU programs shall equalize automatically, once the new program is permitted to 'RUN'.

4.14.00 Updating time and reaction time shall be as follows:

- a) Calling up a mimic : 2 sec or better
- b) Updating status signal in mimic : 1 sec or better
- c) Updating variables in a mimic : 1 sec. or better
- d) Issuance of command to output : 1 sec. or better

(without considering process lag)

4.15.00 Displays shall be classified into overview display, group display, point display and trend display.

4.16.00 Printing of logs shall be initiated automatically at prescribed time intervals, or initiated on demand by the occurrence of predefined events.

System shall permit the operator to specify minimum of 5 summary logs each with minimum of 25 points to be printed on demand.

4.17.00 Salient features of the PLC system for I/O handling shall be as follows:

- a) Input filters to attenuate noise.
- b) Isolation of 1500V AC for the input & output module.
- c) Comm. Mode Noise rejection for analog inputs of 120 db at 50 Hz.
- d) Normal mode noise rejection for analog inputs of 60 db at 50 Hz.
- e) LED indicators on each card to show status of input.
- f) All the outputs shall be with individual fuse.
- g) J/K type thermocouple mV input where applicable.

- h) Pt-100 three / four wire resistance thermometer input where applicable.
- i) 24 V DC power supply to field mounted two wires transmitters.

4.18.00 Salient hardware/ software features of the CPUs shall be as follows:

- a) Watch dog timer : Periodical reset. Alarm and interruption, if not reset within stipulated time.
- b) Max. scan time for inputs: 1 sec. max.
- c) Maximum Scan Rate : 1 ms (Per K Word) or better
- d) Memory capacity : 25% spare capacity after full utilization. Expandable in multiples of 16 K.
- e) Comm. processor : Separate
- f) Battery back up for RAM : 360 hrs continuous operations.
- g) Diagnostic feature : Periodic, automatic self- diagnostic.

4.19.00 Salient features of the Input / Output modules are as follows:

- a) All modules
 - 1. Surge withstand capability : IEC-255.4
- b) Digital General
 - 1. No. of channels / module : 16
 - 2. Interrogation voltage : 24V DC or 48 V DC
 - 3. Status indicator : LED type.
 - 4. Isolation : Optical
- c) Digital Input Module
 - 1. Contact bounce filtering : Adjustable time constant of 15 m. sec.
 - 2. Diagnostic : Module fault
- d) Digital Output Module
 - 1. Output protection : Short ckt. Proof & Individual fuse
 - 2. Diagnostic : Module fault
- e) Analog General
 - 1. No. of channels / module : 8
 - 2. Isolation : Galvanic/Optical

- f) Hi-level Analog Input Module
1. Type of input : 4-20 mA DC / 1-5V DC
 2. A/D Converter : 11 bits + Sign (or better)
 3. Accuracy : 0.1% or better
 4. Diagnostic : Module fault
 5. Powering of transmitter : 24 V DC 2 W type
- g) Low Level Analog Input Module
1. Type of input : PT-100; T/C(As required)
 2. C-J-C : On Module
 3. Accuracy : 0.1% or better
 4. A/D converter : 15 bits + Sign (or better)
 5. Diagnostic : Module fault
- h) Analog Output Module
1. Type of output : 4-20 mA DC
 2. Accuracy : + 0.1% or better
 4. A/D Converter : 11 bits + Sign (or better)
 5. Load : 600 OHM
 6. Diagnostic : Module fault

5.00.00 **OPTICAL FIBRE CABLE**

5.01.00 This specification defines the minimum general requirements for the Design, manufacture, supply, inspection, installation, testing & commissioning of optical fiber cables and accessories, such as fiber distribution (patch) panels, adapters, connectors, joint boxes, pigtailed and other components, as required to complete the system. Bidder shall consider all related activities, such as cable stripping, cable entry in boxes and panels, cable fiber splicing/fusion, cable performance testing and other services, to achieve a properly documented and operational cable network.

5.02.00 Fiber Optic Cables shall be installed on cable tray, duct bank, cable trench, as necessary. For outdoor applications the cable shall be armoured with Poly Ethylene sheathing. Cable shall be routed through suitable grade permanently lubricated HDPE protection pipe as per IS 4984, IS 12235 & TEC.G/CDS-08 /01of suitable size @ 53% fill factor.

5.03.00 The Optical Fiber core shall be of ultra pure fused silica glass coated with UV-cured acrylate suitable to withstand temperature of about 80°C (continuous).

- 5.04.00 Fiber optic cable shall be of loose tube design. Typically, fibers shall be housed in-groups of 6 (minimum) within gel-filled buffer tubes to protect against ingress of moisture and vibration. The tubes shall be manufactured with industry standard material like Poly-Butelene Terathylate (PBT). They shall be colored for easy identification. Buffer tubes shall be approachable with industry standard tools and practices. The buffer tubes shall be stranded around the Central Strength Member utilizing Reverse Oscillating Lay (ROL). Blank fillers shall be used as necessary to maintain circular cable structure. Cable shall withstand water penetration when tested with a one meter static head or equivalent continuous pressure applied at one end of a one meter length of filled cable for one hour. No water shall leak through the open cable end.
- 5.05.00 The central strength member of the cable shall be Fiberglass Reinforced Plastic (FRP) or other material with equivalent mechanical strength to provide both tensile and anti buckling strength to the cable.
- 5.06.00 In addition to central strength member, additional strengthening substance like aramid yarns shall be helically applied over the cable core to provide additional tensile strength to the cable.
- 5.07.00 The cable shall be of dual jacket & armoured. Inner sheath consists of a medium density polyethylene (MDPE) jacket extruded over the cable core. Two highly visible ripcords are placed under the jacket to aid in sheath removal. A co-polymer coated steel tape is corrugated and wrapped around the inner jacket to provide additional cable compression strength and rodent protection. The armor is covered with an outer black FRLS MDPE jacket. A ripcord is also placed underneath the armor for easy outer jacket removal.
- 5.08.00 Minimum bending radius shall be equal or more to 15 D. A continuous strength member shall be provided for the entire length of the cables. Every tube and fiber shall be colour coded to provide easy identification. The outer sheath shall be marked to show fiber type and cable classification at suitable intervals.
- 5.09.00 Entire length of the cable shall be marked with the following at regular intervals:
- a) Manufacturer's Name
 - b) Month and year of manufacturer
 - c) Coded description of the cable based on Telcordia's (Bellcore) SR-2014 Suggested Optical Cable Code (SOCC).
 - d) Sheath Identification Number
 - e) Sequential Length Marking in meter
 - f) A Telephone Handset symbol to distinguish communication from power cable as per NESC section –35 G.
- 5.10.00 Fiber optic cable shall provide a long life expectancy of minimum 25 years and shall meet the industrial standard of continuous operation at temperature

of 55 O C and humidity to 100% without degradation to optical or mechanical performance.

5.11.00 Optical fiber used in the plant shall generally conform to the following specification:

ATTRIBUTES		
a)	Cladding Diameter	125 $\mu\text{m} \pm 1.0 \mu\text{m}$
b)	Cladding non-circularity	$\leq 1.0\%$
c)	Attenuation Coefficient at (a) 1290 nm to 1340 nm (b) 1525 nm to 1575 nm	< 0.36 dB/km < 0.25 dB/km
d)	Chromatic Dispersion Coefficient at (a) 1310 nm (b) 1550 nm	< 3.5 ps/nm.km < 18 ps/nm
e)	Polarization Mode Dispersion (PMD)	$\leq 0.5 \text{ ps}/\sqrt{\text{km}}$
f)	Mode Field Diameter at (a) 1310 nm (b) 1550 nm	$9.2 \pm 0.4 \mu\text{m}$ $10.50 \pm 1.0 \mu\text{m}$
g)	Mode Field Concentricity Error	$\leq 0.5 \mu\text{m}$
h)	Proof Test	$\geq 1\%$
i)	Fiber Curl (ROC)	$\geq 4.0 \text{ m}$
j)	Macro-bend Test on Fiber at 1550 nm	$\leq 0.1 \text{ dB}$

5.12.00 Cable Assembly

5.13.00 Optical Fiber Environmental Splice Enclosure

Optical fiber environmental splice joint enclosures shall be re-enterable and rack / wall mountable. The interior splice case shall be equipped to mechanically accommodate single-mode optical fibers connected by the

fusion method. Splice case shall be equipped to organize the splice trays and the required service loops of buffered incoming optical fibers and outgoing 'pigtails' in such a way that allows each completed splice and associated optical fiber to be maintained in an unstrained configuration. Splice enclosure shall be dust and weather proof.

5.14.00 Fiber Optic Distribution Patch Panel

Fiber optic distribution panels shall be provided as required. Fiber optic distribution panels shall be of a standard wall mounted sheet metal enclosure type. Fiber optic distribution panels shall be equipped to secure optical fiber patch cables and pigtails to prevent damage during all operation and maintenance functions. In general splice enclosure are envisaged. However, if no optical fiber splice enclosures are implemented, than the fiber optic distribution panels shall be equipped with splice trays for storage and protection of fusion splice connections of single-mode fiber optic cable and pigtails. Each fiber optic distribution panel shall be fully equipped with 'SC' type bulkhead connector sleeves or equivalent. Unused sleeve ports shall be equipped with reusable caps to prevent the intrusion of dust.

5.15.00 Pigtail and Patch Cord

All pigtails shall be factory SC-connectorized, and satisfy specified performance for optical links. All unused pigtails (including spares) shall be terminated with the connector to a bulkhead connector sleeve, protected by a reusable cap on the opposite sleeve port, to prevent the intrusion of foreign material or dust. All necessary connectorized pigtails shall be provided in the lengths required.

5.16.00 Fiber Optic Tool Kit

5.16.01 Optical Time Domain Reflectometer

- a) A recording optical time domain reflectometer (OTDR) will be utilized to test for end-to-end continuity and attenuation of each optical fiber. The OTDR shall be equipped with data storage, printer, help feature, compare trace features and OTDR software. The data storage unit must include a built-in floppy disk drive capable of storing a minimum of 100 test traces.
- b) Data traces saved to disk shall include the following labels:
 - Fiber Identification (ID) with a minimum of 10 characters
 - Cable ID with a minimum of 10 characters
 - OTDR location with a minimum of 20 characters
 - Far End location with a minimum of 20 characters
 - Test Operator initials with a minimum of 3 characters
- c) The printer shall preferably be internal. The printer shall be able to print data traces within 30 seconds or less. The machine settings used to repeat tests at a later time shall include: index, range, wavelength, average time,

pulse width and scale settings. The test results (on printout) shall provide information including: loss, distance, reflectance, date and time.

- d) The requirements for the compare trace feature include the ability to recall two historical traces from a diskette and display them simultaneously for analysis and printing. The compare trace must compute and display a single graph representing any differences between two traces. The compare trace must be able to recall historical traces from a diskette and perform the same tests on connected live fibers. The compare trace shall perform a two point loss measurement test for any two particular fibers in a comparison analysis. The losses between the two points on each fiber shall be displayed, and the differences between the two readings clearly shown.
- e) The OTDR must be equipped with software to support all of the required functions. The software shall provide for printing of whole set of traces (batch print) with minimal commands eliminating the time spent for printing traces individually.
- f) Contractor shall provide all mounting accessories, cables and connectors required to establish data communication.

5.16.02 Fiber Optic Splicer, Terminator And Tool Kit Box

Bidder shall provide new unused tools comprise of Splicer and Fusion Joints and tool kit comprise of cutter, stripper, polishing tool, handheld microscope, heat shrinkable sleeve, scissor, knife etc. as required for maintenance and commissioning.

5.16.03 Tests

Following minimum test as per any approved standards shall be carried out on the cables:

- a) Attenuation And Dispersion Characteristics Tests
- b) Proof Tests
- c) Macro-Bend Resistance Test
- d) Mechanical Tests
- e) Low And High Temperature Cable Bend Test
- f) Impact Resistance Test
- g) Compressive Strength Test
- h) Tensile Strength Test
- i) Cable Twist Test
- j) Cable Cyclic Flexing Test
- k) Environmental Characteristics Test

- l) Temperature Cycling Test
- m) Color Permanence Test Cable Aging Test
- n) Water Penetration Test
- o) Lightning Test
- p) Routine Test / Sample Test
- q) Site Test (Like Continuity & Attenuation)



**STANDARD QUALITY PLAN
FOR
PROGRAMMABLE LOGIC CONTROLLER**

QUALITY PLAN NO.: PE-QP-999-145-I036	
VOLUME	IIB
SECTION	D
REV. NO.	01
DATE:	24.08.2007
SHEET	1 OF 8

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency [§]			Remarks
									P	W	V	
1.0	Materials /Components											
1.1	Panels & Control Desks	Physical Inspection for Dimensions, Painting, Cutouts, Lifting / Locking Arrangements, Components, Drawing Pocket, Mounting accessories, Plinth & AV Pads, Cable Gland Plates, Hardwares, Hinges, Louvers & Filters, Fans & Panel Lamps	MA	Visual	100%	Contract specifications, Approved GA Drawings, BOQ	As per ref documents. No physical damage.	BHEL Quality Inspection Report.	3/2	2	1	
1.2	Power Supply/Packs, Battery & Battery charger, Transformer, UPS.	Physical Inspection Physical Damages Dimensions Mounting Accessories	MA	Visual	100%	Contract specifications, BOQ.	As per reference documents, Test Report	BHEL Quality Inspection Report.	3/2	2	1	
1.3	Indicating Lamp, Annunciator, Meters, Transducers, Signal Converters, Instruments, Single Loop Controllers	Physical Verification Physical Damages Dimensions Accessories	MA	Visual	100%	Contract specifications, BOQ.	As per ref documents No physical damage. Test/ Calibration report.	BHEL Quality Inspection Report	3/2	2	1	
1.4	PLC processors, I/O modules, Power Supply modules, Communication modules, Mounting Racks, Ethernet	Physical Inspection <ul style="list-style-type: none"> • Identification Labels • Physical Damages • Quantity • Spare Capacity 	MA	Visual	100%	Product Catalogue, Data sheets, Approved Configuration diagram, BOQ	As per ref documents. Test Certificates	BHEL Quality Inspection Report.	3/2	2	1	

LEGEND: * CR - Critical characteristics MA - Major characteristics MI - Minor characteristics	[§] P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test.	1 - BHEL 2 - Vendor 3 - Sub-vendor
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STANDARD QUALITY PLAN FOR PROGRAMMABLE LOGIC CONTROLLER

QUALITY PLAN NO.: PE-QP-999-145-I036 ___	
VOLUME	IIB
SECTION	D
REV. NO.	01
DATE:	24.08.2007
SHEET	2 OF 8

SI. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency [§]			Remarks
									P	W	V	
1.5	CPU, Monitor, Keyboard, Mouse, CD Drives, Printers, OS, System Software, Engineering software in the form of Licensed CD.	Physical Inspection Identification Labels, Tech. Specification Physical Damages Accessories Installation arrangements for Computers & Printers	MA	Visual	100%	Contract specifications, Product Catalogue, Approved GA / Configuration drawing, BOQ.	As per reference documents.	BHEL Quality Inspection Report.	3/2	2	1	

LEGEND: * CR - Critical characteristics
 MA - Major characteristics
 MI - Minor characteristics

[§] P - Agency Performing the Test.
 W - Agency Witnessing the Test.
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1 - BHEL
 2 - Vendor
 3 - Sub-vendor



STANDARD QUALITY PLAN FOR PROGRAMMABLE LOGIC CONTROLLER

QUALITY PLAN NO.: PE-QP-999-145-I036 ___	
VOLUME	IIB
SECTION	D
REV. NO.	01
DATE:	24.08.2007
SHEET	3 OF 8

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency [§]			Remarks
									P	W	V	
2.0	Assembly											
2.1	Functional Test for HMI/OWS devices such as Monitors, Keyboards, Mouse, Printers etc.	Operation	MA	Functional	100%	Approved Configuration Diagram & BOQ and FAT	Correct Operation of interconnected Devices of HMI system.	BHEL Quality Inspection Report.	2	1	1	
2.2	Hardware Functional Verification.	Physical arrangement, Wiring check & labeling, Continuity Checking, IR & HV test	MA	Visual/ Electrical	100%	Approved GA Drawing, Panel Wiring Diagram, IR & HV as per relevant International standard	Test Certification	BHEL Quality Inspection Report.	2	2	1	
2.3	Powering Up	Healthiness of all the modules/equipment, associated with Powering of PLC system	MA	Visual /Electrical	100%	Approved power supply scheme	All equipment to be healthy on power ON	BHEL Quality Inspection Report.	2	1	1	
2.4	Burn in test for PLC modules	Healthiness of PLC modules on Continuous Energisation, Temperature maintenance	MA	Visual/ Electrical	100%	FAT Procedure	Test certification as per FAT	BHEL Quality Inspection Report.	2	2	1	

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**STANDARD QUALITY PLAN
FOR
PROGRAMMABLE LOGIC CONTROLLER**

QUALITY PLAN NO.: PE-QP-999-145-I036 ___	
VOLUME	IIB
SECTION	D
REV. NO.	01
DATE:	24.08.2007
SHEET	4 OF 8

SI. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency [§]			Remarks
									P	W	V	

3.0	Factory Acceptance Test (FAT)											
3.1	Input Output Functional Verification	I/O configuration, I/O operation	MA	Visual/ Eletrical	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.2	Processor Verification	Processor configuration, Powering up, standby operation (as applicable) and Loading	MA	Visual	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.3	Power Supply Module Verification	Redundancy Operation	MA	Electrical	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.4	Communication System Verification	Redundancy operation of Communication System, Measurement of Response Time, Communication with third party system	MA	Electrical	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.5	Diagnostic Verification	Self Diagnostic features of PLC system	MA	Visual	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.6	Control Panel/Desk Verification	Operation of PLC driven annunciation system, Mosaic, Push buttons & selector switches, Indicating lamps	MA	Visual	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.7	Software Verification	(i) Control Logics (ii) Engineering Features (iii) HMI Features	MA	Visual	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	

LEGEND: * CR - Critical characteristics MA - Major characteristics MI - Minor characteristics	[§] P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test.	1 - BHEL 2 - Vendor 3 - Sub-vendor
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**STANDARD QUALITY PLAN
FOR
PROGRAMMABLE LOGIC CONTROLLER**

QUALITY PLAN NO.: PE-QP-999-145-I036			
VOLUME IIB			
SECTION D			
REV. NO.	01	DATE:	24.08.2007
SHEET	5	OF	8

FACTORY ACCEPTANCE TEST (FAT) PROCEDURE

This document covers procedure to conduct/witness PLC system functional tests in order to demonstrate conformity to purchase specifications and related engineering documents. The test shall be conducted at the system suppliers works. The system supplier shall conduct all functional tests before commencing FAT and test results shall be made available during FAT. Vendor must furnish following relevant drawings, duly approved by BHEL Engineering, for reference during FAT.

- a) Technical Specification of PLC.
- b) PLC System Configuration
- c) General Assembly Drawings.
- d) Panel Wiring Diagrams.
- e) Bill of Quantity for PLC System.
- f) Logic Diagram.
- g) HMI Schematics.
- h) Input / Output List.

Further the vendor shall furnish applicable product specification, datasheets, catalogues, test-certificates, and internal inspection records to enable FAT. Vendor shall also submit, [to the inspecting agency](#), his standard test procedure, for clauses given below; where vendor's standard practice has been referred.

APPLICABLE TEST PROCEDURE:

1. Input/Output Functional Verification.

Check for correctness of addressing of racks, slots and I/O modules as per applicable PLC configuration diagram. Appropriate signal generators shall be used to simulate Inputs and outputs to check operation and SCAN time. [Check online replacement of cards, processors, power supply etc.](#)

2. Processor Verification

PLC Configuration drawing to be referred for ascertaining

- i) Redundancy

**STANDARD QUALITY PLAN
FOR
PROGRAMMABLE LOGIC CONTROLLER**

QUALITY PLAN NO.: PE-QP-999-145-I036			
VOLUME IIB			
SECTION D			
REV. NO. 00	DATE: 23.03.2005		
SHEET 6	OF	8	

ii) Type (Hot or Cold)

Both the processors are to be checked for healthiness in case of redundant configuration as per vendor's standard practice. In case of hot redundancy, switchover of control from primary processor to standby processor shall be demonstrated for uninterrupted control and data processing as per vendor's standard practice. Switchover shall be witnessed, by manual power off or resetting the Primary CPU or simulating failure of primary processor. Checking should be by witnessing the lighting up of Processor's LEDs as per manufacturer's product standard.

Vendor shall demonstrate, as per Vendor's standard practice, adequate Loading (Spare Capacity) of Processors, as mentioned in contract specs. This shall be done, by simulating worst load operation of fully integrated PLC system.

3. Power Supply Module Verification

Check if PSM is in redundant mode as per specification. Check the healthiness of power supply from both the modules' lamp indication/measurement. Simulate failure of one PSM and verify that standby PSM has taken over without any interruption.

4. Communication System Verification

Communication system has to be in line with approved PLC Configuration Diagram. Verify that both the communication buses are intact and connected. Communication between PLC processors, I/O rack, OWS etc. is to be checked through simulation of input data. Simulate the bus failure by disconnection of working bus. Check that the communication continues without interruption or loss of data.

Following response times are to be demonstrated as per vendor's standard practice for conformance to contract specifications:

1. Screen update time
2. I/O scan time
3. SOE resolution time
4. Data transfer time with third party system using Communication Protocol as per Contract specification and as per quantum of data as per approved signal exchange list.

5. Diagnostic Verification

Product Catalogue/Literature shall be referred for checking of all diagnostic features. Hardware failure to be simulated by removing an I/O

**STANDARD QUALITY PLAN
FOR
PROGRAMMABLE LOGIC CONTROLLER**

QUALITY PLAN NO.: PE-QP-999-145-I036			
VOLUME IIB			
SECTION D			
REV. NO. 00	DATE: 23.03.2005		
SHEET 7	OF	8	

6. Control Panel /Desk Verification

- i) PLC driven annunciation system should be checked by alarm signal simulation.
- ii) Push Button and selector switch operation should be checked by verification of corresponding change of status of Data Base point.
- iii) Indicating lamp / MIMIC should be checked by corresponding Data Base point simulation.

7. Software Verification

- i). Control Logics:- Software switches, lamps and Analog sources shall be used for simulation of field conditions .Control logics shall be checked for its correct functionality as per approved logic schemes
- ii). Engineering features:-
 - a) Online changing of parameters, set points.
 - b) Online modification in Control Logic Diagrams.
 - c) Online configuration of Graphics, Trends, Logs, HSR.
- iii). HMI features:-
Check for configuration & operation of Graphics, Trends, Logs, HSR and Alarms, in the form of Displays and Printouts, by simulation of Inputs as per approved documents.

8. Burn in Elevated Temperature test

Electronic equipments shall be subjected to Burn in elevated temperature test as per the procedure detailed below:

- a) (i) PLC modules are kept at 50 Deg c under continuous energized condition for 48 hours.

**STANDARD QUALITY PLAN
FOR
PROGRAMMABLE LOGIC CONTROLLER**

QUALITY PLAN NO.: PE-QP-999-145- I036			
VOLUME IIB			
SECTION D			
REV. NO. 00		DATE:	
23.03.2005			
SHEET	8	OF	8

ii) 48 hours test period shall be divided into 4 equal time segment of 12 hours duration each. For every 12 hours duration segment, after lapse of first 11 hours 110% of nominal voltage shall be applied to the panel under test for a period of 30 minutes followed by application of 90% of nominal voltage for the next 30 minutes.

b) Assembled Panels with complete wiring shall be kept under continuous energized condition for 120 hours at ambient temperature. Temperature rise in panels should be below 10 Deg C above ambient.

Checklist for Serial Communication between maxDNA Systems and Foreign Device :BHEL

A Device Specific :

SN	Parameters	Options available	Remarks if any
1	Modle No.& Make of Device		
2	Communications Link Options	<input type="checkbox"/> Multidrop <input type="checkbox"/> Peer to Peer <input type="checkbox"/> N/w topology attached	
3	Protocol Mode (Device is a)	<input type="checkbox"/> Master <input type="checkbox"/> Slave <input type="checkbox"/> Master/Slave	
4	Protocol	<input type="checkbox"/> RTU <input type="checkbox"/> ASCII <input type="checkbox"/> Other -----	
5	Master	<input type="checkbox"/> System maxDNA <input type="checkbox"/> Other -----	
6	Dist.bet.maxDNA System & Device*	<input type="checkbox"/> ----- Feet <input type="checkbox"/> ----- Meters	

B Electrical Specific :

1	Interface Type	<input type="checkbox"/> RS232 <input type="checkbox"/> RS422 <input type="checkbox"/> RS485	
2	Wiring at Device end	<input type="checkbox"/> 2 Wire <input type="checkbox"/> 4 Wire	
3	Transmission Channel	<input type="checkbox"/> Half Duplex <input type="checkbox"/> Full Duplex	
4	Baud Rates (bps)	<input type="checkbox"/> 1200 <input type="checkbox"/> 2400 <input type="checkbox"/> 4800 <input type="checkbox"/> 9600 <input type="checkbox"/> 19200	
5	Databits	<input type="checkbox"/> 8 <input type="checkbox"/> 7	
6	Stopbits	<input type="checkbox"/> 1 <input type="checkbox"/> 2	
7	Parity	<input type="checkbox"/> None <input type="checkbox"/> Odd <input type="checkbox"/> Even	
8	H/w & Software Handshake	<input type="checkbox"/> Yes <input type="checkbox"/> No	
9	Response Timeout time (Sec)	<input type="checkbox"/> ----- <input type="checkbox"/> Configurable timeout	
10	Data Formats Supported	<input type="checkbox"/> Boolean <input type="checkbox"/> Real <input type="checkbox"/> Char <input type="checkbox"/> Sn.Int <input type="checkbox"/> UnSn.Int	
11	Transmission mode	<input type="checkbox"/> Asynchronous <input type="checkbox"/> Synchronous	

C Application Specific : *

1	Primary Function*	<input type="checkbox"/> Data Acquisition <input type="checkbox"/> Data Acquisition & Control	
		<input type="checkbox"/> Download parameter sets	
2	Analog Points to read	-----Nos. <input type="checkbox"/> Details attached <input type="checkbox"/> Details not attached	
3	Analog Points to write	-----Nos. <input type="checkbox"/> Details attached <input type="checkbox"/> Details not attached	
4	Digital Points to read	-----Nos. <input type="checkbox"/> Details attached <input type="checkbox"/> Details not attached	
5	Digital Points to write	-----Nos. <input type="checkbox"/> Details attached <input type="checkbox"/> Details not attached	
6	Memory / Flag Points to read	-----Nos. <input type="checkbox"/> Details attached <input type="checkbox"/> Details not attached	
7	Memory / Flag Points to write	-----Nos. <input type="checkbox"/> Details attached <input type="checkbox"/> Details not attached	

D Hardware Specific :

1	Cable type	<input type="checkbox"/> Boolean cable <input type="checkbox"/> Twisted pair cable	
2	Cable Details Enclosed	<input type="checkbox"/> Yes <input type="checkbox"/> No	
3	Any specific Converter required	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Details enclosed	

E Device Documents :

1	Manufacturer's Documents*	<input type="checkbox"/> Tech., Spec. <input type="checkbox"/> Operating Manual	
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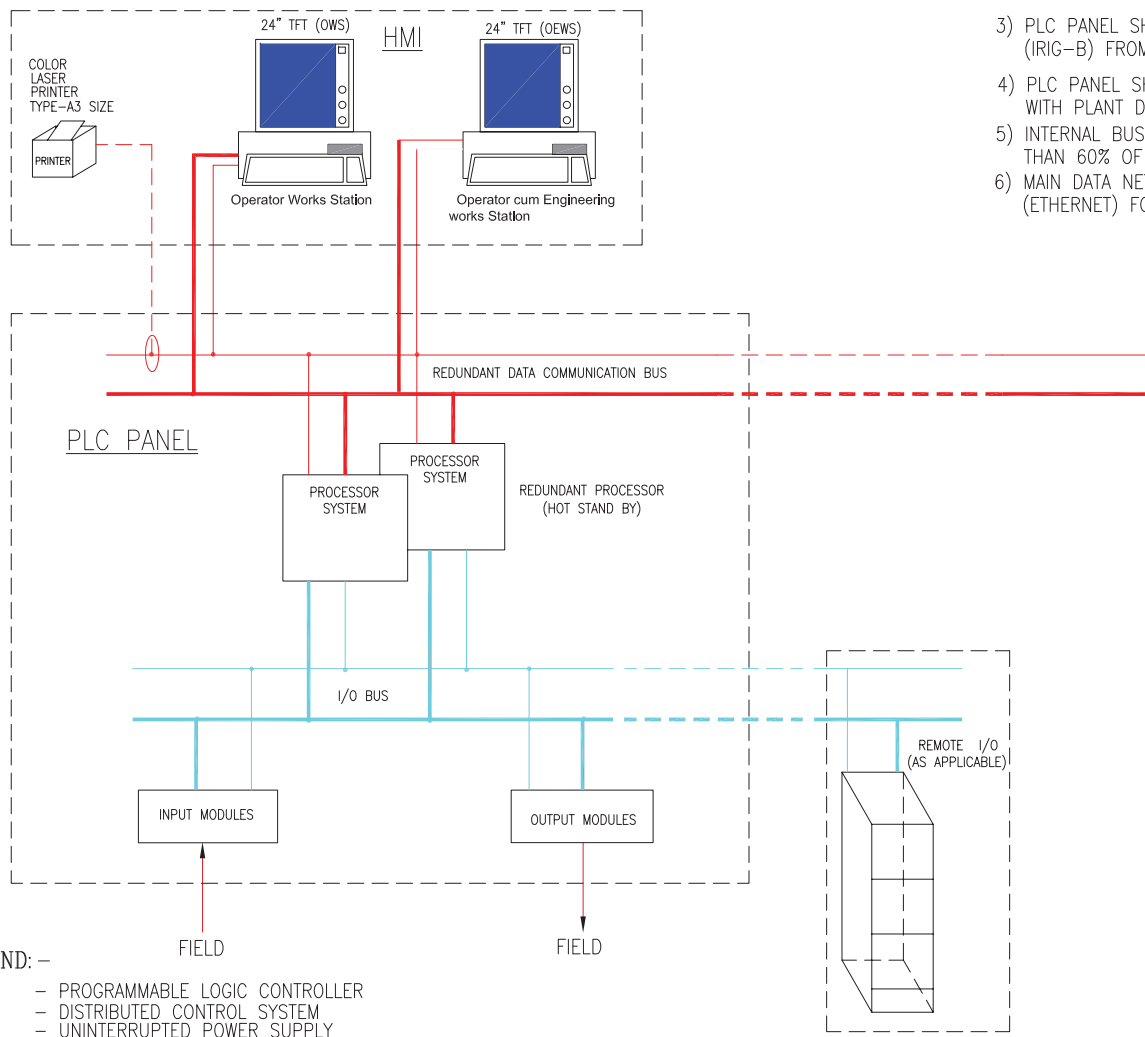
***Notes:**

A6 To identify converter requirement and cable length.

C The sr.no.1 to 7 are reqd.to be furnished for interface impl. :such as Tagname,Description,point type, modbus(Register) address,EU,range & device (dlave) address

C1 What is the primary purpose of the communications link?

E1 Reqd. Contents : This document must provide an overview of the device including its intended use(a general technical,communication & electrical details)



NOTES:

- 1) PLC SYSTEM SHALL HAVE REDUNDANCY IN PROCESSOR, COMMUNICATION SYSTEM, POWER SUPPLY, MEMORY MODULES, RACK POWER SUPPLY UNITS, BULK IO POWER SUPPLY UNITS, IO COMMUNICATION MODULES, DATA HIGHWAY AND HIGH SPEED(100Mbps) DATA NETWORK CONNECTING THE OPERATOR STATIONS.
- 2) UPS POWER SUPPLY SHALL BE PROVIDED FOR PLC PANEL(S), OWES, NETWORK COMPONENTS.
- 3) PLC PANEL SHALL HAVE PROVISION TO ACCEPT TIME SYNC. SIGNAL (IRIG-B) FROM MASTER CLOCK SYSTEM(PLANT AREA).
- 4) PLC PANEL SHALL HAVE PROVISION FOR REDUNDANT DATA EXCHANGE(MODBUS ON RS-485) WITH PLANT DCS.
- 5) INTERNAL BUS AND EXTERNAL DATA NETWORK LOADING SHALL IN NO CASE BE MORE THAN 60% OF ITS CAPACITY.
- 6) MAIN DATA NETWORK SHALL COMPLY WITH THE INTERNATIONAL STANDARD IEEE-802.3 (ETHERNET) FOR DATA EXCHANGE AND COMMUNICATION.

LEGEND: -

- PLC - PROGRAMMABLE LOGIC CONTROLLER
- DCS - DISTRIBUTED CONTROL SYSTEM
- UPS - UNINTERRUPTED POWER SUPPLY
- OWES - OPERATOR WORK CUM ENGINEERING WORK STATION
- HMI - HUMAN MACHINE INTERFACE
- NTP - NETWORK TIME PROTOCOL
- OPC - OLE PROCESS CONTROL
- RPU - REMOTE PROCESSING UNIT



PLC SYSTEM CONFIGURATION

DRG. NO.	
REV. No.	DATE
SHEET	01 OF 01

	1X800 MW Wanakbori STPP	SECTION: C SUB SECTION : C&I SHEET 13 of 18
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	

CONTROL PANELS SPECIFICATION

|

7.12.00 Panels, Cubicles and Enclosures

7.12.01 General

- a) All panels, cubicles and enclosures shall be furnished complete with integral piping, internal wiring, convenience outlets, internal lighting, grounding, ventilation, space heating, vibration isolating pads and other accessories.
- b) Unless otherwise specified cable entry for panels / desks / cabinets shall be through bottom via glanding plate. Fireproof seal shall be used to seal the bottom to prevent entry of dust.
- c) Panels and cabinets shall be constructed from steel sheet reinforced as required to provide true surface and adequate support for devices mounted thereon. Thickness of the steel plate shall conform to the requirements of UL 50 or equivalent standard. Panels and cabinets shall be of adequate strength to support mounted components during shipment and to support a concentrated load of 100 Kilograms on their top after erection.
- d) Panel /cabinet shall have eyebolt on top for lifting.

7.12.02 Surface Preparation and Painting

Sheet metal exterior steel surfaces shall be sand blasted, ground smooth and painted as specified below:

- a) Suitable filler shall be applied to all pits, blemishes and voids in the surface. The filler shall be sanded so that surfaces are level and flat; corners are smooth and even. Exposed raw metal edges shall be ground burr-free. The entire surface shall be blast clean to remove rust and scale. Oil, grease and salts etc. shall be removed from by one or more solvent cleaning methods prior to blasting.
- b) Two spray coats of epoxy primer surfacer shall be applied to all exterior and interior surfaces, each coat of primer surfacer shall be of dry film thickness of 1.5 mil. A minimum of two spray coats of final finish color (Catalyzed epoxy or polyurethane) shall be applied to all surface of dry film thickness 2.0 Mil. The finish colors for exterior and interior surfaces shall conform to the following shades:
 - i) Exterior – RAL 7032.
 - ii) Interior - Brilliant White.
- c) Paint films, which show sags, cheeks, blisters, teardrops, fat edges or other painting imperfections shall not be acceptable.

7.12.03 Wiring

Wiring within the panels shall conform to NEC standards and shall be factory installed and tested at the works. All interior wiring shall be installed neatly. Features shall not be limited to the following :

- a) All spare contacts of relays, switches and push buttons shall be wired up to the terminal blocks.
- b) Each wire shall be identified at both ends with wire designation as per approved wiring diagram. Heat shrinkable type ferrules with indelible computerized print shall be used with cross- identification.
- c) Wire termination shall be made with insulated sleeve and crimping type lugs. All external connections shall be made with one wire per terminal. Wire shall not be spliced or tapped between terminals. Open-ended terminal lugs shall not be used.
- d) Internal wiring should be terminated uniformly on one side of the terminal block leaving the other side available for termination of outgoing cables.
- e) Thermocouple lead wires, analyzer measuring lead wires, or any other lead wires carrying measuring signal of the order of low milli volt or micro volt shall be electrically and physically isolated from other AC and DC wiring.
- f) All low-level signal cables shall be separately bundled from control cable.
- g) Wires shall be dressed and run in troughs with clamp-on type covers. Wirings shall be neatly bunched in groups by non-metallic cleats or bands. Each group shall be adequately supported along its run to prevent sagging or strain on termination.
- h) Shield wires shall be terminated on separately.
- i) Common connections shall be limited to two wires per terminal.
- j) Wiring to door mounted devices shall be provided with multi-strand wires of (49 strands minimum) adequate loop lengths of hinge-wire so that multiple door openings will not cause fatigue to the conductor.
- k) Wiring shall be arranged to enable instruments or devices to be removed and/or serviced without disturbing the wiring. No wire shall be routed across the face or rear of any device in a manner, which will impede the opening of covers or obstruct access to leads, terminals or devices.
- l) Panel internal wiring shall follow distinct color-coding to segregate different voltage levels viz. 24V DC, 48V, 110V AC, 240V AC, 220V DC etc.
- m) Panels /cabinets /desks shall be provided with removable gasketed cable gland plates and cable glands. Split type grommets shall be used for prefab cables.
- n) Wire shall be multistranded annealed flexible high purity copper conductor with heat resistant FRLS PVC insulation and shall pass vertical flame test per IPCEAS-1981.

- o) Wire sizes used for internal wiring shall not be lower than the followings :
- Control wiring (switches, pushbuttons etc.) : 1.5 Sq.mm
 - Power supply/receptacle /illumination wiring : 2.5 sq. mm or higher as per load
 - 4-20mA DC current and low voltage signal upto 48V DC : 1.0 Sq. mm
- p) Identification of conductors shall be done by insulation color-coding identified on drawings or by printed wiring lists.

7.12.04 Grounding

- a) System cabinet AC and DC ground shall be electrically isolated from each other and also electrically isolated from the Instrumentation signal ground. All the above ground shall be individually connected to the single point on the ground pit. Dedicated redundant earth pit shall be provided which shall be away from the HV equipment. This earth pit shall not be shared with other electrical equipment ground and shall also be insulated from other electrical system ground to ensure single point grounding of the system. Grounding resistance shall be better than 1.0 ohm. IEEE guideline shall be followed while designing the grounding system.
- b) Panels and cabinets shall be provided with a continuous tinned copper ground bus bar of minimum 25 mm x 3 mm cross section, extending along the entire length of the panel / desk / cabinet assembly. The ground bus shall be bolted to the panel structure and effectively ground the entire structure.
- c) The panel /desk /enclosure /JB ground shall have two (2) bolt drilling with GI bolts and nuts at each end to connect to GI/ copper flat ground riser by means of insulated copper ground cable of required cross section with lug.
- d) Circuits requiring grounding shall be individually and directly connected to the panel ground bus.
- e) For electronic system cabinets, the electronic system ground bus shall be similar but insulated from the cabinet and shall be separately connected to the system ground. Signal cable shields shall be grounded at the panel end only and shall not be left open. The ground in between panels of a shipping section shall be firmly looped.
- f) Electrical meters, relays, transmitters and switching devices, operating at a voltage less than 50V may be grounded through the steel structure.

7.12.05 Panel / Cabinet/ Desk/Enclosures Environmental Protections

- a) Panels, cabinets, desks, distribution boxes, junction boxes, terminal boxes and all other field mounted equipment / enclosures shall suit the environmental condition of the area and shall not be inferior than the requirement indicated in the following table.

SL. NO.	LOCATION	ENCLOSURE TYPE
1.	Indoor type non- ventilated enclosure in non-hazardous area	IP-54
2.	Indoor type ventilated enclosure in non-hazardous area	IP -42
3.	Enclosure in Air conditioned area	IP-22 with suitable canopy at top to prevent ingress of dripping water.
4.	Outdoor type in non-hazardous areas	IP-55
5.	Outdoor in hazardous areas	As per requirements of the NEC Code for the location

- b) The construction of electrical enclosures located in areas subject to conditions classified in the National Electrical Code (NEC) as hazardous shall be of a type designated suitable for the environment in which they are located.

7.12.06 Terminal Blocks

- a) Terminals shall be chromated galvanized DIN rail mounted screwless cage clamp type. Terminals shall have screwed connection for conductor cross-section above 2.5 mm². Terminal blocks shall conform to IEC 947-7-1.
- b) The characteristics of the terminal blocks shall be as follows.
- i) High contact force, independent of conductor cross-section and large contact surface area.
 - ii) Self-loosening protection.
 - iii) Resistant to thermal aging and vibration.
 - iv) Low and constant voltage drop
- c) Tension spring shall be made of high quality, non-rusting, acid-resistant steel. The current bar shall be of tin-lead plated copper or brass.

- d) Terminals shall be of non flammable suitable thermoplastic material such as polyamide.
- e) Terminal blocks shall be mounted vertically in panels and cubicles with clearance for at least 100 mm between two sets and between wall and terminal block.
- f) Terminal blocks shall be provided with white marking strips / self-adhesive marker cards. Power terminals shall have protection covers.
- g) At least 10%percent spare unwired terminals shall be provided for all panels /cabinets /desks /junction box etc.. This shall be in addition to 10%spare wired terminals of spare IO channels and 10% wired spare modules.
- h) Bottom of the terminal block shall be at least 200 mm above the cable gland plate for bottom entry type panels.
- i) For extending 24 V / 48 V DC supply to panels, the size of the terminals shall be decided based on voltage drop and not based on current.
- j) Other requirements of the terminal blocks are as follows:
 - i) The last block in a rail-mounted assembly shall be closed with an end plate and end bracket.
 - ii) For visual and electrical separation of terminal groups, partition plates shall be provided, which can be push fitted after forming an assembly.
 - iii) Design shall permit testing of incoming and outgoing signals by using suitable test plug and socket without disconnecting the cable connections.
 - iv) It shall be possible to use jumper plugs through the test plug socket to connect adjacent terminals.
 - v) Where more than one connection to a terminal block is required, two tier terminals shall be used.
 - vi) Terminal blocks shall be of different colors depending on voltage levels.

7.12.07 Nameplates and Labels

- a) Each item shall have permanently attached to it, in a prominent position, a rating plate of non-corrosive material upon which is to be engraved the manufacturer's name, equipment, type / model number, range, serial number, together with details of the loading conditions under which the item of plant in question has been designed to operate.
- b) Such nameplates or labels are to be of white non-hygroscopic material with engraved black lettering, or alternatively of transparent plastic

material with suitably colored lettering engraved on the back.

- c) The nameplates shall be held by self-tapping screws. The size of nameplate shall be approximately 20 mm x 75 mm for equipment and 40 mm x 150 mm for the panels.
- d) Items of plant such as valves, which are subject to handling, are to be provided with an engraved chromium plated nameplate or label with engraving filled with enamel, suitably mounted or affixed with strong rustproof chain.
- e) All such nameplates, instruction plates, lubrication charts etc. shall be with English inscriptions.

8.00.00 **METERING BASES AND CHART UNITS**

The following system of units shall be followed for various displays and scales unless otherwise mentioned:

- i) Pressure : Kg/cm²
Differential Pressure : mm of H₂O column / Kg/cm²
- ii) Draught : mm of H₂O column
- iii) Vacuum : Kg/cm² (abs)/mm of Hg column
- iv) Temperature : Degree Celsius (° C)
- v) Flow (Steam, Water) : Tonnes / hr, M³/Hr
- vi) Flow (Oil) : M³ / Hr, Litter/Hr
- vii) Flow Air : Tonnes / hr / M³ / Hr.
- viii) Density : gms / c.c.
- ix) Level : mm /%
- x) Conductivity : μS / cm or mS/cm
- xi) Gas Analyzer : Percentage by weight or as specified in respective case.
- xii) Dissolved Oxygen / Silica / Sodium : ppm /ppb

~~9.00.00 **PROCESS CONNECTION & INSTRUMENT HOOK UP**~~

~~9.01.00 Instrument connection to the process system (piping, vessel etc.) shall be according to the process & piping specification upto and including the root valves. Root valves shall be installed as close as possible to the piping or vessel.~~

As a rule tap orientation of high and low pressure side should be parallel and symmetrical.

9.15.00 Pressure & Differential pressure instruments in steam and liquid services shall be located below the taps and the piping shall be sloped to avoid formation of air pocket.

9.16.00 Pressure & Differential pressure instruments in air and flue gas service shall be located above the taps and the piping shall be sloped back to process to avoid formation of any liquid.

9.17.00 Impulse pipe including taps for furnace, flue gas and coal mill application shall be provided with air purge connection. Differential instruments for such application shall have continuous and as well as intermittent purging. Whereas, pressure measurement shall have only intermittent purging.

9.18.00 Material of impulse pipe for the instruments mounted on rack and enclosure shall be same as that of main process pipe except stainless steel tube of Gr. 316 or better shall be provided for connection in between impulse pipe (from tee connection on impulse pipe) and instrument manifold valve & instruments. Impulse pipe, tubes, fittings and accessories shall have the same design pressure and temperature applicable for the related main pipe.

10.00.00 **POWER SUPPLY SYSTEMS**

10.01.00 Instrumentation power supply system shall include all conditioning equipment required to accommodate normal variations in the electrical supply. All panels and cabinets shall accept redundant power feeds from two different sources.

10.02.00 Type of power supply systems envisaged for the various I & C system including DCS are as follows:

- a) 240V AC Redundant UPS system HMIs, Main Plant Field devices / equipment, CCTV, EWLI, CEMS, SWAS etc. and PLC of package System
- b) 24V / 48 VDC Supply for DCS

11.00.00 **ENVIRONMENTAL CONSIDERATIONS**

I & C components should operate properly with no degradation in expected lifetime or in operation parameter in the normal power plant environment. I & C system shall be designed considering all the operating conditions which may be encountered during installation and operation.

11.01.00 Temperature

11.01.01 Where the environmental extreme exceeds the capabilities of the selected system, Bidder should take appropriate steps to control the environment.

11.02.00 Humidity

11.02.01 I & C system shall be designed to withstand the humidity limits specified for the project. Condensation shall not be allowed to form in the cabinets nor

should water be allowed to be admitted through conduit entering the cabinets from top or sides.

11.03.00 Atmospheric Contamination

11.03.01 Particulate contamination from fly ash and coal dust and gaseous contaminants such as SO₂ and other flue gas constituents in the coal fired plant are foreseen. This hazard shall be taken into design considerations.

11.04.00 Vibration

11.04.01 Design of the systems shall include features such as locking devices, anti vibration pads etc, to withstand vibration. In general, I&C equipment shall be installed away from the vibration zone.

11.05.00 Lightning

11.05.01 Protection against lightning shall be considered by providing proper grounding, metal oxide varistors, spark gap lightning arrestor, optical isolator and isolation transformer.

12.00.00 **SECURITY**

12.01.00 Door lock shall be provided in all Panels, Cabinets and Enclosures.

12.02.00 System mode key switch or password to prevent tampering of system program.

12.03.00 Redundant elements of the system shall not be exposed to the common hazards. For example routing of the redundant network cable through separate cable raceway, using separate cabinet / separate rack for redundant controller and redundant IO modules.

13.00.00 **ACCEPTANCE TESTS**

The Bidder shall be required, as part of his Tender, to fully integrate and test all the equipment, included in his Tender, at site and respective Control packages at the manufacturer's works. Owner / Consultants shall witness these tests.

However, for DCS the Bidder shall consider in his Tender the following tests:

(a) Factory Acceptance Test (FAT)

After completion of manufacture of DCS and prior to delivery to Site, the manufacturer shall functionally test the assembled system. The test shall be carried out with all input / output cubicles, control processors, data highway, operator's consoles, Engineer's console and peripheral devices connected in the specified configuration. The fully configured software shall also be loaded and tested at the same time.

The FAT shall include the following activities:

- Complete hardware inspection;

- Heat cycle run test as per the prevailing standards;
- Functional test of a minimum 25 % of all configured points, logic routines, control functions, graphic displays, reports and logs;
- Demonstration of special calculations (e.g. efficiency calculation, performance calculations etc.);
- Testing of redundancy facilities to demonstrate automatic change over to standby data highway, power supply and control processor etc.;
- Demonstration of system diagnostic facilities;

The FAT shall be witnessed by the Owner / Engineer who shall be notified at least three (3) weeks before the commencement of the tests. The system shall have been fully pre-tested by the manufacturer at his works prior to notifying the Owner / Engineer to ensure any component, equipment or system fault have been identified and cleared. The test procedure for the FAT shall be issued to the Engineer and agreed prior to notification. All documents / drawings and test equipment shall be available at the manufacturer's works during the FAT.

The FAT shall include a 72 hour continuous operational run, any equipment fault or failure during this time shall make this part of the test null and void and the test run shall be re-started after rectification of the fault. A test certificate, accompanied by the relevant test results, shall be issued after successful completion of the tests.

(b) Site Acceptance Test (SAT)

After installation, connection, integration with other systems and all pre-commissioning checks have been carried out on the complete system, the SAT shall be performed and witnessed by the Engineer. The SAT shall include the following as a minimum:

- a) Complete hardware and installation inspection;
- b) Testing of redundancy facilities by simulating data highway, power supplies and control processor failures. All such units shall be tested to demonstrate of the automatic operation of the standby units and initiation of the relevant system alarms;
- c) Demonstration of system diagnostic facilities; by the simulation of the appropriate fault conditions. The system fault reporting techniques shall also be demonstrated;
- d) Testing of data highway integrity using continuity test equipment based on signal injection / reflection techniques;
- e) Demonstration of data logging, sequence of events and trending system operation.
- f) Pre-commissioning checks shall include the following:

- i) Calibration of all field instruments, analysers and equipment, in the scope of supply of this package, at site;
- ii) Loop checking, for all open and close loops, between source and destination with manual signal injection as well as from Operating Consoles for entire DCS I/Os;
- iii) Logic sequence check with the manual signal injection at signal source as well as checking of feed back signals.

All individual configured data points, logic routines, control functions, graphic displays and reporting facilities shall be verified as part of the loop tests.

The Owner shall be notified at least 2 weeks before the commencement of the test. The procedures shall be issued and agreed before notification.

A test certificate accompanied by the relevant test results shall be issued after successful completion of the calibration and test.

Similar tests shall also be applicable for other control system i.e. plant utility system PLC / Microprocessor based control systems.



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STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

STD QUALITY PLAN NO.: PE-QP-999-145-I056	
VOLUME	IIB
SECTION	D
REV. NO.	01
DATE:	22-02-2008
SHEET	1 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency [§]			Remarks
									P	W	V	
1.0	INCOMING Sheet Steel (CRCA & HR)	1. Chemical Composition	MA	Chemical analysis	Sample	IS:1079 IS:513	IS:1079 IS:513	Test Certificate	3	---	2	
		2. Bend Test	CR	Mech. test	Sample	IS:1079 IS:513	IS:1079 IS:513	Log Book	2	---	---	
		3. Surface finish	MA	Visual	100%	Factory Standard / Sample	Factory Standard / Sample	Log Book	2	---	---	
		4. Waviness	MA	Visual	100%	Factory Standard	No Waviness	Log Book	2	---	---	
		5. Thickness	MA	Measurement	100%	BHEL Spec.	BHEL Spec.	Log Book	2	---	---	
		6. Mill marking	MA	Visual	100%	Factory Standard	Factory Standard	Log Book	2	---	1	
2.0	Flats / Angles / Channels	1. Dimensions	MA	Measurement	Sample	IS:2062	IS:2062	Log Book	2	---	---	
		2. Surface Defects	MA	Visual	100%	Factory Standard / Sample	Factory Standard / Sample	Log Book	2	---	---	
		3. Straightness	MA	Measurement	100%	Factory Std.	Factory Std.	Log Book	2	---	---	
		4. Mill marking	MA	Visual	100%	IS:2062	IS:2062	Log Book	2	---	1	
3.0	Cables / Wires	1. Visual / Surface defects	MA	Visual	100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	2	---	---	
		2. IR and HV	MA	Electrical	100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	2	---	---	

LEGEND: * CR - Critical characteristics
MA - Major characteristics
MI - Minor characteristics

[§] P - Agency Performing the Test.
W - Agency Witnessing the Test.
V - Agency Verifying the Test.

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STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

STD QUALITY PLAN NO.: PE-QP-999-145-I056	
VOLUME	IIB
SECTION	D
REV. NO.	01 DATE: 22-02-2008
SHEET	2 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency [§]			Remarks
									P	W	V	
		3. Conductor a) Resistance b) Size c) Sheet colour	MA MA MA	Electrical Measurement Visual	100% 100% 100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	2	---	---	
		4. Type / Routine Test Certificates	MA	Verification	100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	3	---	2	
4.0	Electrical Components like Annunciator Transformers Lamps Switches PBs Contactors Relays Timers Space Heaters Thermostat Indicating meters etc.	1. Verification at make and Type 2. Verification of Test Certificates 3. Operation / Functional check 4. I.R. 5. H.V. 6. Calibration 7. Pick up / Drop off Voltage	CR CR CR MA MA MA MA	Visual Scrutiny of Type / Routine T.Cs. Electrical Electrical Electrical Electrical	Sample 100% Sample+ 100% 100% 100% 100% 100%	BHEL Spec. and BOM Relevant IS Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue	BHEL Spec. and BOM Relevant IS Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue	Log Book Log Book Log Book Log Book Log Book Log Book Log Book	2 2 2 2 2 2 2	---	---	+ for relay & contactors only @ for all components except relays & contactors. 1

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STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

STD QUALITY PLAN NO.: PE-QP-999-145-I056	
VOLUME	IIB
SECTION	D
REV. NO.	01
DATE:	22-02-2008
SHEET	3 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency [§]			Remarks
									P	W	V	
5.0	Misc. Components like Gaskets, Terminal Blocks etc.	1. Verification of Type / Make	MA	Visual	Sample	BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue	Log Book	2	---	---	
		2. Surface defects	MA	Visual	Sample	BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue	Log Book	2	---	---	
		3. IR / HV on Terminal Blocks	MA	Electrical	Sample	BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue	Log Book	2	---	---	
6.0	IN PROCESS Blanking / Bending / Forming	1. Dimensions	MI	Measurement	100%	Approved Mfr. drgs.	Approved Mfr. drgs.	Log Book	2	---	---	
		2. Surface defects after bending	MA	Visual	100%	Factory Standard	Factory Standard	Log Book	2	---	---	
7.0	Nibbling / Punching	1. Cutout Sizes	MI	Measurement	100%	Approved Mfr. drgs.	Approved Mfr. drgs.	Log Book	2	---	---	
		2. Deburring	MA	Visual	100%	Approved Mfr. drgs.	Approved Mfr. drgs.	Log Book	2	---	---	
8.0	ASSEMBLY Frame Assembly & Sheet fixing	1. Dimensions	MA	Measurement	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2	
		2. Alignment	MA	Measurement	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2	
		3. Welding Quality	MA	Visual	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2	
		4. Surface defects	MA	Visual	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2	

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STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

STD QUALITY PLAN NO.: PE-QP-999-145-I056	
VOLUME	IIB
SECTION	D
REV. NO.	01
DATE:	22-02-2008
SHEET	4 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency [§]			Remarks
									P	W	V	
9.0	Pre-treatment and Painting	1. Pretreatment Process	MA	Visual	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		2. Process parameters like bath temp. concentration etc.	MA	Measurement	Periodic	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		3. Dipping / Removal Time	MA	Measurement	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		4. Surface quality after every dip	MA	Visual	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		5. Primer after phosphating	MA	Visual, Thickness	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		6. Putty Application & Rubbing after primer	MA	Visual	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		7. Paint first coat	MA	Visual, Thickness	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		8. Putty Application and Rubbing after first coat of paint	MA	Visual	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		9. Paint second coat	MA	Visual, Thickness, Scratch test Colour adhesion	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	

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STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

STD QUALITY PLAN NO.: PE-QP-999-145-1056	
VOLUME	IIB
SECTION	D
REV. NO.	01
DATE:	22-02-2008
SHEET	5 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency [§]			Remarks
									P	W	V	
10.	Panel Wiring	1. Wiring Layout	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	
		2. Wiring Termination (Crimped Lugs)	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	
		3. Ferrule numbers	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	
		4. Colour of wiring	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	1	
		5. Size of Conductor	MA	Measurement	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	1	
11.	Component Mounting	1. Correct components	MA	Visual	100%	Approved drgs., Specs. & BOM	Approved drgs., Specs. & BOM	Log Book	2	---	---	
		2. Fixing	MA	Visual	100%	Approved drgs., Specs. & BOM	Approved drgs., Specs. & BOM	Log Book	2	---	---	
12.	FINAL Final Inspection	1. Workmanship	MA	Visual	100%	Factory Standard	Factory Standard	Inspection Report	2	1	1	} At Random by BHEL, based on 100 % internal test reports by Mfr.
		2. Component layout (neatness, accessibility & safety) Mounting / Proper fixing of all components	MA	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	
		3. Components identification Marking / Name plates	MA	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	

LEGEND: * CR - Critical characteristics
 MA - Major characteristics
 MI - Minor characteristics

[§] P - Agency Performing the Test.
 W - Agency Witnessing the Test.
 V - Agency Verifying the Test.

1 - BHEL
 2 - Vendor
 3 - Sub-vendor



PEM :: C&I

STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

STD QUALITY PLAN NO.: PE-QP-999-145-I056	
VOLUME	IIB
SECTION	D
REV. NO.	01
DATE:	22-02-2008
SHEET	6 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency [§]			Remarks
									P	W	V	
		5. Dimensions	MA	Measurement	100%	BHEL approved drg. / Spec., BOM	BHEL approved drg. / Spec., BOM	Inspection Report	2	1	1	} At Random by BHEL, based on 100 % internal test reports by Mfr.
		6. Door functioning	MA	Functional	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	
		7. Paint Shade	CR	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	
		8. Paint Thickness	CR	Measurement	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	
		9. Workmanship of Gaskets	MA	Visual	100%	Factory Standard	Factory Standard	Inspection Report	2	1	1	
		10. Wiring Layout	MA	Visual	100%	BHEL approved drg.	BHEL approved drg.	Inspection Report	2	1	1	
		11. Wire Termination	MA	Pulling manually	Sample	----	Firm termination	Inspection Report	2	1	1	
		12. Continuity	MA	Electrical	100%	----	Continuity OK	Inspection Report	2	1	1	

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STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

STD QUALITY PLAN NO.: PE-QP-999-145-I056	
VOLUME	IIB
SECTION	D
REV. NO.	01
DATE:	22-02-2008
SHEET	1 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency [§]			Remarks
									P	W	V	
1.0	INCOMING Sheet Steel (CRCA & HR)	1. Chemical Composition	MA	Chemical analysis	Sample	IS:1079 IS:513	IS:1079 IS:513	Test Certificate	3	---	2	
		2. Bend Test	CR	Mech. test	Sample	IS:1079 IS:513	IS:1079 IS:513	Log Book	2	---	---	
		3. Surface finish	MA	Visual	100%	Factory Standard / Sample	Factory Standard / Sample	Log Book	2	---	---	
		4. Waviness	MA	Visual	100%	Factory Standard	No Waviness	Log Book	2	---	---	
		5. Thickness	MA	Measurement	100%	BHEL Spec.	BHEL Spec.	Log Book	2	---	---	
		6. Mill marking	MA	Visual	100%	Factory Standard	Factory Standard	Log Book	2	---	1	
2.0	Flats / Angles / Channels	1. Dimensions	MA	Measurement	Sample	IS:2062	IS:2062	Log Book	2	---	---	
		2. Surface Defects	MA	Visual	100%	Factory Standard / Sample	Factory Standard / Sample	Log Book	2	---	---	
		3. Straightness	MA	Measurement	100%	Factory Std.	Factory Std.	Log Book	2	---	---	
		4. Mill marking	MA	Visual	100%	IS:2062	IS:2062	Log Book	2	---	1	
3.0	Cables / Wires	1. Visual / Surface defects	MA	Visual	100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	2	---	---	
		2. IR and HV	MA	Electrical	100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	2	---	---	

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STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

STD QUALITY PLAN NO.: PE-QP-999-145-I056	
VOLUME	IIB
SECTION	D
REV. NO.	01
DATE:	22-02-2008
SHEET	2 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency [§]			Remarks
									P	W	V	
		3. Conductor a) Resistance b) Size c) Sheet colour	MA MA MA	Electrical Measurement Visual	100% 100% 100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	2	---	---	
		4. Type / Routine Test Certificates	MA	Verification	100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	3	---	2	
4.0	Electrical Components like Annunciator Transformers Lamps Switches PBs Contactors Relays Timers Space Heaters Thermostat Indicating meters etc.	1. Verification at make and Type 2. Verification of Test Certificates 3. Operation / Functional check 4. I.R. 5. H.V. 6. Calibration 7. Pick up / Drop off Voltage	CR CR CR MA MA MA MA	Visual Scrutiny of Type / Routine T.Cs. Electrical Electrical Electrical Electrical	Sample 100% Sample+ 100% 100% 100% 100% 100%	BHEL Spec. and BOM Relevant IS Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue	BHEL Spec. and BOM Relevant IS Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue	Log Book Log Book Log Book Log Book Log Book Log Book Log Book	2 2 2 2 2 2 2	---	---	+ for relay & contactors only @ for all components except relays & contactors. 1

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STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

STD QUALITY PLAN NO.: PE-QP-999-145-I056	
VOLUME	IIB
SECTION	D
REV. NO.	01
DATE:	22-02-2008
SHEET	3 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency [§]			Remarks
									P	W	V	
5.0	Misc. Components like Gaskets, Terminal Blocks etc.	1. Verification of Type / Make	MA	Visual	Sample	BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue	Log Book	2	---	---	
		2. Surface defects	MA	Visual	Sample	BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue	Log Book	2	---	---	
		3. IR / HV on Terminal Blocks	MA	Electrical	Sample	BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue	Log Book	2	---	---	
6.0	IN PROCESS Blanking / Bending / Forming	1. Dimensions	MI	Measurement	100%	Approved Mfr. drgs.	Approved Mfr. drgs.	Log Book	2	---	---	
		2. Surface defects after bending	MA	Visual	100%	Factory Standard	Factory Standard	Log Book	2	---	---	
7.0	Nibbling / Punching	1. Cutout Sizes	MI	Measurement	100%	Approved Mfr. drgs.	Approved Mfr. drgs.	Log Book	2	---	---	
		2. Deburring	MA	Visual	100%	Approved Mfr. drgs.	Approved Mfr. drgs.	Log Book	2	---	---	
8.0	ASSEMBLY Frame Assembly & Sheet fixing	1. Dimensions	MA	Measurement	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2	
		2. Alignment	MA	Measurement	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2	
		3. Welding Quality	MA	Visual	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2	
		4. Surface defects	MA	Visual	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2	

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STD QUALITY PLAN NO.: PE-QP-999-145-I056	
VOLUME	IIB
SECTION	D
REV. NO.	01
DATE:	22-02-2008
SHEET	4 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency [§]			Remarks
									P	W	V	
9.0	Pre-treatment and Painting	1. Pretreatment Process	MA	Visual	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		2. Process parameters like bath temp. concentration etc.	MA	Measurement	Periodic	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		3. Dipping / Removal Time	MA	Measurement	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		4. Surface quality after every dip	MA	Visual	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		5. Primer after phosphating	MA	Visual, Thickness	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		6. Putty Application & Rubbing after primer	MA	Visual	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		7. Paint first coat	MA	Visual, Thickness	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		8. Putty Application and Rubbing after first coat of paint	MA	Visual	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		9. Paint second coat	MA	Visual, Thickness, Scratch test Colour adhesion	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	

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STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

STD QUALITY PLAN NO.: PE-QP-999-145-I056	
VOLUME	IIB
SECTION	D
REV. NO.	01
DATE:	22-02-2008
SHEET	5 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency [§]			Remarks
									P	W	V	
10.	Panel Wiring	1. Wiring Layout	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	
		2. Wiring Termination (Crimped Lugs)	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	
		3. Ferrule numbers	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	
		4. Colour of wiring	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	1	
		5. Size of Conductor	MA	Measurement	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	1	
11.	Component Mounting	1. Correct components	MA	Visual	100%	Approved drgs., Specs. & BOM	Approved drgs., Specs. & BOM	Log Book	2	---	---	
		2. Fixing	MA	Visual	100%	Approved drgs., Specs. & BOM	Approved drgs., Specs. & BOM	Log Book	2	---	---	
12.	FINAL Final Inspection	1. Workmanship	MA	Visual	100%	Factory Standard	Factory Standard	Inspection Report	2	1	1	At Random by BHEL, based on 100 % internal test reports by Mfr.
		2. Component layout (neatness, accessibility & safety) Mounting / Proper fixing of all components	MA	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	
		3. Components identification Marking / Name plates	MA	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	

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STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

STD QUALITY PLAN NO.: PE-QP-999-145-I056	
VOLUME	IIB
SECTION	D
REV. NO.	01
DATE:	22-02-2008
SHEET	7 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency [§]			Remarks
									P	W	V	
13.	TYPE TEST	Degree of Protection	CR	Mech. Protection	Sample	BHEL approved spec., drg relevant IS-13947 Part-1, IS-2148.	BHEL approved spec., drg relevant IS-13947 Part-1, IS-2148.	Type Test Certificate	3	---	1	
14	ROUTINE TEST	IR before & after HV Test	CR	Electrical	100%	BHEL approved spec., drg., BOM & relevant IS.	BHEL approved spec., drg., BOM & relevant IS.	Test Report	2	1	1	
15	FUCTIONAL TEST	1. Control Logic Operation	CR	Electrical	100%	BHEL approved spec. / drg.	BHEL approved spec. / drg.	Inspection Report	2	1	1	
		2. Instrument Calibratio	CR	Electrical	10%	BHEL approved spec. / drg.	BHEL approved spec. / drg.	Inspection Report	2	1	1	
		3. Temperature rise	CR	Electrical	100%	BHEL approved spec/drg. & relevant IS.	BHEL approved spec/drg & relevant IS.	Inspection Report	2	1	1	

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STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

STD QUALITY PLAN NO.: PE-QP-999-145-I056	
VOLUME	IIB
SECTION	D
REV. NO.	01
DATE:	22-02-2008
SHEET	7 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency [§]			Remarks
									P	W	V	
13.	TYPE TEST	Degree of Protection	CR	Mech. Protection	Sample	BHEL approved spec., drg relevant IS-13947 Part-1, IS-2148.	BHEL approved spec., drg relevant IS-13947 Part-1, IS-2148.	Type Test Certificate	3	---	1	
14	ROUTINE TEST	IR before & after HV Test	CR	Electrical	100%	BHEL approved spec., drg., BOM & relevant IS.	BHEL approved spec., drg., BOM & relevant IS.	Test Report	2	1	1	
15	FUCTIONAL TEST	1. Control Logic Operation	CR	Electrical	100%	BHEL approved spec. / drg.	BHEL approved spec. / drg.	Inspection Report	2	1	1	
		2. Instrument Calibratio	CR	Electrical	10%	BHEL approved spec. / drg.	BHEL approved spec. / drg.	Inspection Report	2	1	1	
		3. Temperature rise	CR	Electrical	100%	BHEL approved spec/drg. & relevant IS.	BHEL approved spec/drg & relevant IS.	Inspection Report	2	1	1	

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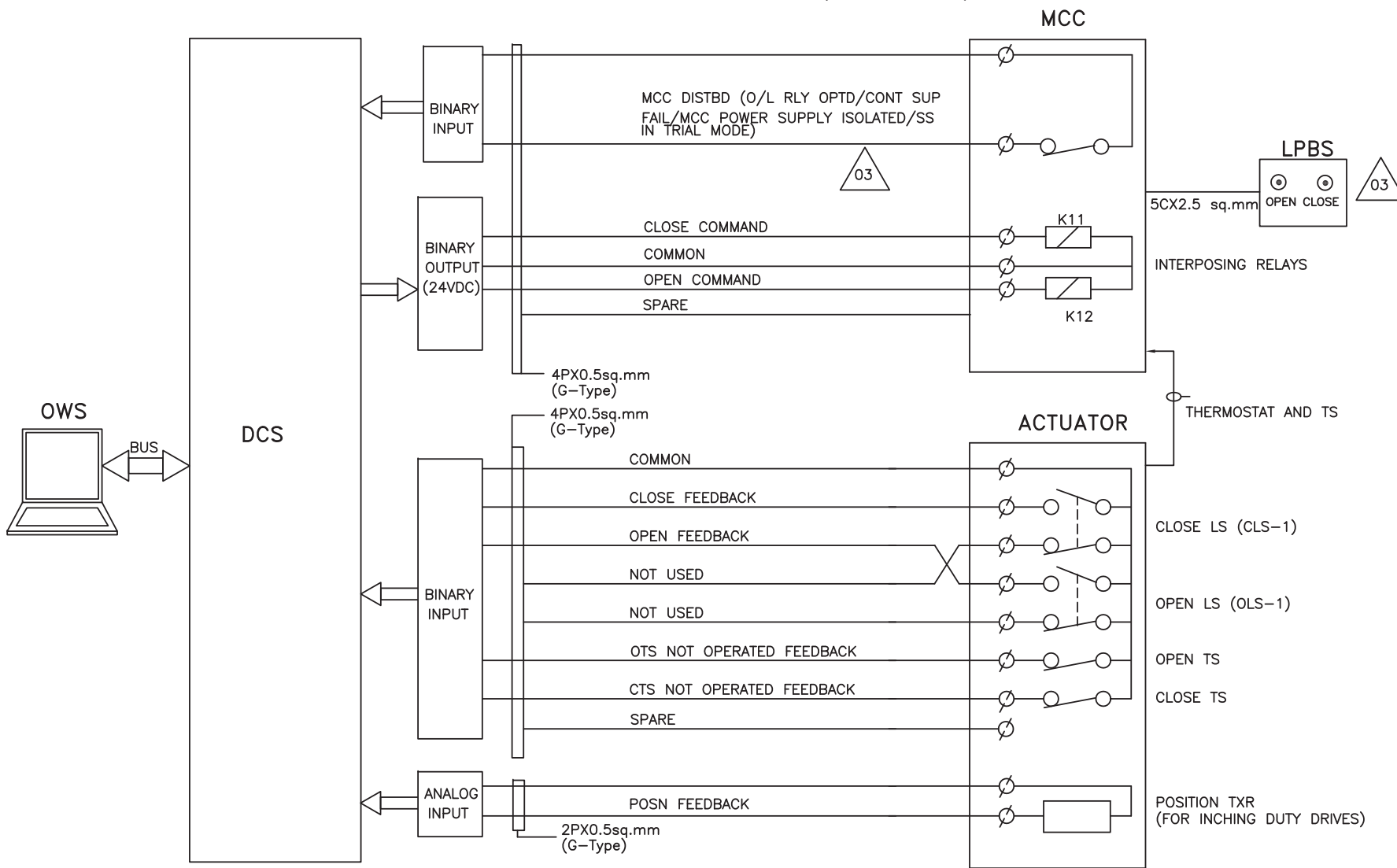
	1X800 MW Wanakbori STPP	SECTION: C SUB SECTION : C&I SHEET 14 of 18
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	


DRIVE CONTROL PHILOSOPHY

|

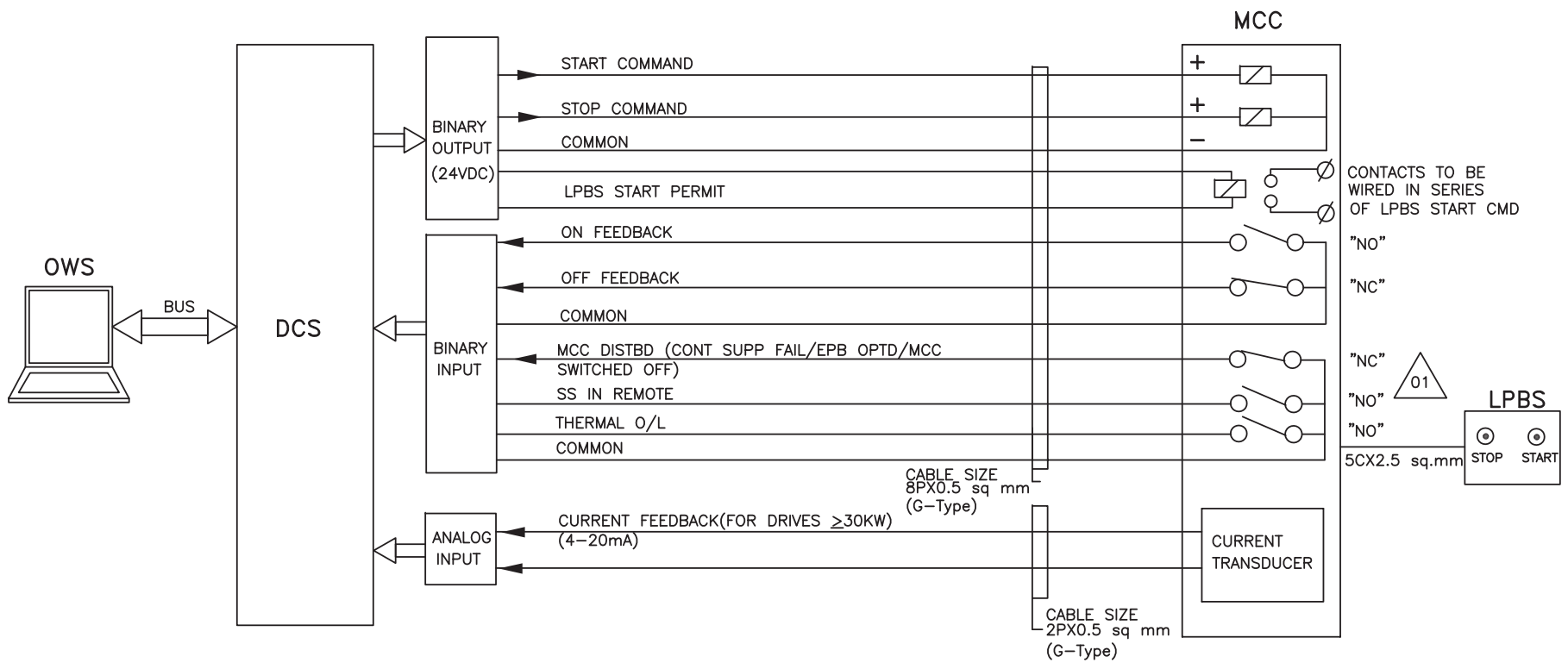
DCS INTERFACE FOR BIDIRECTIONAL DRIVE(WITH MCC)

423 of 574



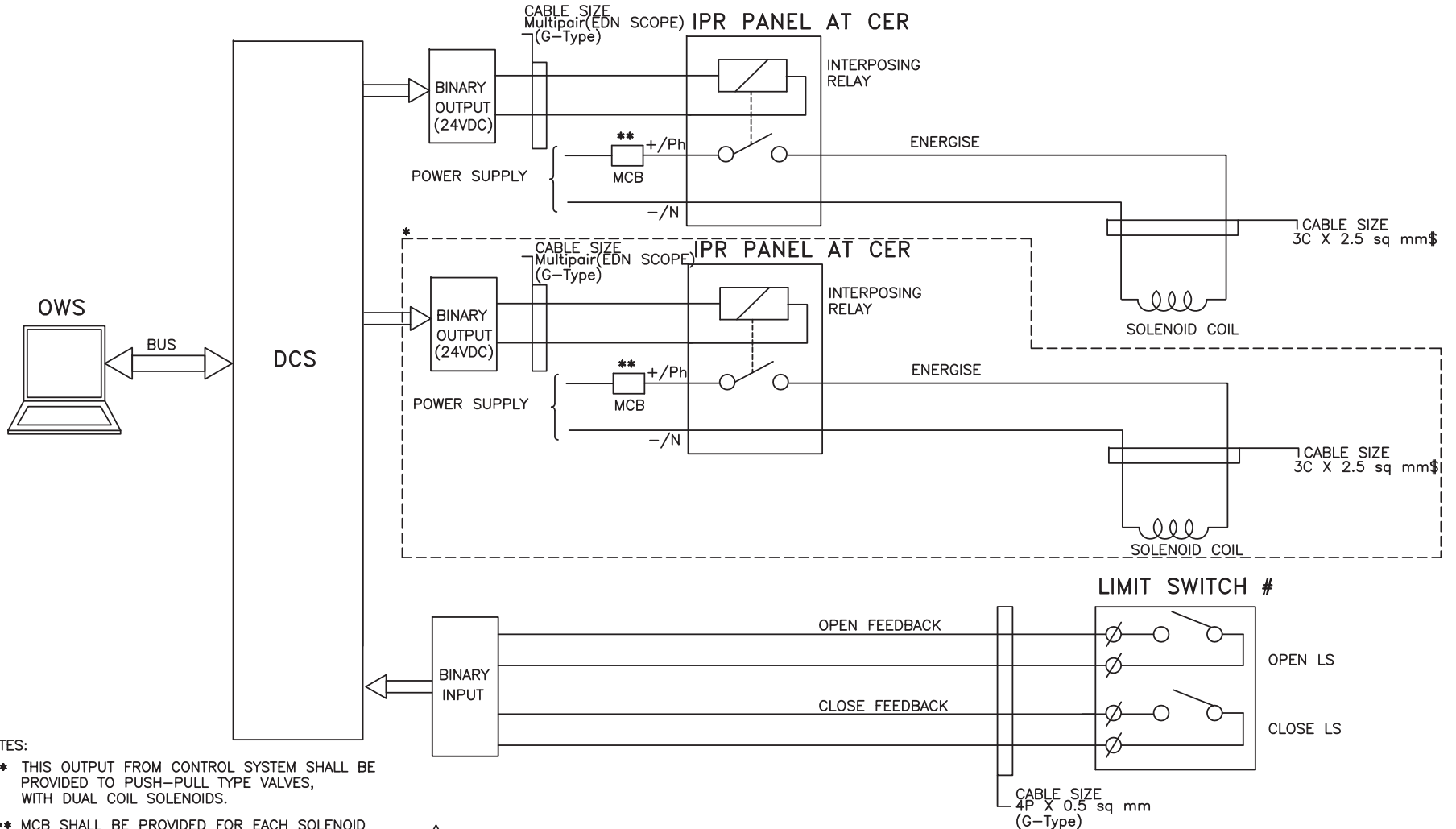
	PROJECT: 1X800MW WANAKBORI THERMAL POWER STN.	DRG.NO. PE-DM-408-145-1002
	EXTN. UNIT-8	DATE 15.06.15
	TITLE : 01 DCS INTERFACE FOR BIDIRECTIONAL DRIVE	REV.NO. 03
		SHT 8 OF 12

DCS INTERFACE FOR UNIDIRECTIONAL LT DRIVE



	PROJECT: 1X800MW WANAKBORI THERMAL POWER STN.	DRG.NO. PE-DM-408-145-1002
	EXTN. UNIT-8	DATE 16.02.15
	TITLE : 01 DCS INTERFACE FOR UNIDIRECTIONAL LT DRIVE	REV.NO. 01
		SHT 8 OF 11

DCS INTERFACE FOR SOLENOID DRIVE (24V DC/220V DC/ 240V AC UPS)



NOTES:

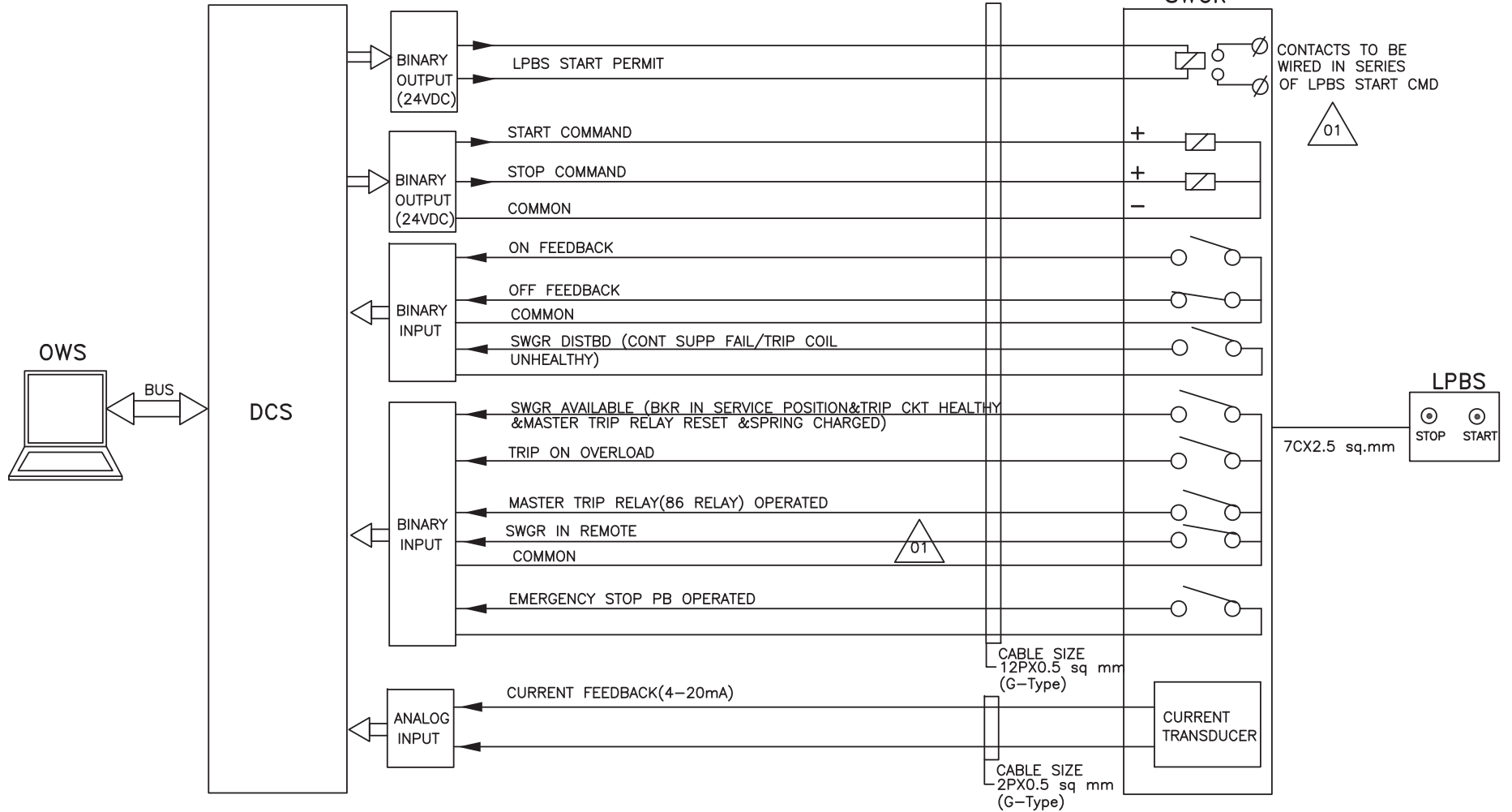
- * THIS OUTPUT FROM CONTROL SYSTEM SHALL BE PROVIDED TO PUSH-PULL TYPE VALVES, WITH DUAL COIL SOLENOIDS.
 - ** MCB SHALL BE PROVIDED FOR EACH SOLENOID
 - # FOR ON/OFF TYPE, SOLENOID ACTUATED CONTROL VALVE.
- CER:-CONTROL EQUIPMENT ROOM
IPR:-INTER POSING RELAY
- § SYSTEMS WHERE EVER MULTIPLE SOLENOIDS CAN BE GROUPED, MULTI CORE CABLE SHALL BE USED.

01

	PROJECT: 1X800MW WANAKBORI THERMAL POWER STN. EXTN. UNIT-8	DRG.NO. PE-DM-408-145-1002
	TITLE : 01 DCS INTERFACE FOR SOLENOID DRIVE	DATE 16.02.15
	REV.NO. 01	SHT 9 OF 11

DCS INTERFACE FOR HT/LT UNIDIRECTIONAL DRIVES(BREAKER OPERATED)

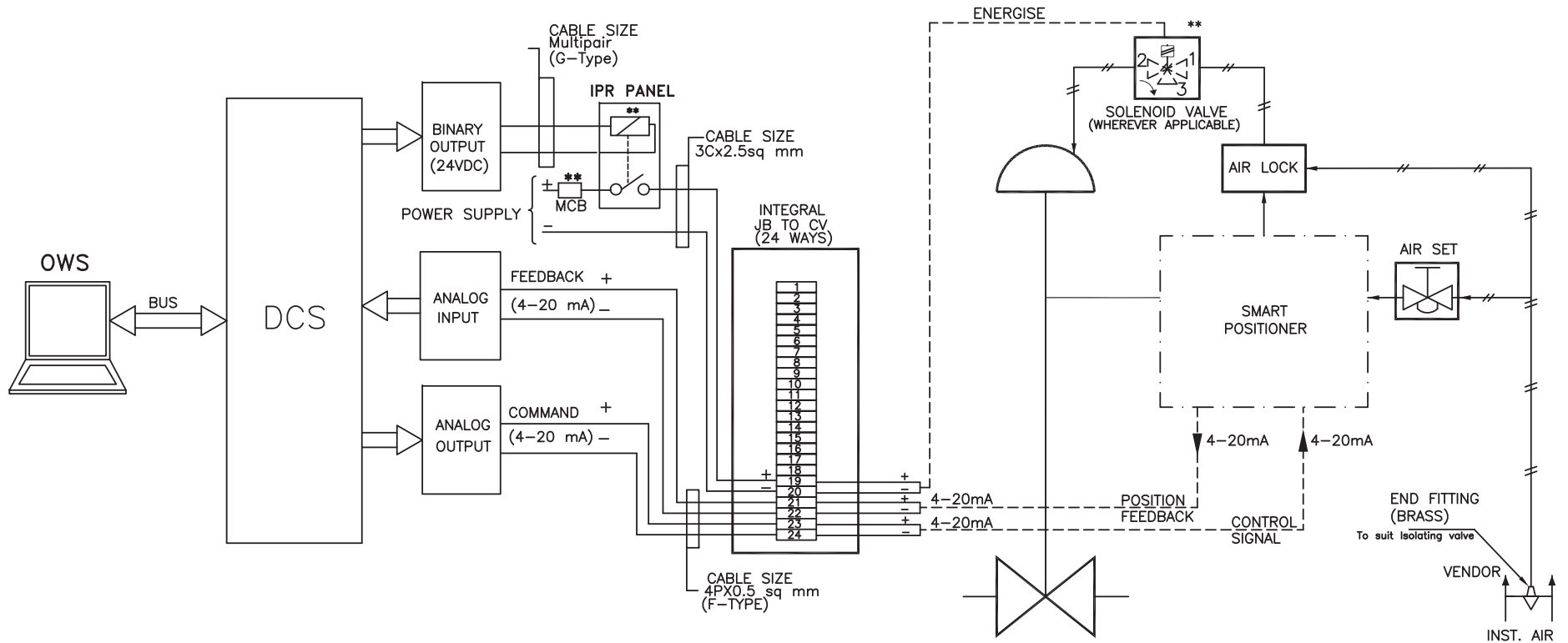
SWGR



426 of 574


	PROJECT: 1X800MW WANAKBORI THERMAL POWER STN.	DRG.NO. PE-DM-408-145-1002
	EXTN. UNIT-8	DATE 16.02.15
	TITLE : 01 DCS INTERFACE FOR UNIDIRECTIONAL HT DRIVE	REV.NO. 01
		SHT 10 OF 11

DCS INTERFACE FOR ANALOG DRIVE (WITH SMART POSITIONER)



NOTES:

** APPLICABLE TO THOSE VALVES ONLY WHERE PROTECTION OPEN/CLOSE ACTION FOR CONTROL DEMAND OVERRIDING IS REQUIRED.

	PROJECT: 1X800MW WANAKBORI THERMAL POWER STN. EXTN. UNIT-8	DRG.NO. PE-DM-408-145-1002
	TITLE : TYPICAL HOOK-UP DIAGRAM ANALOG DRIVE (WITH SMART POSITIONER)	DATE 16.02.15
	REV.NO. 01	SHT 11 OF 11
	VENDOR	INST. AIR



Technical specification for
CONTROL & INSTRUMENTATION

SPEC NO.: **PE-TS-410-145-I**

VOLUME

SECTION

REV. NO. 00

DATE : 10.03.2015

SHEET OF

KKS PHILOSOPHY



DOCUMENT TITLE

KKS NUMBERING PHILOSOPHY**KKS NUMBERING PHILOSOPHY**

For identifying (tagging) an instrument / equipment in Power plant KKS numbering scheme is used. The purpose is to assign a unique number to every equipment in the power plant. For C&I equipment unique number are to be provided up to the signal level so that a unique number Input / Output exist in DCS for every signal.

Normally KKS number is a 10 digit alpha-numeric code and is typically split into the following:


X	X	X	AAY			YB B		
---	---	---	-----	--	--	------	--	--

First three digits indicate the Sub-System. The Code for the major system are given as per **Annexure-1**.

Fourth and Fifth digits are the **Numerical Keys at System Code Level** and used to distinguish between main systems having same Alpha Codes.

Sixth and Seventh digits are the **Equipment / Apparatus / Measuring Circuit Code**. The code of various Equipment / Apparatus / Measuring Circuit is shown in **Annexure-2**

Eight, Nine and tenth digits are the **Numerical Keys at Equipment / Apparatus / Measuring Circuit Code** and used to distinguish between various instruments in the same sub-group. Numerical keys at System / Equipment / Apparatus / Measuring Circuit is shown in **Annexure-3**.

	DOCUMENT TITLE
	KKS NUMBERING PHILOSOPHY

ANNEXURE-1

List of System / Sub-System Codes used in Power Plant:

- 1) Compressed air system : QEA, QEC
- 2) Ventilation System : SAA TO SAZ
- 3) Fire Detection & Protection System + Fire Water pumps : SGM, SGN, SGO, SGP
- 4) Sewage Treatment : SJA TO SJZ
- 5) Pre-treatment Plant : GBI, GBM, GBV
- 6) RO DM Plant : GCI, GCM, GBV


ANNEXURE-2


Standard Equipment Codes:

AA	Valves including drives, also hand operated
AB	Seclusions, Lock, Gates, Doors
AC	Heat Exchanger
AE	Turning, Driving, Lifting equipment
AF	Continuous conveyors, Feeders
AG	Generator Units
AH	Heating and Cooling Units
AK	Pressing and Packaging equipment
AM	Mixer, Stirrer
AN	Blower, Air Pumps / Fans, Compressor Units
AP	Pump Units
AT	Purification, Drying, Filter
AV	Combustion Equipment e.g. grates

Standard Apparatus Codes:

BB	Vessels and Tank
BF	Foundation
BG	Boiler Heating Surfaces
BN	Injector, Ejector
BP	Flow and throughput limitation equipment (Orifice)
BQ	Holder, Carrying Equipment, Support
BR	Piping, Ducts, Chutes, Compensator
BS	Sound Absorber
BU	Insulations, Sheatings

	<p>DOCUMENT TITLE</p> <p style="text-align: center;">KKS NUMBERING PHILOSOPHY</p>																						
<p>Standard Measuring Circuits Codes:</p> <table style="width: 100%; border: none;"> <tr><td>CD</td><td>Density</td></tr> <tr><td>CE</td><td>Electrical Quantities</td></tr> <tr><td>CF</td><td>Flow, throughput</td></tr> <tr><td>CG</td><td>Distance, Length, Position</td></tr> <tr><td>CK</td><td>Time</td></tr> <tr><td>CL</td><td>Level</td></tr> <tr><td>CM</td><td>Humidity</td></tr> <tr><td>CQ</td><td>Analysis (SWAS)</td></tr> <tr><td>CS</td><td>Speed, Velocity, Frequency</td></tr> <tr><td>CT</td><td>Temperature</td></tr> <tr><td>CY</td><td>Vibration, Expansion</td></tr> </table> <p style="text-align: center;">ANNEXURE-3</p> <p style="text-align: center;">Numerical Keys</p> <p>A) Numerical Keys at System Code Level</p> <p>i) Use 10, 20, 30, To distinguish between main systems having same Alpha Codes. Examples:</p> <p style="margin-left: 40px;">a) Main Steam (Left) and Main Steam (Right)</p> <p style="margin-left: 40px;">b) BFP – A/B/C</p> <p style="margin-left: 40px;">c) ID Fan – A/B, FD Fan A/B, AH – A/B</p> <p>ii) For branch off from main system path having code say 10, keep the same alpha code and use 11, 12, 13 etc. Similarly for other branch off from main system path having code say 20, keep the same alpha code and use 21, 22, 23 etc and shall carry on further in the same way.</p> <p>iii) If the branch off from main system / sub system path is used for some other system, where different alpha codes can be applied, then in that case the said branch line will be designated by the alpha codes of the system to which it is providing the input.</p> <p>B) Numerical keys at Equipment Code level:</p> <p>There are three numerical keys available for each type of equipment code. Following has been agreed upon considering present practice, better flexibility and ease in sorting.</p> <p>i) Valves and Dampers --- <i>Equipment Code – AA</i></p> <p style="text-align: right;"><u>N1</u> <u>N2 N3</u></p>		CD	Density	CE	Electrical Quantities	CF	Flow, throughput	CG	Distance, Length, Position	CK	Time	CL	Level	CM	Humidity	CQ	Analysis (SWAS)	CS	Speed, Velocity, Frequency	CT	Temperature	CY	Vibration, Expansion
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DOCUMENT TITLE	
	KKS NUMBERING PHILOSOPHY
<p>Motorised (<i>on/off duty</i>) - 0 01 to 50</p> <p>Motorised (<i>inching duty</i>) - 0 51 to 99</p> <p>Pneumatic (Control) - 1 01 to 50</p> <p>Motorised (<i>thyrestor Control</i>) - 1 51 to 99</p> <p>Sol. Operated (Open / Close duty (Valves, NRVs, Gate) - 2 01 to 99</p> <p>Hydraulic - 3 01 to 99</p> <p>NRV (Without actuation) - 4 01 to 99</p> <p>Manual - 5 01 to 99</p> <p>Manual - 6 01 to 99</p> <p>Relief & Safety Valves - 7 01 to 99</p> <p>Reserve - 8 01 to 99</p> <p>Reserve - 9 01 to 99</p> <p>ii) Field Instruments</p> <p>Field Transmitters & Analog Signals - 0 01 to 99</p> <p>Field Switches & Binary Signals - 1 00 to 99</p> <p>PG Test Point - 4 00 to 99</p> <p>Gauges - 5 00 to 99</p> <p>Automatic Turbine Tester (ATT)-HWR - 2 00 to 99</p> <p>(Reserved for protection Signals used by Hardwar)</p>	
<p>Example of Numerical Key Usage:</p> <p>In line with the philosophy adopted for Valves / Dampers /instruments etc. pumps and fans in the main systems (having different system code) can be numbered as AP/N100 and as AP/N101, 102, Where system code is same.</p>	

	1X800 MW Wanakbori STPP	SECTION: C SUB SECTION : C&I SHEET 15 of 18
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	

APPLICABLE CODES AND STANDARDS

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box or enclosure shall leave from terminal blocks and not from other devices in the enclosure.

The required quantities of cable accessories shall be similarly estimated on the basis of number of terminations and proposed routing of the cables. Any shortfall in the quantity of accessories observed during actual laying shall be compensated at no extra cost.

5.00.00 **PROVEN PRODUCT**

If Bidder is offering their own system or through their collaborator, then same is acceptable subject to satisfactory performance in last 3 years for at least one unit of not less than 600 MW capacity.

If DCS is bought out for bidder then same shall be from following vendors meeting specification and satisfactory performance in last 3 years for at least one unit of not less than 600 MW capacity.

Latest system from following vendors

M/s Siemens

M/s Yokagawa

M/s Honeywell

M/s ABB

Ovation.

5.01.00 Similarly, all other I & C equipment / systems / sub-systems / instruments and accessories in the power cycle shall also be of make and model whose guaranteed and trouble-free performance has been proven at least for two (2) years in not less than two (2) different reheat type pulverized coal fired units of unit size not less than 600 MW.

5.02.00 Bidder shall furnish required information to fully satisfy Owner regarding successful operation and high reliability of products / systems furnished.

6.00.00 **CODES AND STANDARDS**

6.01.00 Items such as thermowells, control valves, flow elements and other in line devices in high and medium pressure steam, feed water and similar services, which fall under the purview of Indian Boiler Regulation Act shall be either certified by IBR or shall be certified by authorities acceptable to IBR. It shall be responsibility of Bidder to obtain the necessary approval of the concerned Authority / Chief Inspector of Boilers for the design and design calculations, manufacturing and erection procedure as called for under the IBR Act for all items requiring such certification.

6.02.00 Generally, the following latest edition of codes and standards prevailing at the time of award of contract shall be applicable.

- 1) Temperature Measurement

- a) Instrument and apparatus for temperature measurement - ASME PTC 19.3 (1974).
 - b) Temperature Measurement - Thermocouples - ANSI - MC 96.1 - 1982.
 - c) Temperature Measurement by electrical resistance thermometers - IS: 2806
 - d) Thermometer-element-Platinum resistance - IS: 2848 / DIN 43760.
- 2) Pressure Measurement
- a) Instrument and apparatus for pressure measurement - ASME PTC 19.2 (1964).
 - b) Bourdon tube pressure and vacuum gauges - IS: 3624/1996.
- 3) Flow Measurement
- a) Instruments and apparatus for flow measurement - ASME PTC 19.5 (1972) Interim supplement, Part-II
 - b) Measurements of fluid flow in closed conduit - BS 1042.
- 4) Electronic Measuring Instruments and Control Hardware
- a) Automatic null balancing electrical measuring instruments -ANSI C 39.4 (Rev. 1973), IS 9319
 - b) Safety requirements for electrical and electronic measuring and controlling instrumentation - ANSI C 39.5 / 1974.
 - c) Compatibility of analog signals for electronic industrial process instruments - ISA-S 50.1: ANSI MC 12.1 / 1975.
 - d) Dynamic response testing of process control instrumentation - ANSI MC 4.1 (1975) - ISA -S26 (1968).
 - e) Surge withstand capability (SWC) tests - ANSI C 37.90A (1989), IEC-255.4.
 - f) Printed circuit boards - IPC TM-650, IEC 326C.
 - g) General requirements and tests for printed wiring boards - IS-7405 (Part-I)/1973.
 - h) Edge socket connectors - IEC 130-11.
 - i) Requirements and methods of testing of wire wrap terminations--DIN 41611 Part-2.
 - j) Dimensions of attachment plugs and receptacles- ANSI C73-1973.(Supplement ANSI C73a – 1980)
- 5) Instrument Switches and Contacts

- a) Contact Rating - AC services NEMA ICS Part-2 125, A-600
- b) Contact Rating - DC services NEMA ICS Part-2 125, N-600
- 6) Enclosures
 - a) Enclosures for Industrial Controls and Systems--NEMA ICS-6-110.15 through 110.22
 - b) Racks, panels and associated equipment -EIA: RS-310-B-1983 (ANSI C83.9 - 1972).
- 7) Apparatus, Enclosures and Installation Practices in Hazardous Area
 - a) Classification of hazardous area - NEMA Article 500, Volume-6, 1978.
 - b) Electrical Instruments in hazardous dust locations - ISA-RP 12.11.
 - c) Intrinsically safe apparatus - NFPA Article 493 Volume-4 1978.
 - d) Purged and pressurized enclosure for electrical equipment in hazardous location - NFPA Article 496 Volume-4, 1978.
- 8) Sampling System
 - a) Stainless Steel material of tubing and valves, for sampling system - ASTM A 269-79 GRTO-316.
 - b) Submerged helical coil heat exchangers for sample coolers -- ASTM D11-98.
- 9) Annunciators
 - a) Specifications and guides for the use of general-purpose annunciators - ISA RP 18.1.
 - b) Surge withstand capability tests -ANSI C37.90 a -1971 and IEEE Standard 472-1974.
- 10) Interlocks, Protections
 - a) Relays and relay system associated with electric power apparatus - IEEE Standards 3.13.
 - b) Surge withstand capability tests - ANSI C37.90 a - 1971 and IEEE Standard 472-1974.
 - c) General requirements and tests for switching devices for control and auxiliary circuits including contactor relays - IS-6875 (Part-I)/1973.
 - d) Turbine water damage prevention - ASME-TDP-1-1980.
 - e) Boiler safety interlocks - NFPA Section 85B, 85D, 85E, 85F, 85G.
- 11) UPS System

- a) Practice and requirements for semi-conductor power rectifiers - ANSI C34.2.
- b) Relays and relay systems associated with electrical power apparatus IEEE Standard - 3.13.
- c) Surge withstand capability tests - ANSI C 70.90 A/1971, IEC-255.4.
- d) Recommended practice for sizing large lead storage batteries for generating stations and sub-stations - -IEEE-485.

12) Control Valves

- a) Control valve sizing (Incompressible fluids) - ISA-S39.2 / 1972.
- b) Control valve sizing (Compressible fluids) - ISA-S39.4 / 1972.
- c) Control Valve seat leakage – ANSI / FCI 70.2
- d) Face to face dimensions of Control Valves - ANSI B16.10
- e) Control Valve Capacity Test Procedure – ISA – S75.02

13) Instrument Tubing

- a) Seamless Carbon Steel Pipe - ASTM-A-106.
- b) Forged carbon steel fittings - ASTM-A-105.
- c) Dimensions of fittings - ANSI-B16.11.
- d) Code for pressure piping, welding, hydrostatic testing - ANSI-B 31.1.
- e) Nomenclature for instrument tube fittings - ISA-RP 42.1 / 1982.
- f) Seamless Stainless Steel Tube ASTM A-213 TP 316 / ASTM A-269 TP 316
- g) Seamless Alloy Steel Pipe ASTM A 335 P22
- h) Seamless Stainless Steel Pipe ASTM A-312 TP 316

14) Cables

- a) Thermocouple extension wires / cables - ANSI MC96.1.
- b) Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy-IPCEA S-61-402
- c) Guide for design and installation of cable system in power generating station (insulation, jacket materials) -IEEE Standard 422.
- d) Requirements of vertical tray flame test - IEEE 383
- e) Standard specification for tinned soft or annealed copper wire for electrical purpose - ASTM B33.

15) Electronic Cards, Subassemblies and Components

a) Unpackaged

- i) Vibration : IEC-68.2.6
- ii) Shock : IEC-68.2.27
- iii) Drop & Topple : IEC-68.2.31

b) Packaged

Vibration, Drop & Static Compression - NSTA.

c) Electromagnetic Compatibility

- i) Electrical Fast Transient : IEC-801.4
- ii) Surge Withstand : IEC-255.4
- iii) Radiated Electromagnetic Field : IEC-801.3
- iv) Electrostatic Discharge : IEC-801.2
- v) Electromagnetic Emissions : VDE 0871, Class-B

16) Cable Trays, Conduits

a) Guide for the design and installation of cable system in power generating station (cable trays, support systems, conduits)- IEEE Standard 422, NEMA VE-1, NEC-1981. Test Standards NEMA VE-1-1979.

b) Galvanizing of carbon steel cable trays - ASTM A-386.

7.00.00 DESIGN CRITERIA

This section lays down the general design criteria to be adapted in designing the instrumentation and control system of the plant.

7.01.00 General Requirements

7.01.01 Instrumentation, control and automation devices and accessories shall be designed with the following considerations:

- a) Stable in spite of temperature fluctuations.
- b) Able to withstand high humidity.
- c) Weather proof.
- d) Dust proof.
- e) Corrosion resistant.
- f) Erosion resistant.

	1X800 MW Wanakbori STPP	SECTION: C SUB SECTION : C&I SHEET 16 of 18
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	

SPECIFICATION FOR QUALITY ASSURANCE & TESTING

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should water be allowed to be admitted through conduit entering the cabinets from top or sides.

11.03.00 Atmospheric Contamination

11.03.01 Particulate contamination from fly ash and coal dust and gaseous contaminants such as SO₂ and other flue gas constituents in the coal fired plant are foreseen. This hazard shall be taken into design considerations.

11.04.00 Vibration

11.04.01 Design of the systems shall include features such as locking devices, anti vibration pads etc, to withstand vibration. In general, I&C equipment shall be installed away from the vibration zone.

11.05.00 Lightning

11.05.01 Protection against lightning shall be considered by providing proper grounding, metal oxide varistors, spark gap lightning arrestor, optical isolator and isolation transformer.

12.00.00 **SECURITY**

12.01.00 Door lock shall be provided in all Panels, Cabinets and Enclosures.

12.02.00 System mode key switch or password to prevent tampering of system program.

12.03.00 Redundant elements of the system shall not be exposed to the common hazards. For example routing of the redundant network cable through separate cable raceway, using separate cabinet / separate rack for redundant controller and redundant IO modules.

13.00.00 **ACCEPTANCE TESTS**

The Bidder shall be required, as part of his Tender, to fully integrate and test all the equipment, included in his Tender, at site and respective Control packages at the manufacturer's works. Owner / Consultants shall witness these tests.

However, for DCS the Bidder shall consider in his Tender the following tests:

(a) Factory Acceptance Test (FAT)

After completion of manufacture of DCS and prior to delivery to Site, the manufacturer shall functionally test the assembled system. The test shall be carried out with all input / output cubicles, control processors, data highway, operator's consoles, Engineer's console and peripheral devices connected in the specified configuration. The fully configured software shall also be loaded and tested at the same time.

The FAT shall include the following activities:

- Complete hardware inspection;

- Heat cycle run test as per the prevailing standards;
- Functional test of a minimum 25 % of all configured points, logic routines, control functions, graphic displays, reports and logs;
- Demonstration of special calculations (e.g. efficiency calculation, performance calculations etc.);
- Testing of redundancy facilities to demonstrate automatic change over to standby data highway, power supply and control processor etc.;
- Demonstration of system diagnostic facilities;

The FAT shall be witnessed by the Owner / Engineer who shall be notified at least three (3) weeks before the commencement of the tests. The system shall have been fully pre-tested by the manufacturer at his works prior to notifying the Owner / Engineer to ensure any component, equipment or system fault have been identified and cleared. The test procedure for the FAT shall be issued to the Engineer and agreed prior to notification. All documents / drawings and test equipment shall be available at the manufacturer's works during the FAT.

The FAT shall include a 72 hour continuous operational run, any equipment fault or failure during this time shall make this part of the test null and void and the test run shall be re-started after rectification of the fault. A test certificate, accompanied by the relevant test results, shall be issued after successful completion of the tests.

(b) Site Acceptance Test (SAT)

After installation, connection, integration with other systems and all pre-commissioning checks have been carried out on the complete system, the SAT shall be performed and witnessed by the Engineer. The SAT shall include the following as a minimum:

- a) Complete hardware and installation inspection;
- b) Testing of redundancy facilities by simulating data highway, power supplies and control processor failures. All such units shall be tested to demonstrate of the automatic operation of the standby units and initiation of the relevant system alarms;
- c) Demonstration of system diagnostic facilities; by the simulation of the appropriate fault conditions. The system fault reporting techniques shall also be demonstrated;
- d) Testing of data highway integrity using continuity test equipment based on signal injection / reflection techniques;
- e) Demonstration of data logging, sequence of events and trending system operation.
- f) Pre-commissioning checks shall include the following:

- i) Calibration of all field instruments, analysers and equipment, in the scope of supply of this package, at site;
- ii) Loop checking, for all open and close loops, between source and destination with manual signal injection as well as from Operating Consoles for entire DCS I/Os;
- iii) Logic sequence check with the manual signal injection at signal source as well as checking of feed back signals.

All individual configured data points, logic routines, control functions, graphic displays and reporting facilities shall be verified as part of the loop tests.

The Owner shall be notified at least 2 weeks before the commencement of the test. The procedures shall be issued and agreed before notification.

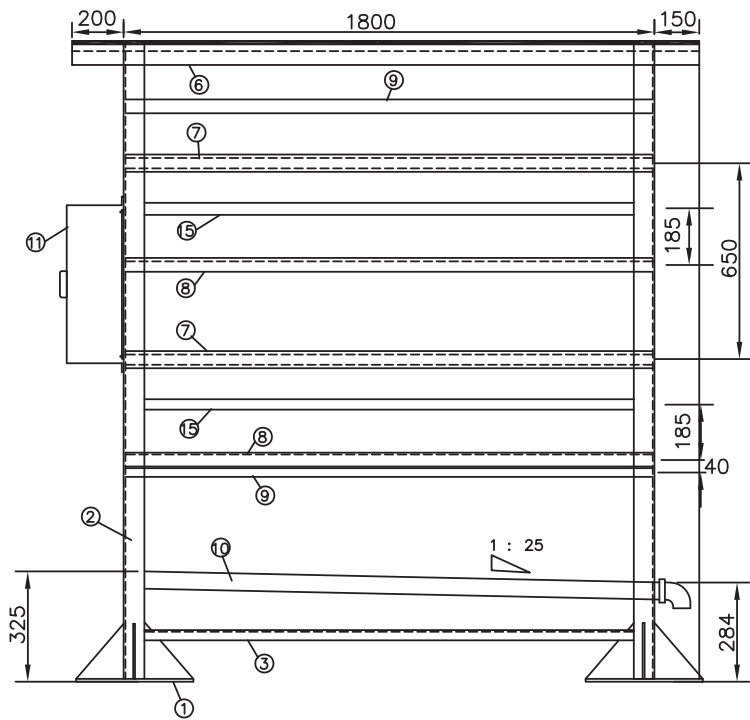
A test certificate accompanied by the relevant test results shall be issued after successful completion of the calibration and test.

Similar tests shall also be applicable for other control system i.e. plant utility system PLC / Microprocessor based control systems.

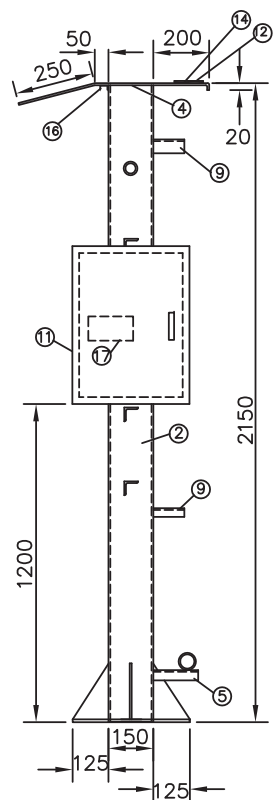
	1X800 MW Wanakbori STPP	SECTION: C SUB SECTION : C&I SHEET 18 of 18
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	

DRAWINGS

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FRONT VIEW



RH SIDE VIEW

LEGEND:


- 1..M.S. PLATE 400 X 400 X 10 mm.
- 2..ISMC 150 X 75 X 6 mm.
- 3..ISMC 75 X 40 X 5 mm.
- 4..CANOPY MOUNTING PLATE 5 mm THICK.
- 5..BRACKET FOR DRAIN PIPE.
- 6..CANOPY ASSEMBLY 3.0 mm THICK CRCA SHEET.
- 7..GI PIPE 2' NB CLASS B FOR TRANSMITTER MOUNTING.
- 8..M.S.ANGLE 40 X 40 X 5 mm.
- 9..BRACKET FOR IMPULSE PIPE SUPPORT.
- 10..DRAIN PIPE MATERIAL ASTM A106 GR. 'C' SIZE 2" NB SCH 80.
- 11..JUNCTION BOX SIZE: 480 (H) X 360 (W) X 180 (D).
- 12..BULKHEAD M.S. PLATE 5 mm THICK.
- 13..COMPACT FLUORESCENT LAMP FOR RACK ILLUMINATION.
- 14..XLPE GASKET IN BETWEEN BULKHEAD PLATE & CANOPY MOUNTING PLATE.
- 15..PVC CABLE TRAY/FLEXIBLE CONDUIT FOR CABLE.
- 16..'C' CHANNEL FOR LIGHT FITTING.
- 17..TAG PLATE.

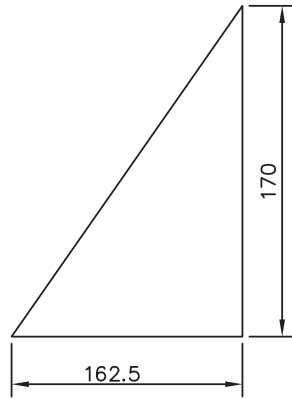
NOTES:

- 1..POWER SOCKET & TB SHALL BE PROVIDED IN JB.
- 2..COLOUR: GREY IS5-631. OVERALL THICKNESS > 100 MICRONS.
- 3..TAG PLATES SHALL BE PROVIDED FOR EACH INSTRUMENT.
- 4..20% TERMINALS SHALL BE PROVIDED AS SPARE.
- 5..ANTIVIBRATION PAD & FOUNDATION BOLTS SHALL BE PROVIDED.
- 6..DIMENSIONS SHOWN ARE TENTATIVE AND SHALL BE FINALISED AT DETAILING.

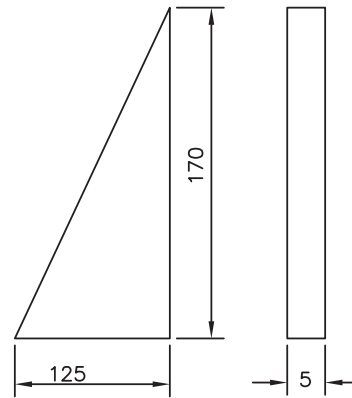
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN MM

PRELIMINARY
TENDER PURPOSE ONLY

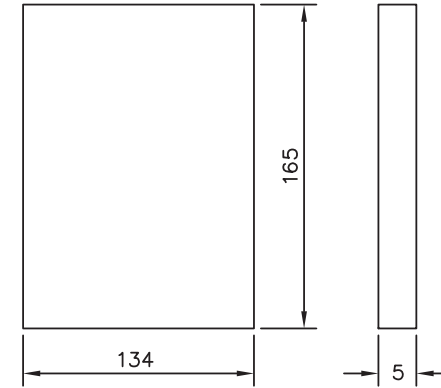
						G.A.DRAWING FOR LOCAL INSTRUMENT RACK		 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA · MUMBAI · CHENNAI · NEW DELHI	
						1x800MW SUPER CRITICAL THERMAL POWER PROJECT (UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)		JOB NO. DCPL-K9213R SCALE NIL SHT. 2 OF 10	
SB	SR	SD		0	21.04.10	GUJARAT STATE ELECTRICITY CORPORATION LIMITED VADODARA, GUJARAT		DWG. NO. K9213R-DWG-I-0200 REV. 0	
APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE				



DETAIL OF-1



DETAIL OF-2




DETAIL OF-3

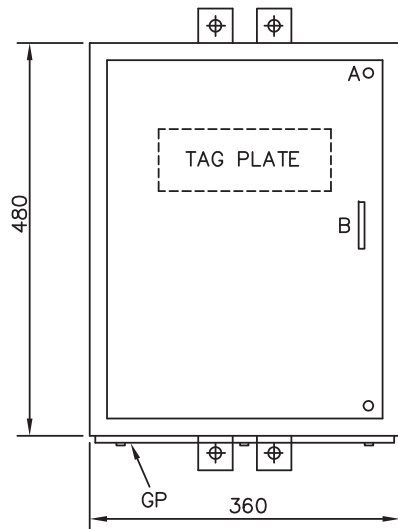
NOTES:

- 1..RIB M.S. PLATE 162.5 X 170 X 5 mm THICK.
- 2..RIB M.S. PLATE 125 X 170 X 5 mm THICK.
- 3..RIB M.S. PLATE 134 X 165 X 5 mm THICK.

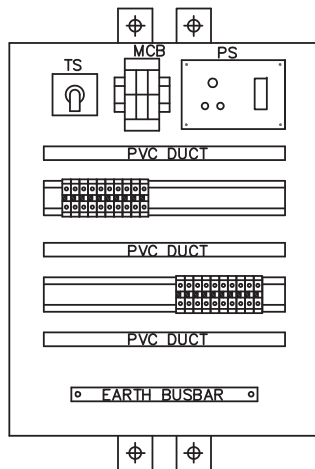
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN MM

PRELIMINARY
TENDER PURPOSE ONLY

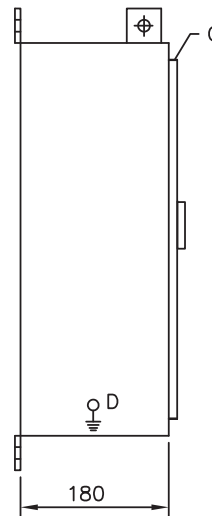
						G.A. DRAWING OF CLEATS FOR LOCAL INSTRUMENT RACK		 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA · MUMBAI · CHENNAI · NEW DELHI		
						1x800MW SUPER CRITICAL THERMAL POWER PROJECT (UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)				
SB	SR	SD		0	21.04.10	GUJARAT STATE ELECTRICITY CORPORATION LIMITED VADODARA, GUJARAT		JOB NO. DCPL-K9213R	SCALE NIL	SHT. 4 OF 10
APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE			DWG. NO. K9213R-DWG-I-0200		REV. 0



FRONT VIEW



INTERNAL FRONT VIEW



SIDE VIEW

LEGEND:

- A - DOOR LOCK
- B - DOOR HANDLE
- C - HINGES
- D - EARTH STUD
- GP - GLAND PLATE
- PS - POWER SOCKET
- TS - TOGGLE SWITCH
- TBS - TERMINAL BLOCKS
- MCB - MINIATURE CIRCUIT BREAKER

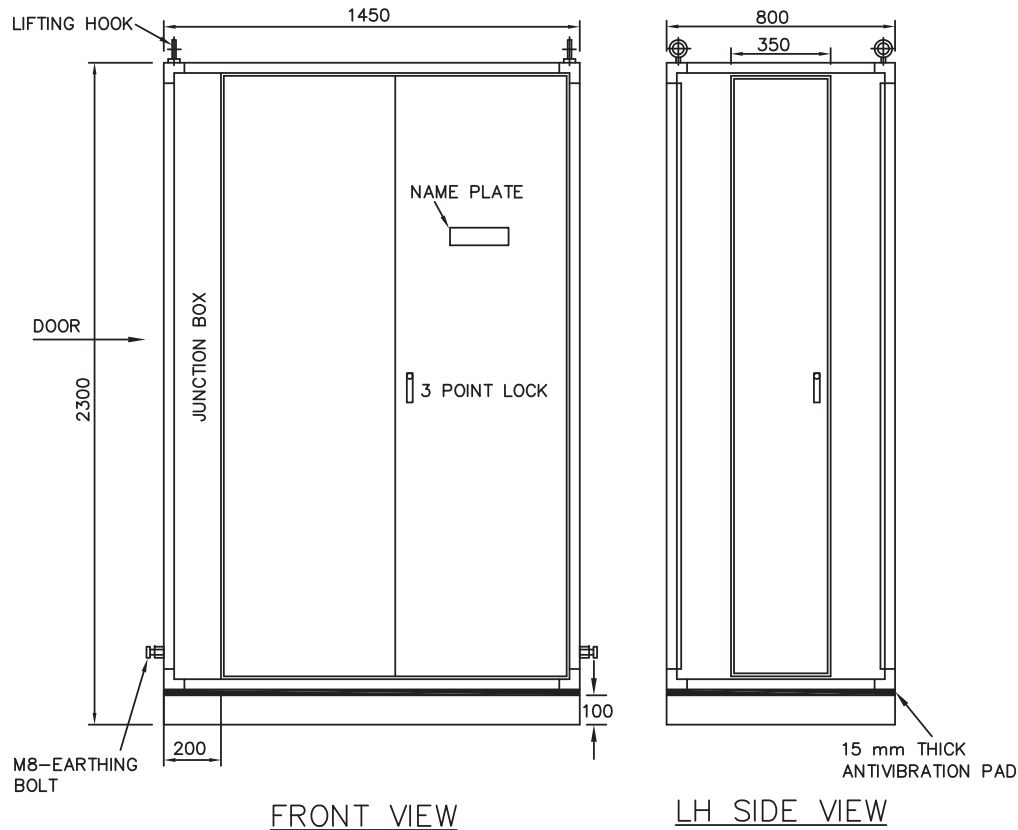
NOTES:

- 1..JB WILL BE MADE OUT OF 2.0 mm CRCA SHEET.
- 2..PROTECTON CLASS IP-65.
- 3..COLOUR EXT-GREY IS5-631, INTERNAL-BRILLIANT WHITE.
- 4..NUTS FOR MOUNTING THE JUNCTION BOX SHALL BE PROVIDED.
- 5..3 MM THICK CRCA GLAND PLATE (GP) AT BOTTOM SHALL BE PROVIDED.
- 6..SCREWLESS CAGE CLAMP TERMINALS SHALL BE USED.
- 7..EARTH BUS BAR SHALL BE OF 25X6 MM TINNED COPPER.
- 8..INSTRUMENT TAG VIS-A-VIS SERVICE AND TERMINAL DETAILS SHALL BE PRINTED ON PHENOLIC BOARD MOUNTED ON BACK SIDE OF DOOR.
- 9..COLOUR CODE FOR POWER SUPPLY- PHASE-RED, NEUTRAL-BLACK & EARTH-GREEN
- 10..CABLE FOR PANEL LIGHTING SHALL BE 1.5 SQ.MM,1100V GRADE
- 11..SIGNAL WIRING SHALL BE 4 PAIR X 0.5 SQ.MM ANNEALED TINNED COPPER, TWISTED PAIR, OVERALL SHIELDED 500V GRADE, UNARMoured FRLS PVC.

PRELIMINARY
TENDER PURPOSE ONLY

						G.A. DRAWING OF JUNCTION BOX FOR LOCAL INSTRUMENT RACK		DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA · MUMBAI · CHENNAI · NEW DELHI		
						1x800MW SUPER CRITICAL THERMAL POWER PROJECT (UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)				
SB	SR	SD		0	21.04.10	GUJARAT STATE ELECTRICITY CORPORATION LIMITED VADODARA, GUJARAT		JOB NO. DCPL-K9213R	SCALE NIL	SHT. 5 OF 10
APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE			DWG. NO. K9213R-DWG-I-0200		REV. 0

LOCAL INSTRUMENT ENCLOSURE



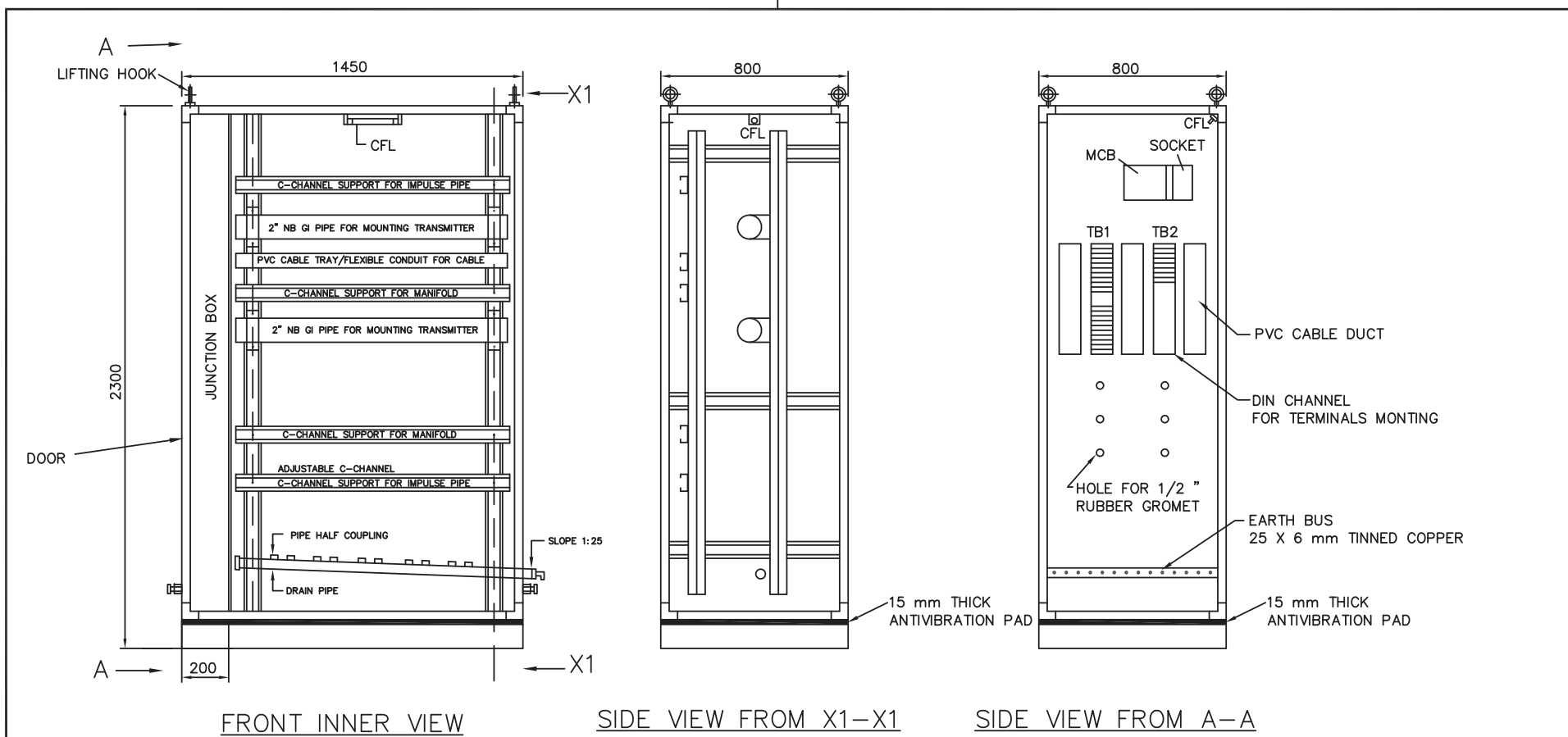
NOTES:

- 1..DIMENSIONS SHOWN ARE TENTATIVE AND SHALL BE FINALIZED AT DETAILING.
- 2..ALL SHEETS SHALL BE 3 mm THICK CRCA SHEET.
- 3.. ALL DOORS SHALL BE FLUSH/CONCEALED TYPE.
- 4..COLOUR :-
 EXTERIOR : GREY IS5-631
 INTERIOR : BRILLIANT WHITE
 OVER ALL THICKNESS WILL BE > 100 MICRONS
- 5..BASE FRAME WILL BE MADE OUT OF ISMC 100 AND COLOUR WILL BE BLACK PAINT FINISH.
- 6..BULKHEAD PLATE FOR TOP AND BOTTOM SHALL BE 1150 X 650 X 6 MM.
- 7..CABLE GLAND PLATE OF THICKNESS 3 mm CRCA SHEET SHALL BE PROVIDED AT BOTTOM OF JUNCTION BOX.
- 8..ENCLOSURE PROTECTION CLASS SHALL BE IP-65.
- 9..TERMINALS INSIDE JUNCTION BOX SHALL BE SCREWLESS CAGE CLAMP TYPE.
- 10..DOORS SHALL BE PROVIDED WITH CONCEALED HINGES, THREE POINT LOCKING FOR FRONT, REAR AND SIDE DOOR HINGES SHALL BE OF STAINLESS STEEL.
- 11..XLPE GASKET SHALL BE PROVIDED BETWEEN BULKHEAD PLATE & ENCLOSURE.
- 12..EARTH BUSBAR 25 X 6 mm TINNED COPPER.
- 13..DRAIN PIPE SLOPE SHALL BE 1:25 APPROX.
- 14..COMMON LOCK/KEY SHALL BE PROVIDED FOR ALL LIE'S & JB'S.
- 15..FOUNDATION BOLTS SHALL BE PROVIDED.
- 16..TAG PLATES SHALL BE PROVIDED FOR EACH INSTRUMENT.
- 17..INSTRUMENT TAG VIS-A-VIS SERVICE AND TERMINAL DETAILS SHALL BE PRINTED ON PHENOLIC BOARD MOUNTED ON BACK SIDE OF JUNCTION BOX DOOR.
- 18..20% TERMINALS SHALL BE PROVIDED AS SPARE.
- 19..NAME PLATE OF PANEL SHALL BE FIXED ON FRONT DOOR.

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN MM

PRELIMINARY
TENDER PURPOSE ONLY

						G. A. DRAWING FOR LOCAL INSTRUMENT ENCLOSURE		DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS <small>KOLKATA · MUMBAI · CHENNAI · NEW DELHI</small>		
						1x800MW SUPER CRITICAL THERMAL POWER PROJECT (UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)				
SB	SR	SD		0	21.04.10	GUJARAT STATE ELECTRICITY CORPORATION LIMITED VADODARA, GUJARAT		JOB NO. DCPL-K9213R	SCALE NIL	SHT. 6 OF 10
APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE			DWG. NO. K9213R-DWG-I-0200		REV. 0



FRONT INNER VIEW

SIDE VIEW FROM X1-X1


SIDE VIEW FROM A-A

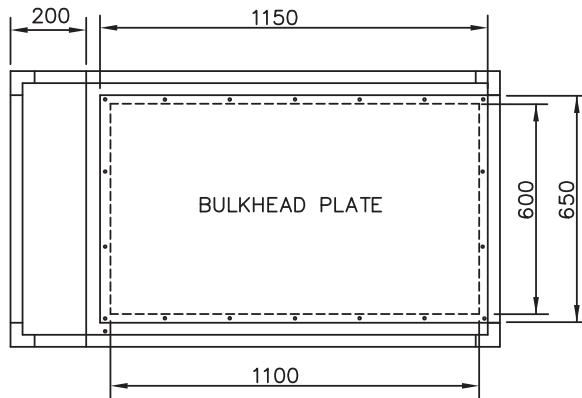
- NOTES:**
- 1..PVC WIRE DUCT WITH COVER SHALL BE PROVIDED.
 - 2..FOR ILLUMINATION COMPACT FLUORESCENT LAMP IN LIE AND IN JB SHALL BE PROVIDED.
 - 3..DRAIN HEADER IS APPLICABLE FOR STEAM/WATER PROCESS IMPULSE LINES ONLY.
 - 4..DRAIN PIPE SHALL BE 2" NB ASTM A106 GRC SCH.80.

PRELIMINARY
TENDER PURPOSE ONLY

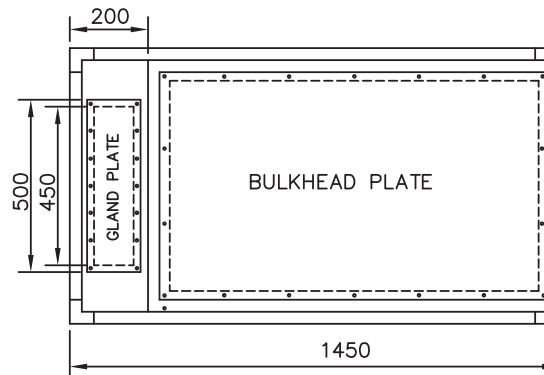
A4_H (08-'06) [297 x 210]

K9213-DWG-I-0200-7-10

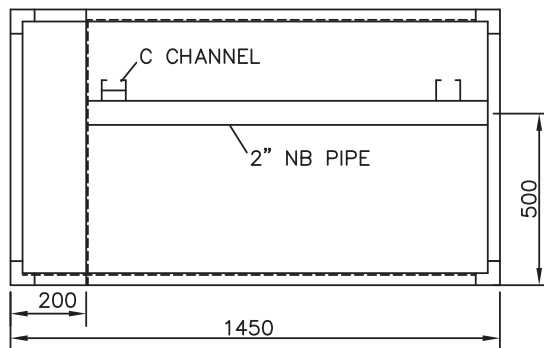
						INNER G.A. DRAWING FOR LOCAL INSTRUMENT ENCLOSURE		 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA · MUMBAI · CHENNAI · NEW DELHI		
						1x800MW SUPER CRITICAL THERMAL POWER PROJECT (UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)				
SB	SR	SD		0	21.04.10	GUJARAT STATE ELECTRICITY CORPORATION LIMITED VADODARA, GUJARAT		JOB NO. DCPL-K9213R	SCALE NIL	SHT. 7 OF 10
APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE			DWG. NO. K9213R-DWG-I-0200		REV. 0



TOP VIEW



BOTTOM VIEW




TOP VIEW WITHOUT BULKHEAD PLATE

NOTES:

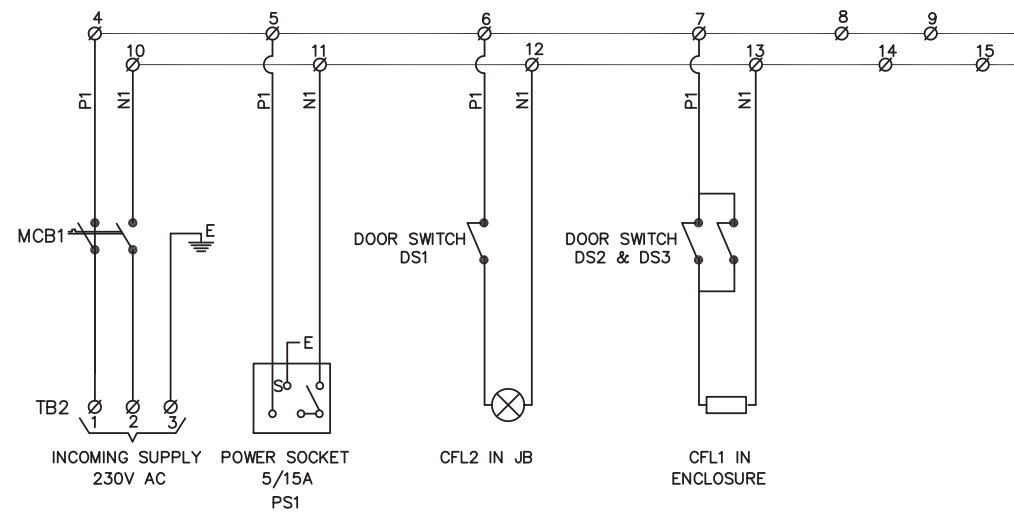
- 1..BULK HEAD PLATE DIMENSION ARE AS FOLLOWS: 1150 X 650 X 6 mm.
- 2..IMPULSE PIPE ENTRY : BOTTOM ENTRY FOR AIR/FLUE GAS APPLICATIONS.
- 3..IMPULSE ENTRY : TOP ENTRY FOR STEAM/WATER APPLICATIONS.

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN MM

PRELIMINARY
TENDER PURPOSE ONLY

						BULKHEAD PLATE DETAILS FOR LOCAL INSTRUMENT ENCLOSURE		 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA · MUMBAI · CHENNAI · NEW DELHI		
						1x800MW SUPER CRITICAL THERMAL POWER PROJECT (UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)				
SB	SR	SD		0	21.04.10	GUJARAT STATE ELECTRICITY CORPORATION LIMITED VADODARA, GUJARAT		JOB NO. DCPL-K9213R	SCALE NIL	SHT. 8 OF 10
APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE			DWG. NO. K9213R-DWG-I-0200		REV. 0

POWER WIRING CIRCUIT



NOTES :

- 1.. COLOUR CODING FOR POWER SUPPLY : PHASE – RED, NEUTRAL– BLACK, EARTH–GREEN
- 2.. CABLE ROUTING FROM TB TO PANEL LIGHT WILL BE 1.5 Sq.mm 1100V AC GRADE.
- 3.. SIGNAL WIRING WILL BE DONE BY 4 PAIR X 0.5 Sq.mm ANNEALED TINNED COPPER, PAIR TWISTED OVERALL & SHIELDED, VOLTAGE GRADE 1100V, UNARMoured FRLS PVC SHIELDED CABLE.

A4_H (08-'06) [297 x 210]

K9213-DWG-I-0200-9-10

PRELIMINARY
TENDER PURPOSE ONLY

SB	SR	SD		0	21.04.10	
APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE	

**ELECTRICAL WIRING AND TERMINATION DRAWING
FOR LOCAL INSTRMENT ENCLOSURE**

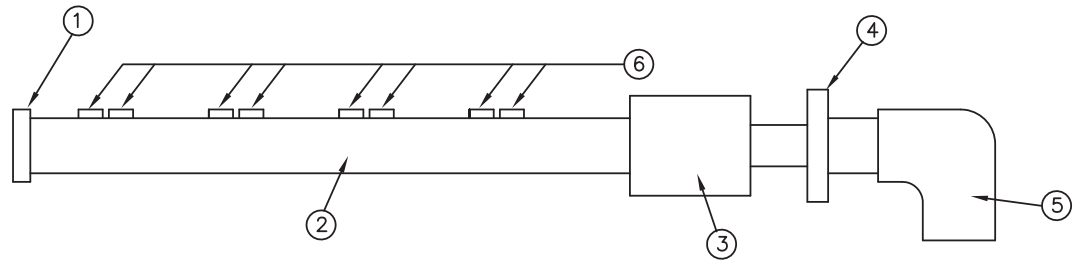
**1x800MW SUPER CRITICAL THERMAL POWER PROJECT
(UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)**

**GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT**



DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS
KOLKATA · MUMBAI · CHENNAI · NEW DELHI

JOB NO. DCPL-K9213R	SCALE NIL	SHT. 9 OF 10			
DWG. NO. K9213R-DWG-I-0200				REV. 0	




BILL OF MATERIAL		
SL.NO.	DESCRIPTION	QTY
1	2" S.W. CAP, CS	1
2	2" NB, ASTM A-106, SCH 80/Gr. C	1
3	2" SW X 1" NPT(F) COUPLING CS	1
4	1" NPT(M) X 1" BSP(M) HEX. NIPPLE WITH FITTING, CS	1
5	1" BSP(F) ELBOW, CS (BOTH ENDS THREADED)	1
6	HALF COUPLING; SIZE:1/2" NB SW	AS REQD

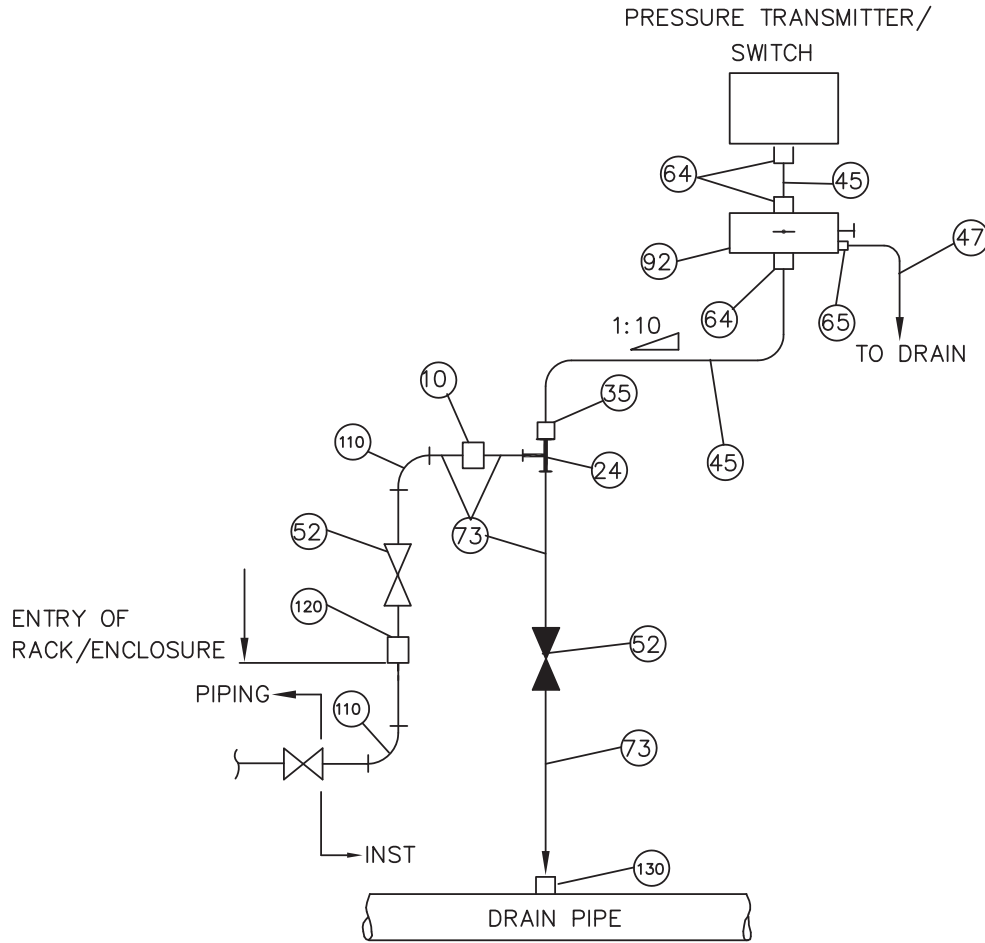
PRELIMINARY
TENDER PURPOSE ONLY

A4_H (08-'06) [297 x 210]

K9213-DWG-I-0200-10-10

						DRAIN HEADER DETAILS FOR LOCAL INSTRUMENT ENCLOSURE		 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA · MUMBAI · CHENNAI · NEW DELHI		
						1x800MW SUPER CRITICAL THERMAL POWER PROJECT (UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)				
SB	SR	SD		0	21.04.10	GUJARAT STATE ELECTRICITY CORPORATION LIMITED VADODARA, GUJARAT		JOB NO. DCPL-K9213R	SCALE NIL	SHT. 10 OF 10
APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE			DWG. NO. K9213R-DWG-I-0200		REV. 0


**PRESSURE TRANSMITTER/PRESSURE SWITCH
MOUNTED ABOVE SOURCE POINT**



BILL OF MATERIAL		
ITEM NO.	QTY./INST	DESCRIPTION
24	1	EQUAL TEE (FEMALE) 1/2" SW 3000lbs
35	1	MALE CONNECTOR 1/2" PE X 1/2" OD 3000 lbs
52	2	GLOBE VALVE 1/2" SW 600lbs
45	3Mtrs.	TUBE 1/2" OD 2.1 MM THICK
64	3	MALE CONNECTOR 1/2" NPT(M) X 1/2" OD 3000 lbs
73	2Mtrs	IMPULSE PIPE 15 NB SCH 80
92	1	2 VALVES MANIFOLD 1/2" NPT(F)
10	1	FULL COUPLING 1/2" SW 3000lbs
47	0.15Mtrs	TUBE 8 MM OD 1.0 MM THICK
65	1	MALE CONNECTOR 1/4" NPT(M) X 8 MM OD 3000 lbs
110	2	90° ELBOW 1/2" SW 3000lbs
120	1	BULK HEAD UNION/COUPLING CL: 3000 LBS/ 1/2" NB-SW/AS PER ANSI B16.11
130	1	HALF COUPLING CL: 3000 LBS/ 1/2" NB-SW/ AS PER ANSI B16.11

SERVICE : CONDENSER PRESSURE, INSTRUMENT AIR ETC.

PRELIMINARY
TENDER PURPOSE ONLY

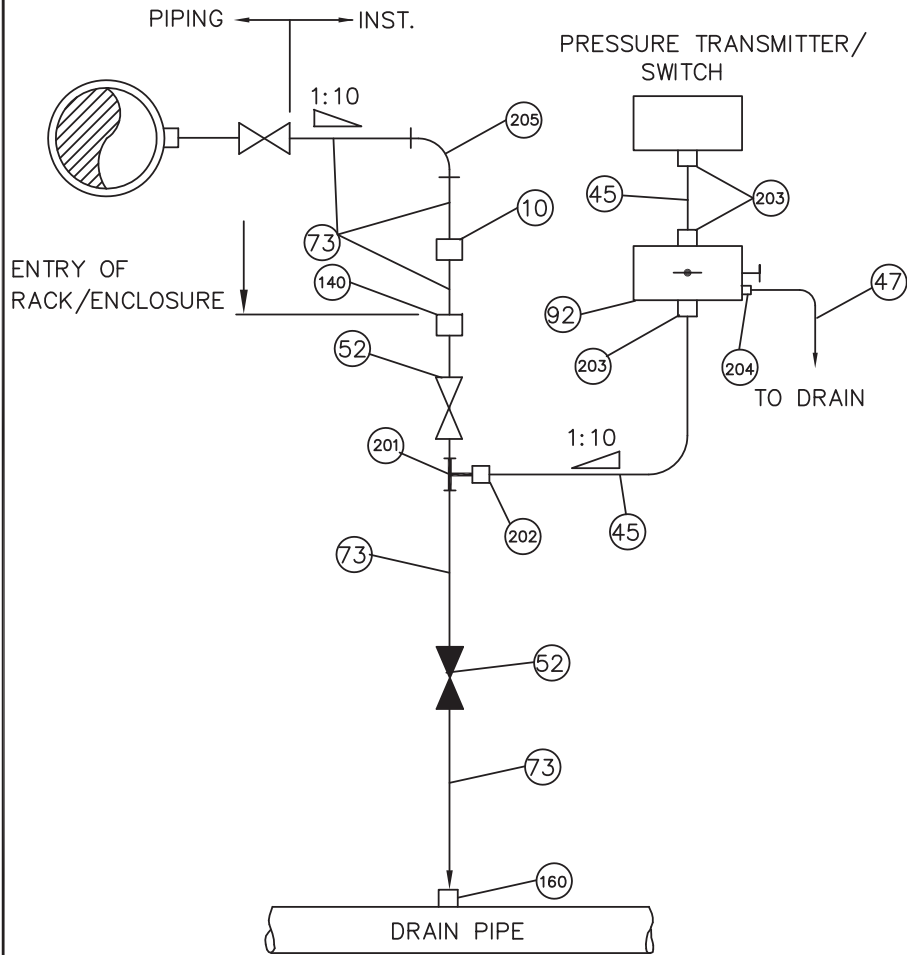
						TYPICAL INSTRUMENT INSTALLATION DIAGRAM		 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA · MUMBAI · CHENNAI · NEW DELHI		
						1x800MW SUPER CRITICAL THERMAL POWER PROJECT (UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)				
GP	AT	SD		0	21.04.10	GUJARAT STATE ELECTRICITY CORPORATION LIMITED VADODARA, GUJARAT		JOB NO. DCPL-K9213R	SCALE NIL	SHT. 3 OF 20
APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE			DWG. NO. K9213R-DWG-I-0060		REV. 0

A4_H (08-'06) [297 x 210]

456 of 574

K9213-DWG-I-0060-3-20-REV-0

**PRESSURE TRANSMITTER/PRESSURE SWITCH
MOUNTED BELOW SOURCE POINT**



BILL OF MATERIAL		
ITEM NO.	QTY./INST	DESCRIPTION
201	1	EQUAL TEE (FEMALE) 1/2" SW 6000lbs
202	1	MALE CONNECTOR 1/2" PE 1/2" OD 6000 lbs
52	2	GLOBE VALVES 1/2" SW 600lbs
45	3 Mtrs	TUBE 1/2" OD 2.1 MM THICK
203	3	MALE CONNECTOR 1/2" NPT(M) X 1/2" OD 6000 lbs
73	15Mtrs.	IMPULSE PIPE 15 NB GR.B SCH 80
92	1	2 VALVES MANIFOLD 1/2" NPT(F)
10	1	FULL COUPLING 1/2" SW 6000lbs
47	0.15Mtrs	TUBE 8 MM OD 1.0 MM THICK
204	1	MALE CONNECTOR 1/4" NPT(M) X 8 MM OD 6000 lbs
205	1	90° ELBOW 1/2" SW 6000lbs
140	1	BULK HEAD UNION/COUPLING CL:6000 LBS/ 1/2" NB-SW AS PER ANSI B16.11
160	1	HALF COUPLING CL:6000 LBS/ 1/2" NB-SW AS PER ANSI B16.11

SERVICE : CONDENSATE, FEED WATER ETC.

PRELIMINARY
TENDER PURPOSE ONLY

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

1x800MW SUPER CRITICAL THERMAL POWER PROJECT
(UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT



DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS
KOLKATA · MUMBAI · CHENNAI · NEW DELHI

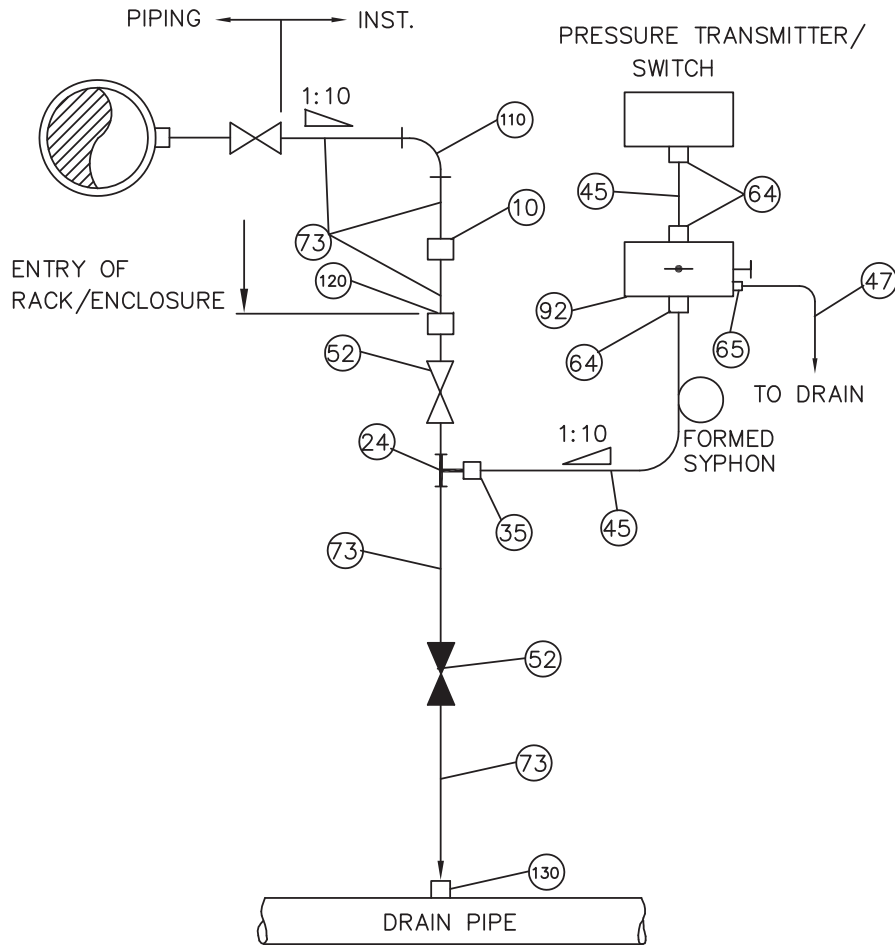
JOB NO. DCPL-K9213R | SCALE NIL | SHT. 4 OF 20

DWG. NO. K9213R-DWG-I-0060

REV. 0

GP	AT	SD	DESCRIPTION	REV.	DATE
				0	21.04.10
APPROVED	CHECKED	DRAWN			


**PRESSURE TRANSMITTER/PRESSURE SWITCH
MOUNTED BELOW SOURCE POINT(WITH SYPHON)**



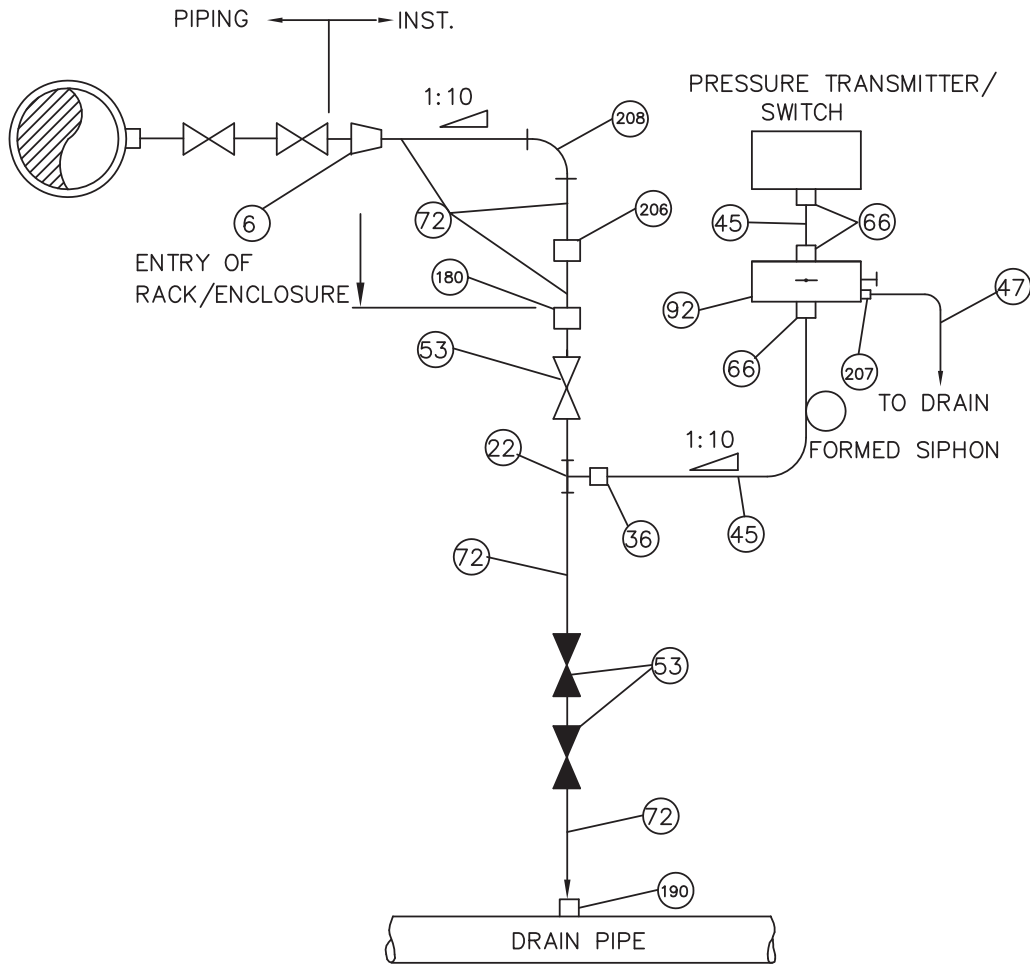
BILL OF MATERIAL		
ITEM NO.	QTY./INST.	DESCRIPTION
24	1	EQUAL TEE (FEMALE) 1/2" SW 3000lbs
35	1	MALE CONNECTOR 1/2" PE 1/2" OD 3000 lbs
52	2	GLOBE VALVES 1/2" SW 600lbs
45	3 Mtrs	TUBE 1/2" OD 2.1 MM THICK
64	3	MALE CONNECTOR 1/2" NPT(M) X 1/2" OD 3000 lbs
73	15Mtrs.	IMPULSE PIPE 15 NB SCH 80
92	1	2 VALVES MANIFOLD 1/2" NPT(F)
10	1	FULL COUPLING 1/2" SW 3000lbs
47	0.15Mtrs.	TUBE 8 MM OD 1.0 MM THICK
65	1	MALE CONNECTOR 1/4" NPT(M) X 8 MM OD 3000 lbs
110	1	90° ELBOW 1/2" SW 3000lbs
120	1	BULK HEAD UNION/COUPLING CL: 3000 LBS/ 1/2" NB-SW AS PER ANSI B16.11
130	1	HALF COUPLING CL: 3000 LBS/ 1/2" NB-SW AS PER ANSI B16.11

SERVICE : LOW PRESSURE STEAM

PRELIMINARY
TENDER PURPOSE ONLY

						TYPICAL INSTRUMENT INSTALLATION DIAGRAM		 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA · MUMBAI · CHENNAI · NEW DELHI		
						1x800MW SUPER CRITICAL THERMAL POWER PROJECT (UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)				
GP	AT	SD		0	21.04.10	GUJARAT STATE ELECTRICITY CORPORATION LIMITED		JOB NO. DCPL-K9213R	SCALE NIL	SHT. 5 OF 20
APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE	VADODARA, GUJARAT		DWG. NO. K9213R-DWG-I-0060		REV. 0

PRESSURE TRANSMITTER/PRESSURE SWITCH
MOUNTED BELOW SOURCE POINT(WITH CONDENSATE POT)



BILL OF MATERIAL		
ITEM NO.	QTY./INST	DESCRIPTION
6	1	REDUCER 1"SW X 1/2"SW 9000lbs
22	1	EQUAL TEE (FEMALE)1/2" SW 9000lbs
36	1	MALE CONNECTOR 1/2" PE X 1/2" OD 9000 lbs
53	3	GLOBE VALVES 1/2" SW 1500 lbs
45	3 Mtrs	TUBE 1/2" OD 2.1 MM THICK
66	3	MALE CONNECTOR 1/2" NPT(M) X 1/2" OD 9000 lbs
72	15Mtrs	IMPULSE PIPE 15 NB SCH. 80
92	1	2 VALVES MANIFOLD 1/2" NPT(F)
206	1	FULL COUPLING 1/2" SW 9000lbs
47	0.15Mtrs	TUBE 8 MM OD 1.0 MM THICK
207	1	MALE CONNECTOR 1/4" NPT(M) X 8 MM OD 9000 lbs
180	1	BULK HEAD UNION/COUPLING CL: 9000 LBS- AS PER ANSI B16.11, 1/2" NB-SW
190	1	HALF COUPLING CL: 9000LBS/ 1/2" NB-SW AS PER ANSI B16.11
208	1	90° ELBOW 1/2" SW CL: 9000 lbs

SERVICE : MEDIUM & HIGH PRESSURE STEAM

PRELIMINARY
TENDER PURPOSE ONLY

GP	AT	SD	DESCRIPTION	REV.	DATE
				0	21.04.10
APPROVED	CHECKED	DRAWN			

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

1x800MW SUPER CRITICAL THERMAL POWER PROJECT
(UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)

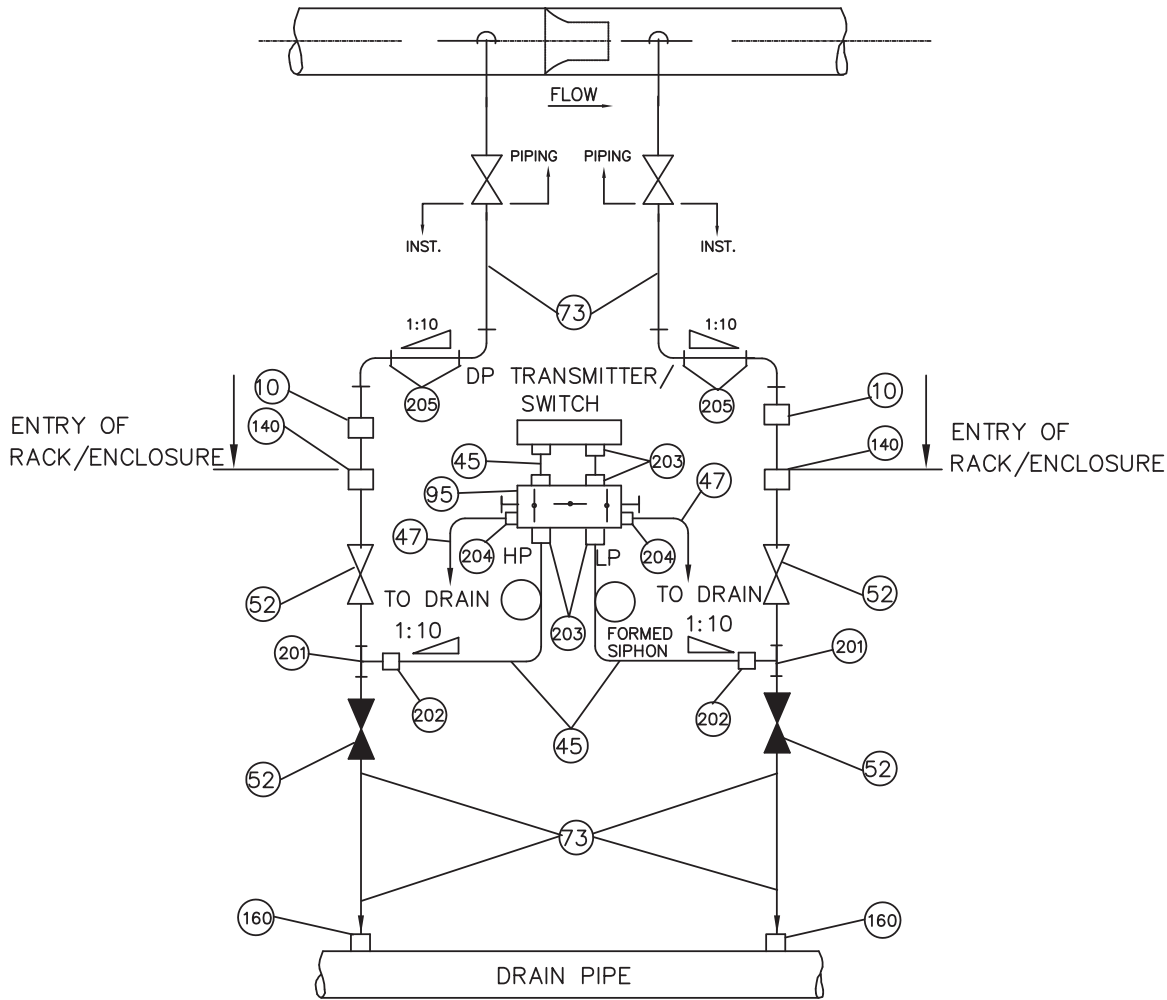
GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT



DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS
 KOLKATA · MUMBAI · CHENNAI · NEW DELHI

JOB NO. DCPL-K9213R SCALE NIL SHT. 6 OF 20
 DWG. NO. K9213R-DWG-I-0060 REV. 0

**DIFF. PRESS. TRANSMITTER/DIFF. PRESS. SWITCH
MOUNTED BELOW SOURCE POINT**



BILL OF MATERIAL		
ITEM NO.	QTY./INST	DESCRIPTION
201	2	EQUAL TEE (FEMALE) 1/2" SW 6000lbs
202	2	MALE CONNECTOR 1/2" PE X 1/2" OD 6000 lbs
52	4	GLOBE VALVES 1/2" SW 600lbs
45	6 Mtrs	TUBE 1/2" OD 2.1 MM THICK
203	6	MALE CONNECTOR 1/2" NPT(M) X 1/2" OD 6000 lbs
73	30Mtrs	IMPULSE PIPE 15 NB GR.B SCH 80
95	1	5 VALVE MANIFOLD 1/2" NPT(F)
10	2	FULL COUPLING 1/2" SW 6000lbs
47	0.3Mtrs	TUBE 8 MM OD 1.0 MM THICK
204	2	MALE CONNECTOR 1/4" NPT(M) X 8 MM OD 6000 lbs
205	4	90° ELBOW 1/2" SW 6000lbs
140	2	BULK HEAD UNION/COUPLING CL: 6000 LBS/ 1/2" NB-SW AS PER ANSI B16.11
160	2	HALF COUPLING CL: 6000 LBS/ 1/2" NB-SW AS PER ANSI B16.11

SERVICE : CONDENSATE, FEED WATER ETC.

PRIMARY ELEMENT : FLOW NOZZLE/ORIFICE

PRELIMINARY
TENDER PURPOSE ONLY

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

1x800MW SUPER CRITICAL THERMAL POWER PROJECT
(UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

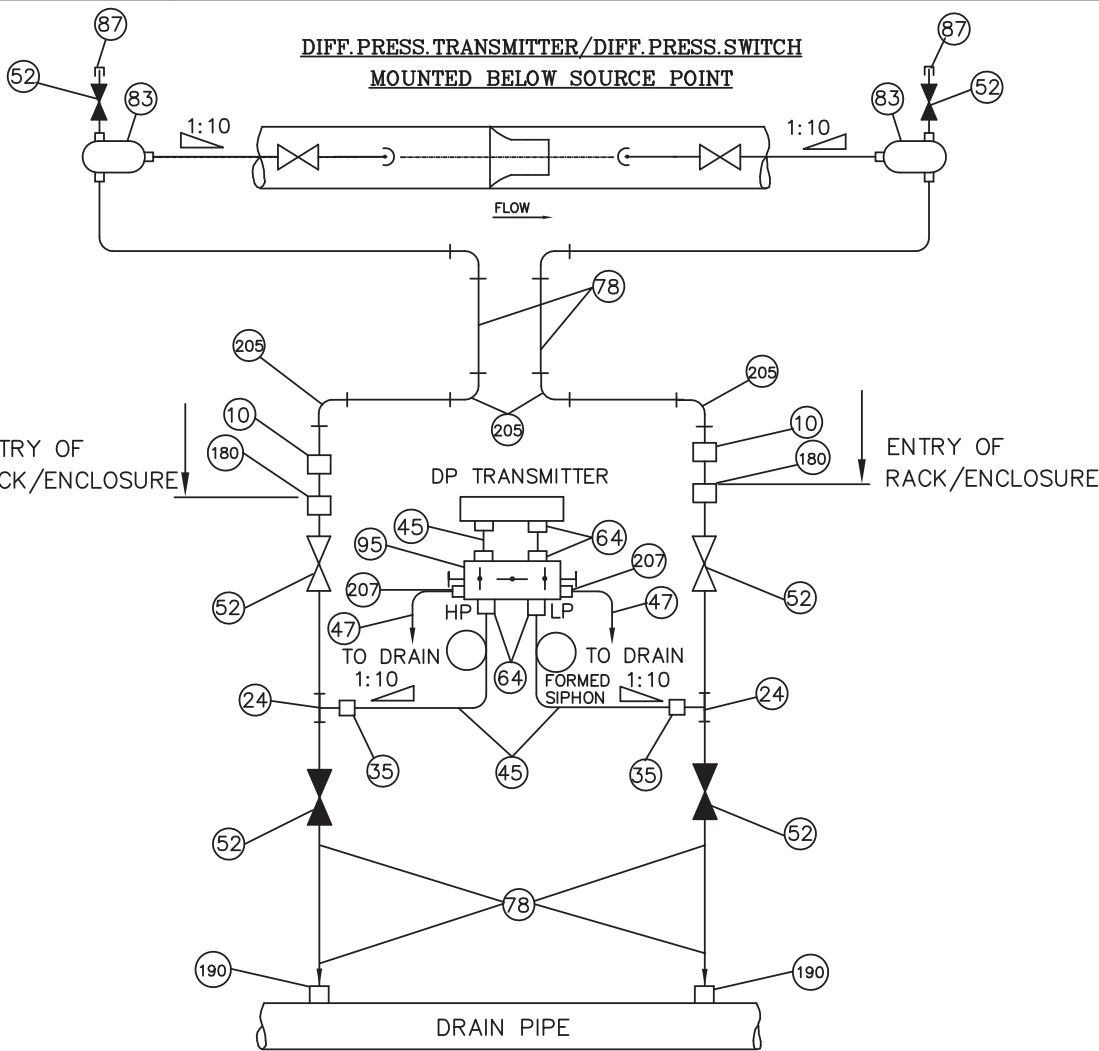


DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS
KOLKATA · MUMBAI · CHENNAI · NEW DELHI

JOB NO. DCPL-K9213R SCALE NIL SHT. 7 OF 20

DWG. NO. K9213R-DWG-I-0060 REV. 0

GP	AT	SD		0	21.04.10
APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE




BILL OF MATERIAL		
ITEM NO.	QTY./INST.	DESCRIPTION
24	2	EQUAL TEE (FEMALE) 1/2" SW 9000lbs
35	2	MALE CONNECTOR 1/2" PE X 1/2" OD 9000 lbs
52	6	GLOBE VALVES 1/2" SW 600lbs
45	6Mtrs.	TUBE 1/2" OD 2.1 MM THICK
64	6	MALE CONNECTOR 1/2" NPT(M) X 1/2" OD 9000 lbs
78	30Mtrs	IMPULSE PIPE 15 NB SCH 80
95	1	5 VALVES MANIFOLD 1/2" NPT(F)
10	2	FULL COUPLING 1/2" SW 9000lbs
83	2	CONDENSATION POT 1/2" SW NPT(F) 9000 lbs
87	2	PLUG 1/2" NPT(F) 9000lbs
47	0.3Mtrs	TUBE 8 MM OD 1.0 MM THICK
207	2	MALE CONNECTOR 1/4" NPT(M) X 8 MM OD 9000 lbs
205	6	90° ELBOW 1/2" SW 9000lbs
180	2	BULK HEAD UNION/COUPLING CL:9000 LBS-AS PER ANSI B16.11, 1/2" NB-SW
190	2	HALF COUPLING CL:9000 LBS/ 1/2" NB-SW AS PER ANSI B16.11

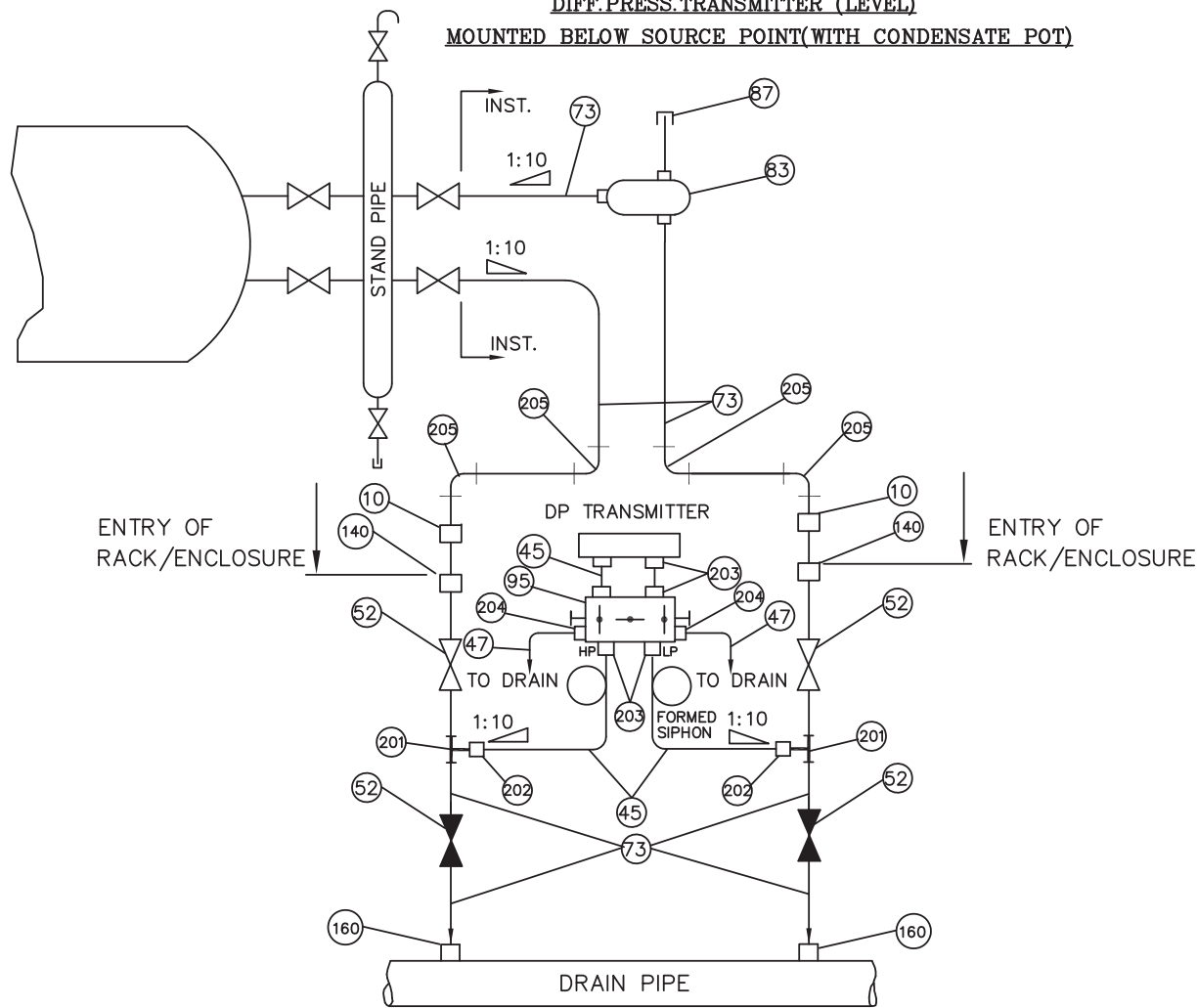
SERVICE : STEAM

PRIMARY ELEMENT : FLOW NOZZLE/ORIFICE

PRELIMINARY
TENDER PURPOSE ONLY

TYPICAL INSTRUMENT INSTALLATION DIAGRAM						 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA · MUMBAI · CHENNAI · NEW DELHI
GP	AT	SD	0	21.04.10		
APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE	1x800MW SUPER CRITICAL THERMAL POWER PROJECT (UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT) GUJARAT STATE ELECTRICITY CORPORATION LIMITED VADODARA, GUJARAT
						JOB NO. DCPL-K9213R SCALE NIL SHT. 8 OF 20 DWG. NO. K9213R-DWG-I-0060 REV. 0


**DIFF. PRESS. TRANSMITTER (LEVEL)
MOUNTED BELOW SOURCE POINT(WITH CONDENSATE POT)**



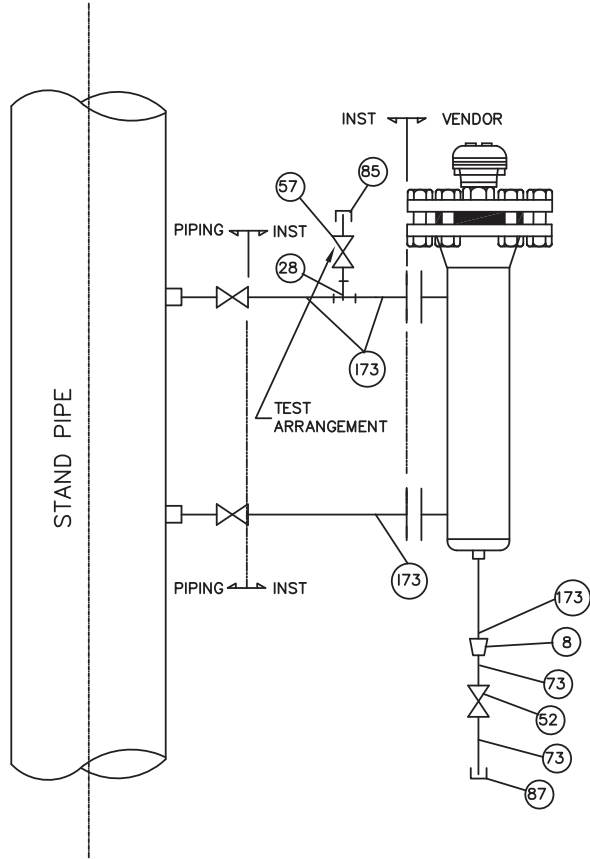
BILL OF MATERIAL		
ITEM NO.	QTY./INST	DESCRIPTION
201	2	EQUAL TEE (FEMALE) 1/2" SW 6000lbs
202	2	MALE CONNECTOR 1/2" PE X 1/2" OD 6000 lbs
52	4	GLOBE VALVES 1/2" SW 600lbs
45	6Mtrs.	TUBE 1/2" OD 2.1 MM THICK
203	6	MALE CONNECTOR 1/2" NPT(M) X 1/2" OD 6000 lbs
73	30Mtrs	IMPULSE PIPE 15 NB SCH 80
95	1	5 VALVES MANIFOLD 1/2" NPT(F)
10	2	FULL COUPLING 1/2" SW 6000lbs
83	1	CONDENSATE POT 1/2" SW 6000lbs
87	1	PLUG 1/2" NPT(M) 6000lbs
205	4	90° ELBOW 1/2" SW 6000lbs
47	0.3Mtrs	TUBE 8 MM OD 1.0 MM THICK
204	2	MALE CONNECTOR 1/4" NPT(M) X 8 MM OD 6000 lbs
140	2	BULK HEAD UNION/COUPLING CL:6000 LBS-AS PER ANSI B16.11, 1/2" NB-SW
160	2	HALF COUPLING CL:6000 LBS/ 1/2" NB-SW AS PER ANSI B16.11

SERVICE : BOILER DRUM, DEAERATOR, HEATERS

PRELIMINARY
TENDER PURPOSE ONLY

TYPICAL INSTRUMENT INSTALLATION DIAGRAM						 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA · MUMBAI · CHENNAI · NEW DELHI
GP	AT	SD	0	21.04.10	1x800MW SUPER CRITICAL THERMAL POWER PROJECT (UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)	
APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE	JOB NO. DCPL-K9213R SCALE NIL SHT. 9 OF 20 DWG. NO. K9213R-DWG-I-0060 REV. 0
GUJARAT STATE ELECTRICITY CORPORATION LIMITED VADODARA, GUJARAT						

FLOAT OPERATED LEVEL SWITCH




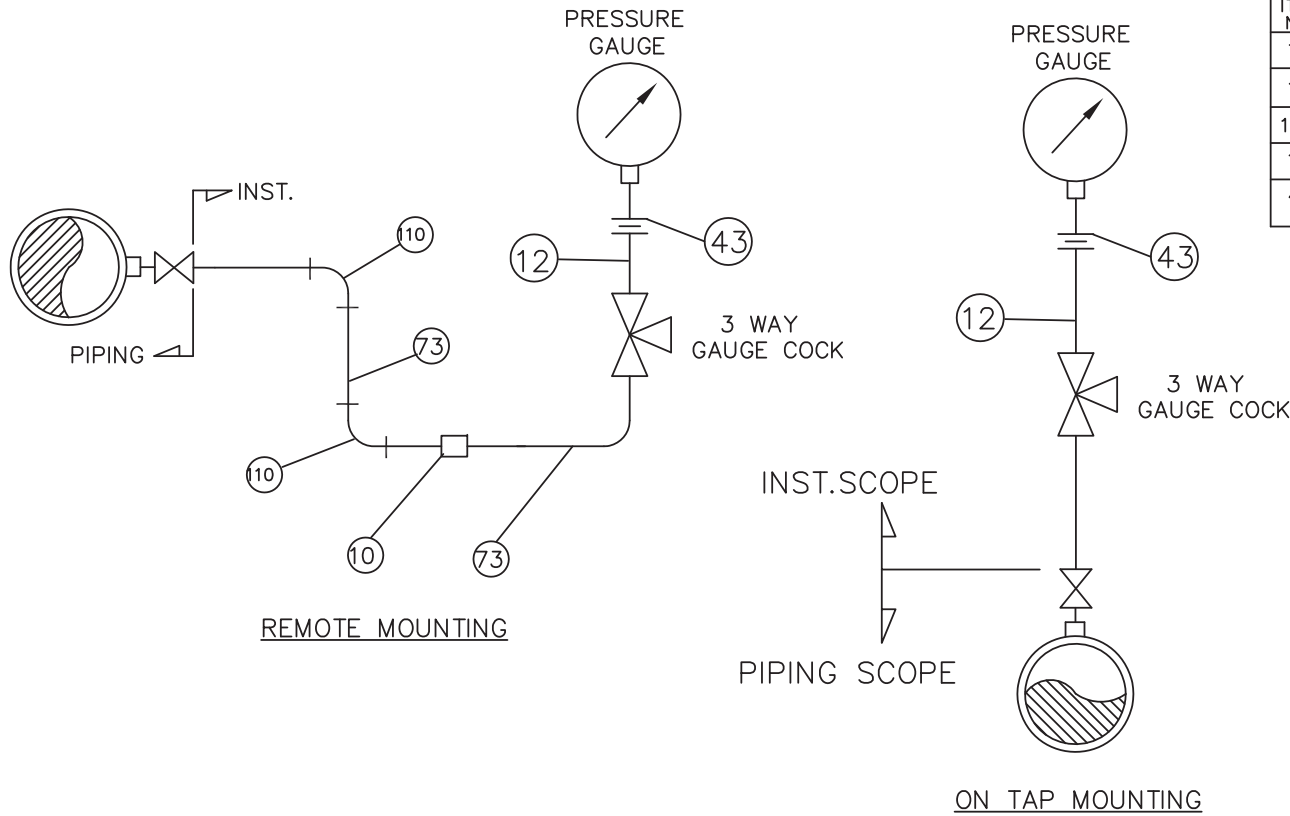
BILL OF MATERIALS		
ITEM NO	QTY/ INST	DESCRIPTION
52	1	GLOBE VALVE 1/2" SW 600lbs
73	0.5Mtrs	IMPULSE PIPE 15 NB SCH.80
87	1	PULG 1/2" NPT(M) 3000lbs
28	2	EQUAL TEE (FEMALE) 1" SW 3000lbs
173	1 Mtrs	IMPULSE PIPE 25 NB SCH.80
8	1	REDUCER 1" SW X 1/2" SW 3000lbs
57	1	GLOBE VALVE 1" SW 600 lbs
85	1	PLUG 1" NPT(F) 3000 lbs

SERVICE : CONDENSATE

PRELIMINARY
TENDER PURPOSE ONLY

A4_H (08-'06) [297 x 210]


						TYPICAL INSTRUMENT INSTALLATION DIAGRAM 1x800MW SUPER CRITICAL THERMAL POWER PROJECT (UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)	 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA · MUMBAI · CHENNAI · NEW DELHI	JOB NO. DCPL-K9213R		SCALE NIL	SHT. 10 OF 20
GP	AT	SD		0	21.04.10			GUJARAT STATE ELECTRICITY CORPORATION LIMITED VADODARA, GUJARAT	DWG. NO. K9213R-DWG-I-0060		REV. 0
APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE						



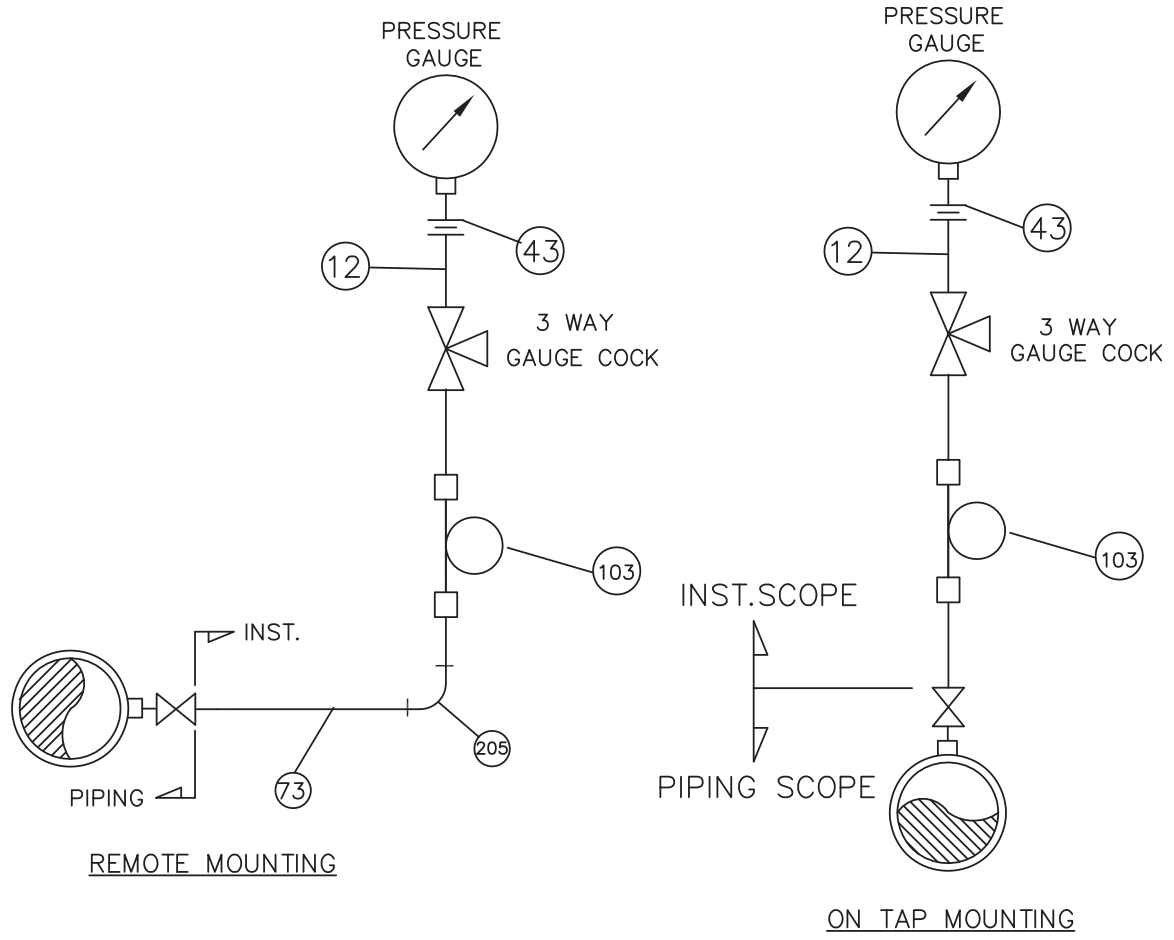
BILL OF MATERIAL		
ITEM NO.	QTY./INST	DESCRIPTION
73	15Mtrs	IMPULSE PIPE 15 NB SCH.80
10	1	FULL COUPLING 1/2" SW 3000lbs
110	2	90° ELBOW 1/2" SW 3000lbs
12	1	1/2" NPT(M) X 1/2" PE 4" LONG NIPPLE
43	1	NUT & TAIL FITTING WITH CU WASHER 1/2" NPT(F) X 1/2" PE

SERVICE : WATER, CONDENSATE ETC.

PRELIMINARY
TENDER PURPOSE ONLY

						TYPICAL INSTRUMENT INSTALLATION DIAGRAM		 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA · MUMBAI · CHENNAI · NEW DELHI		
						1x800MW SUPER CRITICAL THERMAL POWER PROJECT (UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)				
GP	AT	SD		0	21.04.10	GUJARAT STATE ELECTRICITY CORPORATION LIMITED		JOB NO. DCPL-K9213R	SCALE NIL	SHT. 11 OF 20
APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE	VADODARA, GUJARAT		DWG. NO. K9213R-DWG-I-0060		REV. 0


A4_H (08-'06) [297 x 210]



BILL OF MATERIAL		
ITEM NO.	QTY./INST.	DESCRIPTION
73	15Mtrs	IMPULSE PIPE 15 NB SCH.80
205	2	90° ELBOW 1/2" SW 6000lbs
12	1	1/2" NPT(M) X 1/2" PE 4" LONG NIPPLE
43	1	NUT & TAIL FITTING WITH SS WASHER 1/2"NPT(F) X 1/2" PE
103	1	SYPHON 1/2" OD SCH.80

SERVICE : STEAM, FEED WATER

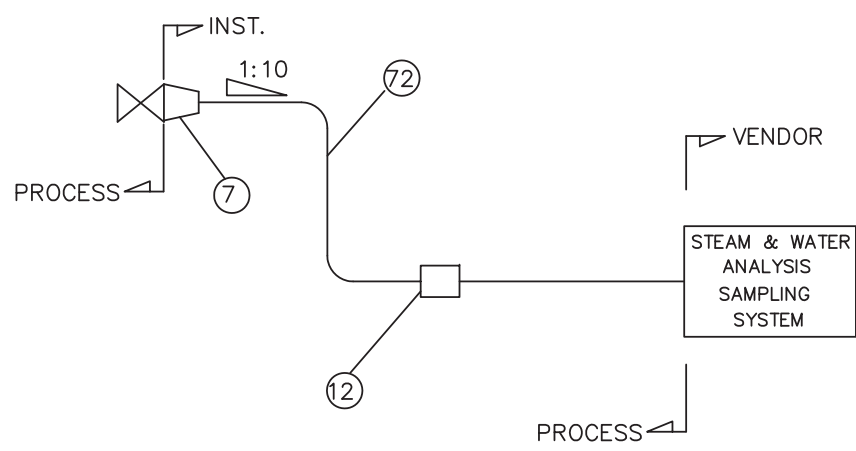
PRELIMINARY
TENDER PURPOSE ONLY

						TYPICAL INSTRUMENT INSTALLATION DIAGRAM		 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA · MUMBAI · CHENNAI · NEW DELHI
						1x800MW SUPER CRITICAL THERMAL POWER PROJECT (UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)		
GP	AT	SD		0	21.04.10	GUJARAT STATE ELECTRICITY CORPORATION LIMITED		JOB NO. DCPL-K9213R SCALE NIL SHT. 12 OF 20
APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE	VADODARA, GUJARAT		DWG. NO. K9213R-DWG-I-0060 REV. 0

465 of 574


K9213-DWG-I-0060-12-20-REV-0

A4_H (08-'06) [297 x 210]



BILL OF MATERIAL		
ITEM NO.	QTY./INST.	DESCRIPTION
12	1	FULL COUPLING 1/2" SW 6000 lbs
7	1	REDUCER 1" SW X 1/2" SW 6000 lbs
72	A/R	IMPULSE PIPE 15 NB SCH 80

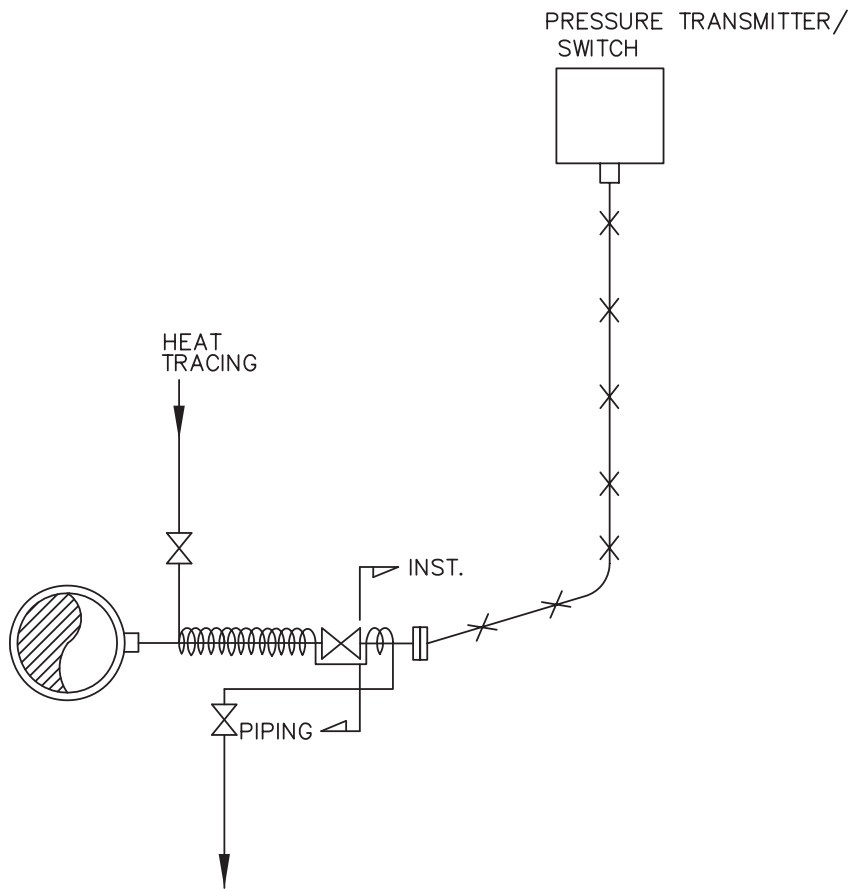
PRELIMINARY
TENDER PURPOSE ONLY

						<p>TYPICAL INSTRUMENT INSTALLATION DIAGRAM</p> <p>1x800MW SUPER CRITICAL THERMAL POWER PROJECT (UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)</p> <p>GUJARAT STATE ELECTRICITY CORPORATION LIMITED VADODARA, GUJARAT</p>		 <p>DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA · MUMBAI · CHENNAI · NEW DELHI</p>	
GP	AT	SD		0	21.04.10	<p>JOB NO. DCPL-K9213R SCALE NIL SHT. 13 OF 20</p>		<p>DWG. NO. K9213R-DWG-I-0060 REV. 0</p>	
APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE				


466 of 574

K9213-DWG-I-0060-13-20-REV-0

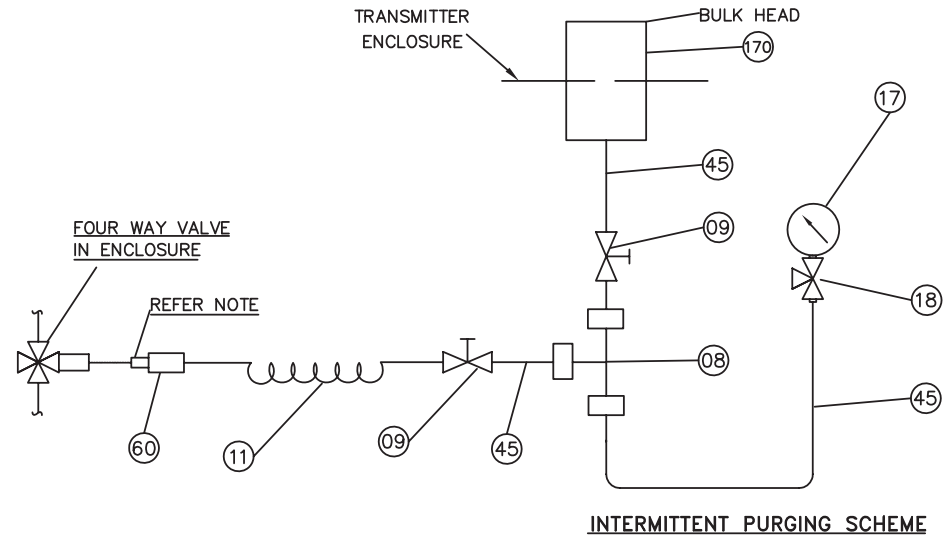
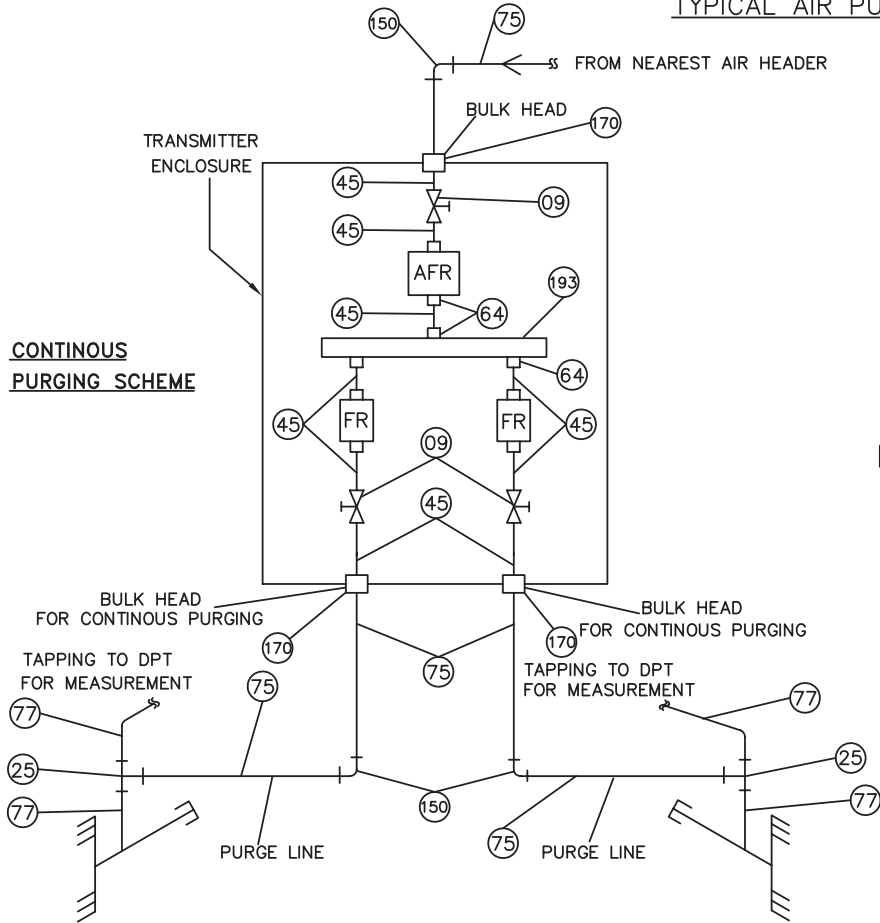
**PRESSURE TRANSMITTER/PRESSURE SWITCH
IN HFO SERVICE**



PRELIMINARY
TENDER PURPOSE ONLY

						TYPICAL INSTRUMENT INSTALLATION DIAGRAM		 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA · MUMBAI · CHENNAI · NEW DELHI		
						1x800MW SUPER CRITICAL THERMAL POWER PROJECT (UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)				
GP	AT	SD		0	21.04.10	GUJARAT STATE ELECTRICITY CORPORATION LIMITED VADODARA, GUJARAT		JOB NO. DCPL-K9213R	SCALE NIL	SHT. 14 OF 20
APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE			DWG. NO. K9213R-DWG-I-0060		REV. 0

TYPICAL AIR PURGING SCHEMES



NOTE:

QUICK DISCONNECTING FITTING IS CONNECTED TO FOUR WAY VALVE WHERE INTERMITTENT PURGING IS CALLED IN SCHEME.

FR—FLOW REGULATOR


CONTINUE TO SHT. NO. 16/20

PRELIMINARY
TENDER PURPOSE ONLY

A4_H (08-06) [297 x 210]


468 of 574

K9213-DWG-I-0060-15-20-REV-0

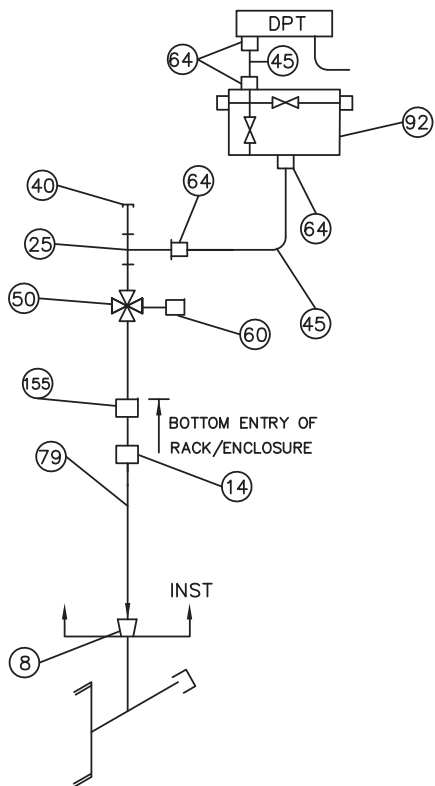
TYPICAL INSTRUMENT INSTALLATION DIAGRAM						 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA · MUMBAI · CHENNAI · NEW DELHI		
1x800MW SUPER CRITICAL THERMAL POWER PROJECT (UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)								
GP	AT	SD		0	21.04.10	JOB NO. DCPL-K9213R	SCALE NIL	SHT. 15 OF 20
APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE	GUJARAT STATE ELECTRICITY CORPORATION LIMITED VADODARA, GUJARAT	DWG. NO. K9213R-DWG-I-0060	REV. 0

BILL OF MATERIAL		
ITEM NO.	QTY./INST	DESCRIPTION
77	15Mtrs	IMPULSE PIPE 3/4" NB
75	A/R	GI PIPE/1/2" NB
25	2	FORGED UNEQUAL TEE/AS PER ANSI B16.11 SIZE: 2 X 3/4" NB SW X 1/2"NPTF/CL 3000
150	3	GALVANISED ELBOW CL 3000 SIZE: 1/2" NPTF
60	1	QUICK DISCONNECTING FITTING MALE/END CONN. TO SUIT 1/2" OD CONN.
11	A/R	NYLON NOSE TO SUIT 1/2" END CONN./Pr. TESTING 10 Kg/cm ²
45	A/R	SEAMLESS TUBE 1/2" OD TUBE X 2.1 MM THK.
170	3	BULK HEAD COUPLING TO SUIT 1/2" OD TUBE & 1/2" NB PIPE
09	5	BALL VALVETO SUIT 1/2" OD TUBE
64	9	MALE CONNECTOR 1/2" NPT(M) X 1/2" OD 3000lbs
193	1	INSTRUMENT AIR HEADER 1" NB PIPE
08	1	EQUAL TEE/SS 316/TO SUIT 1/2" OD TUBE.
17	1	Pr. GAUGE/4" DIAL SIZE/RANGE 0-10 Kg/cm ² CONNECTION 1/2" NPTM
18	1	3 WAY GAUGE 1/2"NPTF X TO SUIT 1/2" TUBE.

PRELIMINARY
TENDER PURPOSE ONLY

						TYPICAL INSTRUMENT INSTALLATION DIAGRAM		 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA · MUMBAI · CHENNAI · NEW DELHI		
						1x800MW SUPER CRITICAL THERMAL POWER PROJECT (UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)				
GP	AT	SD		0	21.04.10	GUJARAT STATE ELECTRICITY CORPORATION LIMITED VADODARA, GUJARAT		JOB NO. DCPL-K9213R	SCALE NIL	SHT. 16 OF 20
APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE			DWG. NO. K9213R-DWG-I-0060	REV. 0	

**DIFF. PRESSURE TRANSMITTER
MOUNTED ABOVE SOURCE POINT**




BILL OF MATERIAL		
ITEM NO.	QTY./INST	DESCRIPTION
8	1	REDUCER 1" BSPF X 3/4" NB-SW CL 3000
14	1	FORGED COUPLING 3/4" SW CL 3000/AS PER ANSI B16.11
25	1	FORGED UNEQUAL TEE AS PER ANSI B16.11 SIZE : 2 X 3/4" NB-SW X 1/2" NPTF/CL3000
40	1	NIPPLE & CAP 3/4" NB-SCH 80/CAP-3/4" NPTF
45	6 Mtrs.	SEAMLESS TUBE 1/2" OD X 2.1 MM THK.
50	1	FOUR WAY VALVE SIZE :(2 X 3/4" NB-SW)(2 X 1/2"NPTF) CL:800
60	1	QUICK DISCONNECTING FITTING SIZE:1/2"NPTM
64	3	MALE CONNECTOR /SS 316 1/2" NPT(M) X TO SUIT 1/2" OD TUBE
79	30Mtrs	SEAMLESS PIPE/3/4" NB SCH 80
92	1	2 VALVE MANIFOLD 1/2" NPT(F)
155	1	BULK HEAD COUPLING CL 3000 SIZE :3/4" SW /CL 3000/AS PER ANSI B16.11

SERVICE : FLUE GAS, PRIMARY AIR, SECONDARY AIR ETC.

NOTE : AIR PURGING ARRANGEMENT SHALL BE INCLUDED.

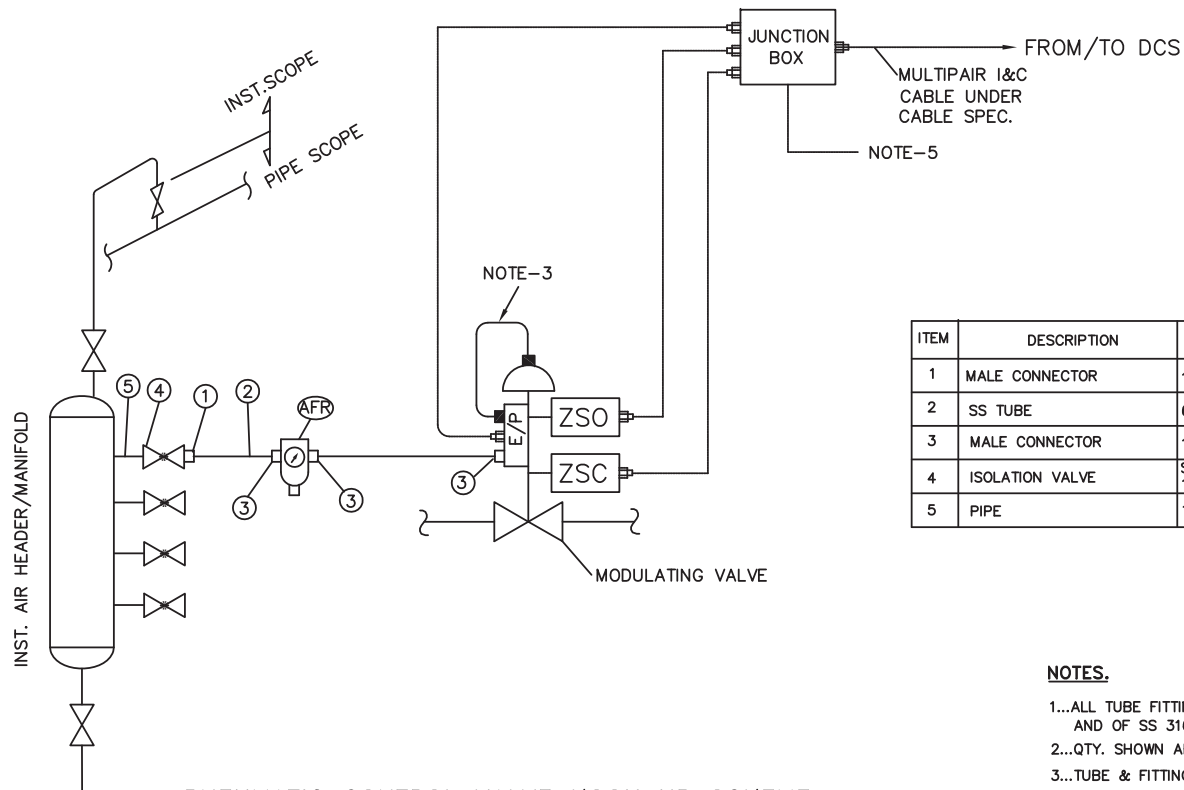
PRELIMINARY
TENDER PURPOSE ONLY

TYPICAL INSTRUMENT INSTALLATION DIAGRAM						 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA · MUMBAI · CHENNAI · NEW DELHI		
1x800MW SUPER CRITICAL THERMAL POWER PROJECT (UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)						JOB NO. DCPL-K9213R SCALE NIL SHT. 18 OF 20		
GP	AT	SD		0	21.04.10	GUJARAT STATE ELECTRICITY CORPORATION LIMITED VADODARA, GUJARAT		
APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE	DWG. NO. K9213R-DWG-I-0060		REV. 0

A4_H (08-'06) [297 x 210]

471 of 574

K9213-DWG-I-0060-18-20-REV-0



ITEM	DESCRIPTION	SPECIFICATION	QTY.	REMARKS
1	MALE CONNECTOR	1/2"NPT(M) X 6 mm OD COMPRN.	1	
2	SS TUBE	6 mm OD X 1 mm THK.	10 MTRS.	
3	MALE CONNECTOR	1/4"NPT(M) X 6 mm OD COMPRN.	3	
4	ISOLATION VALVE	SS BALL TYPE 600LBS 1/2" SW X 1/2" NPT(F)		
5	PIPE	1/2" NB SCH 40S	A/R	

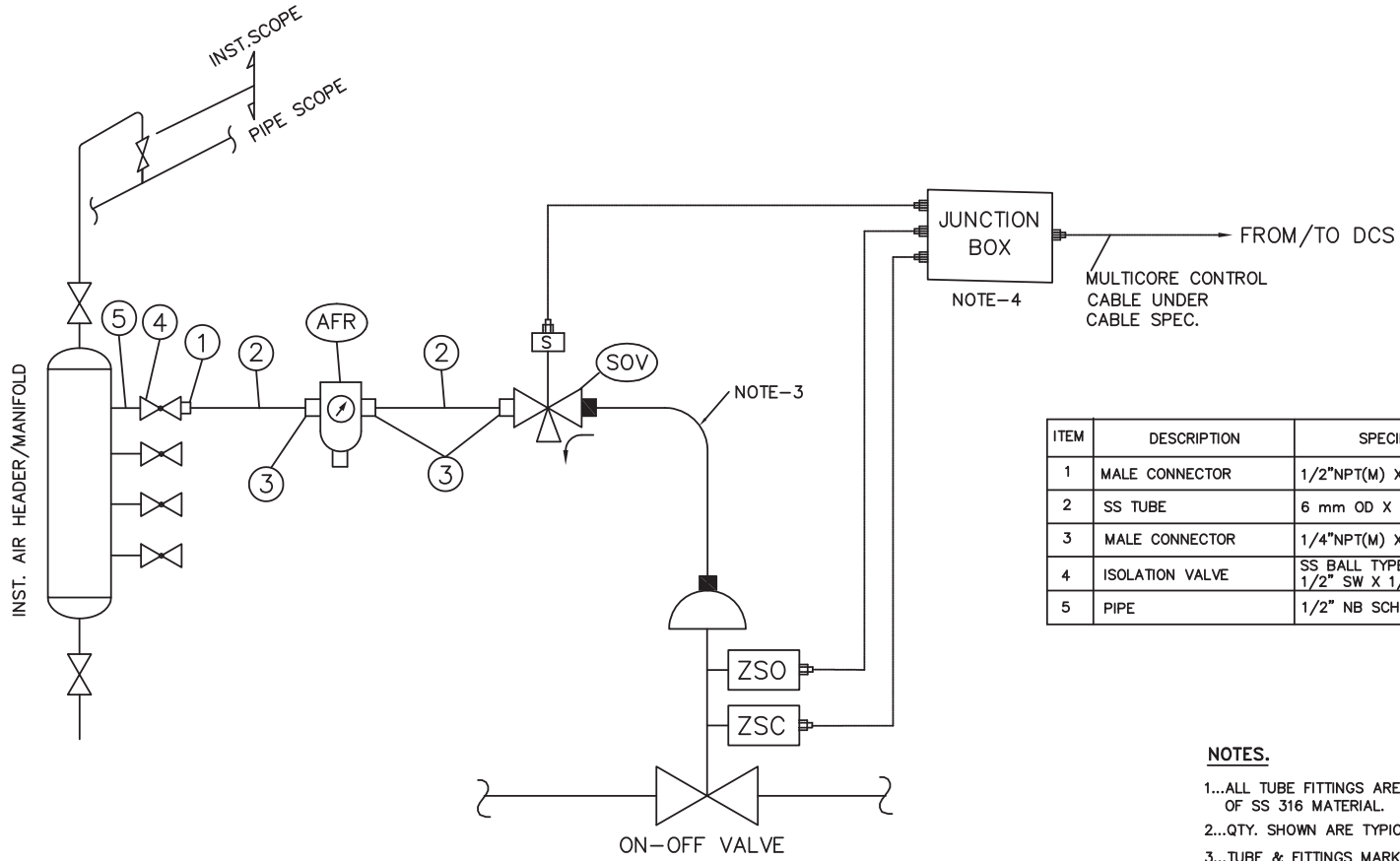
NOTES.

- 1...ALL TUBE FITTINGS ARE OF DOUBLE COMPRESSION TYPE AND OF SS 316 MATERIAL.
- 2...QTY. SHOWN ARE TYPICAL FOR ONE INSTALLATION ONLY.
- 3...TUBE & FITTINGS MARKED ■ ARE INTEGRAL TO THE VALVE.
- 4...LIMIT SWITCHES WILL BE CONNECTED WHEREVER APPLICABLE.
- 5...JUNCTION BOX WILL BE INTEGRAL TO ACTUATOR.
- 6...ISOLATION VALVE SHALL BE INSTALLED CLOSE TO THE VALVE ASSEMBLY.

PNEUMATIC CONTROL VALVE HOOK UP SCHEME

PRELIMINARY
TENDER PURPOSE ONLY

TYPICAL INSTRUMENT INSTALLATION DIAGRAM						DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA · MUMBAI · CHENNAI · NEW DELHI
1x800MW SUPER CRITICAL THERMAL POWER PROJECT (UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)						
GP	AT	SD		0	21.04.10	JOB NO. DCPL-K9213R SCALE NIL SHT. 19 OF 20 DWG. NO. K9213R-DWG-I-0060 REV. 0
APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE	
GUJARAT STATE ELECTRICITY CORPORATION LIMITED VADODARA, GUJARAT						



ITEM	DESCRIPTION	SPECIFICATION	QTY.	REMARKS
1	MALE CONNECTOR	1/2"NPT(M) X 6 mm OD COMPRN.	1	
2	SS TUBE	6 mm OD X 1.0 mm THK.	10 MTRS.	
3	MALE CONNECTOR	1/4"NPT(M) X 6 mm OD COMPRN.	3	
4	ISOLATION VALVE	SS BALL TYPE 600LBS 1/2" SW X 1/2" NPT(F)		
5	PIPE	1/2" NB SCH 40S	A/R	

NOTES.

- 1...ALL TUBE FITTINGS ARE OF DOUBLE COMPRESSION TYPE AND OF SS 316 MATERIAL.
- 2...QTY. SHOWN ARE TYPICAL FOR ONE INSTALLATION ONLY.
- 3...TUBE & FITTINGS MARKED ■ ARE INTEGRAL TO THE VALVE.
- 4...JUNCTION BOX WILL BE INTEGRAL TO ACTUATOR.
- 5...ISOLATION VALVE SHALL BE INSTALLED CLOSE TO THE VALVE ASSEMBLY.

PNEUMATIC SOV HOOK UP SCHEME

PRELIMINARY
TENDER PURPOSE ONLY

TYPICAL INSTRUMENT INSTALLATION DIAGRAM						DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA · MUMBAI · CHENNAI · NEW DELHI
1x800MW SUPER CRITICAL THERMAL POWER PROJECT (UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)						
GP	AT	SD		0	21.04.10	JOB NO. DCPL-K9213R SCALE NIL SHT. 20 OF 20
APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE	DWG. NO. K9213R-DWG-I-0060 REV. 0
GUJARAT STATE ELECTRICITY CORPORATION LIMITED VADODARA, GUJARAT						



**1X 800 MW GSECL WANAKBORI
COMPRESSED AIR SYSTEM**

STANDARD TECHNICAL SPECIFICATIONS

SPECIFICATION No: PE-TS-408-555 -A001

VOLUME: II B

SECTION : D

REV. 00

DATE: 14.08.2015

SECTION: D

STANDARD TECHNICAL SPECIFICATIONS



TITLE:

COMPRESSED AIR SYSTEM

**STANDARD TECHNICAL SPECIFICATION
FOR
COMPRESSED AIR SYSTEM**

SPECIFICATION NO. PE-TS-888-555-A001

VOLUME - IIB

SECTION-D



**BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NEW DELHI, INDIA**



**TECHNICAL
SPECIFICATION
COMPRESSED AIR SYSTEM**

SPECIFICATION NO. PE-SS-EPC-555-A-001

VOLUME II B

SECTION D

SUB-SECTION A8

REV. 0

SHEET 1 OF 14

INDEX

1. GENERAL.....	2
2. SYSTEM DESCRIPTION	2
3. DESIGN CRITERIA	2
4. OIL FREE MULTISTAGE SCREW TYPE COMPRESSORS.....	3
5. RECIPROCATING OIL FREE COMPRESSOR	6
6. AIR RECEIVERS.....	10
7. AIR DRYING PLANTS.....	11
8. INTER CONNECTING PIPING, FITTING AND VALVES.....	13
9. INSTRUMENTATION (GENERAL).....	14



**TECHNICAL
SPECIFICATION
COMPRESSED AIR SYSTEM**

SPECIFICATION NO. PE-SS-EPC-555-A-001

VOLUME II B

SECTION D

SUB-SECTION A8

REV. 0

SHEET 2 OF 14

1. GENERAL

1.1 This specification covers the design, manufacture, testing at Manufacturer's works, delivery to site, handling at site, installation, commissioning and carrying out acceptance tests and final painting at site of various equipment of the compressed air system, as specified hereinafter.

2. SYSTEM DESCRIPTION

2.1 The compressed air system shall consist of instrument air compressors & air drying plant (ADP), plant air compressors, air receivers, control panels interconnecting compressed air piping, cooling water piping, instrumentation and control.

2.2 The compressors shall be arranged such that all the plant air compressors shall supply air to the upstream (header of instrumentation air of each ADP through an isolation and a non-return valve so that in the event of failure of instrument air compressor, the instrument are in ensured at all time continuously.

3. DESIGN CRITERIA

3.1 The instrument air compressor will be designed to meet the instrument air requirements of all the equipments /plants/systems as specified elsewhere in the specification (excluding the compressed air requirement of Ash Handling Plant).

3.2 The Plant/Service air compressor will be designed to meet the plant/service air requirements of all the equipments / plants / systems as specified elsewhere in the specification (excluding the plant air requirement of Ash Handling Plant) or capacity be identical as that of the instrument air compressors whichever is higher.

3.3 Design margin of 25% is to be considered for IA & PA/SA requirement for sizing of the Instrument Air Compressor & Plant/Service Air Compressor.

3.4 Each compressor will be designed to deliver the nominal capacity at the required delivery pressure.

3.5 The compressors' capacity will be designed for 45⁰ C DBT and 75% RH

3.6 For Instrument Air, Delivery pressure will be 7.5 Kg/cm² (g) at ADP outlet.

3.7 For Plant / Service Air, Delivery pressure will be 8.0 Kg/cm² (g) at Compressor outlet.

3.8 Air compressors will be designed for continuous operation with high efficiency to satisfy the performance requirement.

3.9 The continuous motor rating (at 50⁰ C ambient) will be at least ten percent (10%) above the maximum load demand of the driven equipment under the entire operating range. When the driver is not directly coupled to the compressor, due consideration will be made for losses in power transmission, in addition to the above margin.

3.10 Velocity of air in the air piping shall be limited from 6 to 9 m/sec.

3.11 Velocity of water flow shall be limited to 2.5 m/sec and for gravity flow the same shall be limited to 1.5 m/sec.

3.12 For calculating friction loss in piping system: WILLIAM & HAZEN formula shall be used with C value as 100.



**TECHNICAL
SPECIFICATION
COMPRESSED AIR SYSTEM**

SPECIFICATION NO. PE-SS-EPC-555-A-001

VOLUME II B

SECTION D

SUB-SECTION A8

REV. 0

SHEET 3 OF 14

3.13 Noise level of compressors not to exceed 85 dBA to a reference of 0.0002 microbar when measured at a distance of 1.5 m above the floor in elevation and at a distance of 1 m horizontally from the nearest surface of compressor.

3.14 Compressors to be designed for Continuous, Load-Unload and On-Off mode operation.

3.15 Satisfactory operation in parallel shall be ensured without any uneven load sharing, undue vibration, noise etc.

4. OIL FREE MULTISTAGE SCREW TYPE COMPRESSORS

4.1 AIR COMPRESSOR SHALL COMPLY WITH THE FOLLOWING REQUIREMENTS.

4.1.1 Design / Construction

- i) Compression chamber Wall thickness to withstand maximum design pressure.
- ii) Casing with a large inlet port for fast filling and low air velocity.
- iii) To provide suitable arrangement for cleaning of the cooling water jackets during maintenance of compressor.
- iv) Dynamically balanced, one piece Rotors with asymmetric profile, to keep leakage losses to a minimum and ensure high efficiency.
- v) Rotor shaft mounted, oil lubricated, highly precise timing gear shall be designed to counter act the axial forces incurred in compression.
- vi) Life of Oil lubricated anti-friction type bearing be at least 8000 running hours.
- vii) Shaft Seals of floating restrictive ring type design.
- viii) The shaft seal rings and retainers shall be free for radial self-adjustment on the rotor shafts.
- ix) Minimum design service factor for the integral, oil lubricated type, step-up Gear Box shall be of 1.5.
- x) To provide safety valves on low pressure and high pressure stages.
- xi) A direct driven positive displacement type oil pump connection to the main drive shaft is preferred. Alternatively a separate motor driven oil pump be provided.
- xii) The lubrication system to include oil pump, oil filter, oil cooler and oil tank / sump.
- xiii) Cooling shall be by closed circuit Demineralised water.
- xiv) Compressor shall be directly coupled with constant speed squirrel cage induction motor conforming to the technical specification attached elsewhere.

4.1.2 Material of construction

The materials of various components shall conform to the applicable BIS / BS / ASTM / DIN standard or any other reputed standards.

- i) Compressor chamber: Cast iron coated with corrosion resistant material.
- ii) Rotors: Forged carbon steel coated with corrosion resistant material



**TECHNICAL
SPECIFICATION
COMPRESSED AIR SYSTEM**

SPECIFICATION NO. PE-SS-EPC-555-A-001

VOLUME II B

SECTION D

SUB-SECTION A8

REV. 0

SHEET 4 OF 14

- | | |
|---|-------------------------------------|
| iii) Timing Gear: | Low, Alloy Steel. |
| iv) Inlet throttle valve & Housing: | Aluminium |
| v) Shaft Seals: | High, Alloy Steel. |
| vi) Safety valves: | Brass |
| vii) Water separator: | Cast Iron |
| viii) Non-return valves: | Stainless steel spring loaded type. |
| ix) Blow off valve: | Stainless steel. |
| x) Unloading Cylinder header: | Aluminium |
| xi) Tube of Blow off cooler / oil cooler: | SS 304 |
| xii) Outer casing of coolers: | Carbon Steel |
| xiii) Gear box: | Cast Iron |
| xiv) Gears: | Alloy Steel. |

However, Material of Construction of components of Screw Compressor of reputed manufacturer shall also be acceptable subject to BHEL/Customer's approval.

4.1.3

Accessories

Each compressor skid to include Suction filter, silencer, intercooler & After cooler with moisture separators, automatic drain traps, instruments, control panel Base plate, coupling guard. Foundation bolt, nuts, anti vibration pads, Eye bolts and operation and maintenance tools.

4.1.4

Control Philosophy

- i. Each compressor be operatable under continuous, auto, "Load-Unload" or "On-Off" mode (i.e.) "Dual control modes".
- ii. Any of the compressors shall be selectable at control panel to operate either for Base duty (Auto Load-Unload) or Standby duty (Auto On-Off) operation.
- iii. In "Base duty" mode, whenever air supply from compressors exceeds the demand, control system shall:
 - a) Operate the load-unload circuit at a predetermined set pressure.
 - b) Throttle the inlet valve.
 - c) Open the blow off valve.

Unloaded compressors to run in idling mode and when system pressure drops due to more demand, the load-unload circuit shall operate again to bring the compressor to 100% load after closing the blow-off valve.

- iv. In "Stand-by" duty the compressor shall automatically assist base load compressors during periods of peak air demand. When air pressure in the system reaches a pre-set lower limit, compressor shall be started to unloaded condition. After a suitable time delay, the compressor shall be fully loaded.
- v. When the pressure in the system rises to pre-set high value, the compressor shall be unloaded and shall run in idling mode for a specific period, (set by a timer), the compressor may be loaded to; full load in case of drop in system



**TECHNICAL
SPECIFICATION
COMPRESSED AIR SYSTEM**

SPECIFICATION NO. PE-SS-EPC-555-A-001

VOLUME II B

SECTION D

SUB-SECTION A8

REV. 0

SHEET 5 OF 14

pressure or compressor may be stopped in case the system pressure does not drop and compressor continues to idle for more than a pre-set time.

- vi. The pressure and duration of time to be set shall be adjustable at site from the panel.
- vii. Further all interlocks for safe and proper operation of the compressors shall be provided by the Bidder.
- viii. All pressure and temperature conditions used for tripping the compressor shall be provided with pre-trip annunciation in the control panel.
- ix. Independent switches shall be used for alarms (annunciations) and tripping or interlock as far as possible.
- x. An electrically operated automatic valve shall be provided on cooling water supply line of each compressor which will automatically shut off the cooling water supply, in case compressor is not running for more than set time duration. Suitable interlock shall also be provided for opening the valve before starting of the compressor.

4.2 Intake Filter and Silencer

Intake Air Filter and Silencer shall be comply with the following requirements:

4.2.1

Performance

- i. Filtering efficiency minimum 99% down to 10 microns.
- ii. Maximum pressure drop across filter at design flow rate in new condition be 250 mm of water column.
- iii. Design Airflow rate corresponding to compressor airflow.

4.2.2

Quantity: One per compressor

4.2.3

Design air data

- i. Dust concentration: 30 mg / M³
- ii. Particle size in microns: Up to 10 microns

4.2.4

Type/Design: Heavy duty type

4.2.5

Construction

- i. To provide densely packed, replaceable type paper as filtering media.
- ii. Filter to be designed to have sound suppressing characteristics.
- iii. Preferably Filter and silencer be combined type.
- iv. Filter to take suction from outside not from compressor room.

4.3

Inter Cooler & After Cooler

Inter cooler and After cooler shall comply with the following requirements:

4.3.1

Performance

- i. Outlet temperature of air from intercooler to suit the equipment offered.
- ii. Outlet temperature of air After cooler to be limited to 10 Deg.C of inlet cooling water temperature.

4.3.2

Type: Shell and tube type

4.3.3

Construction

- i. Design code: TEMA class "C" or equivalent.



**TECHNICAL
SPECIFICATION
COMPRESSED AIR SYSTEM**

SPECIFICATION NO. PE-SS-EPC-555-A-001

VOLUME II B

SECTION D

SUB-SECTION A8

REV. 0

SHEET 6 OF 14

- ii. With removable tube bundle type.
- iii. With internal baffling.
- iv. Design pressure in airside: 2 Kg / Cm² more than air inlet pressure.
- v. Design pressure in waterside: Not less than shut off head of DM cooling water pump.

4.3.4

Material

- i. Tube : Admiralty brass or Aluminium brass or SS 304.
- ii. Shell : SA 285 Gr.C or equivalent
- iii. Tube sheet: SA 285 Gr.C or equivalent
- iv. Baffle : Carbon steel
- v. Flanges : Steel IS 2862.

4.3.5

Accessories

- i. To provide necessary vent & drain connections.
- ii. Moisture separation units with level gauge.
- iii. Automatic drain trap stations with bypass & isolating valves for moisture separators.
- iv. Safety valves
- v. Lifting eye bolts, tools & tackles if any.

4.3.6

Additional Data

After coolers are not to be fitted with instrument air compressors if bidder offers "Heat of compression" type air drying plants and the same shall be provided at down stream of ADP.

5.

RECIPROCATING OIL FREE COMPRESSOR

5.1

Each of the Compressors shall comprise but not be limited to the following:

5.1.1

LP and HP cylinders as required to meet the compressor rating, intercoolers, automatic drain trap station, relief valves and other accessories.

5.1.2

Drive machinery including drive motor and accessories.

5.1.3

Frame lubrication system, complete with protective devices and instruments.

5.1.4

After cooler and moisture separator both complete with automatic trap station, relief valves and other accessories and instruments .

5.1.5

Air intake filter and silencer unit

5.1.6

Set of local instruments as applicable

5.1.7

Set of cooling water control valves.

5.1.8

Set of foundation bolts, nuts etc. for compressors, motors, after coolers, suction filters etc.

5.1.9

Control panel comprising of all relays, contactors, solenoid valves, pressure switches, instruments, pneumatic impulse air tubing annunciation window selector switches etc.

5.1.10

Flow indicator of jacket cooling water after the inter and after coolers

5.1.11

Relief valves on the instrument and service air headers and also after the interconnection header between SA and IA headers.



**TECHNICAL
SPECIFICATION
COMPRESSED AIR SYSTEM**

SPECIFICATION NO. PE-SS-EPC-555-A-001

VOLUME II B

SECTION D

SUB-SECTION A8

REV. 0

SHEET 7 OF 14

- 5.1.12 Instruments like pressure / temperature gauges and switches as required for the following:-
- i. Pressure switches
 - a) Compressor lube oil pressure low alarm
 - b) Compressor lube oil pressure very low trip
 - c) To load the compressor
 - d) To unload the compressor
 - e) To start the compressor
 - f) To stop the compressor
 - g) Low water pressure alarm on common water inlet heater of the Compressor.
 - h) Very low water pressure trip on common water inlet heater of the Compressor.
 - ii. Temperature switches
 - a) Air after after-cooler high alarm
 - b) Air after after-cooler very high trip
 - c) Compressor cylinder water outlet temperature high alarm
 - d) Compressor cylinder water outlet temperature very high trip.
 - iii. Pressure gauges
 - a) After compressor inter-cooler
 - b) After compressor after-cooler
 - c) At water inlet common header of the compressors
 - iv. Temperature gauges
 - a) After cooler water outlet
 - b) After cooler air outlet
 - c) Inter cooler water inlet
 - d) Inter cooler air outlet
 - e) After air compressor cylinder jacket
- 5.1.13 Flow indicator of jacket cooling water after the inter and after coolers
- 5.1.14 Relief valves on the after coolers, intercoolers, instrument and service air headers and also after the inter connection headers between SA & IA headers, moisture separators etc.
- 5.1.15 Counter flanges, bolts, nuts and gaskets at all equipment/piping terminating points.
- 5.1.16 Base plate/plates, support plates, anchor bolts and nuts, inserts, lifting lugs, eye bolts, etc. as required.
- 5.1.17 Set of special tools and tackles including tools boxes.
- 5.1.18 Cleaning, protection and painting
- 5.1.19 Initial fill of lubricating oil for compressors and filtering media for all filters.



**TECHNICAL
SPECIFICATION
COMPRESSED AIR SYSTEM**

SPECIFICATION NO. PE-SS-EPC-555-A-001

VOLUME II B

SECTION D

SUB-SECTION A8

REV. 0

SHEET 8 OF 14

5.2 CONSTRUCTION FEATURES

5.2.1 Air Compressors

- i. Each compressor shall be multi stage, reciprocating, water cooled type. Compressor cylinder shall be closed grained cast Iron conforming to IS:210 FG 260 or equivalent. The cylinder shall be provided with renewable liners or recording allowance as per API-015, 1974. The crankshaft and connecting rods shall be of forged steel conforming to IS:1875 or equivalent and statically and dynamically balanced,. The service air compressors shall be lubricated / non lubricated type (as required in the data sheet A) whereas the instrument air compressors shall essentially be non lubricated type and the air delivered by these instrument air compressors shall be completely free of any oil, grease and other impurities. To ensure, this the piston rings shall be of Teflon and no lubricating oil shall be used in the cylinder. Special care shall be taken to prevent any oil from finding its way into the cylinders from the crank case.
- ii. The piston rod packing shall also be of oil less self lubricating type. Any oil adhering to the piston rod shall be wiped off by suitable water rings. Suitable collar may also be fixed in the piston rod so that any trickling oil flow can be stopped from movement towards the cylinder.
- iii. The intake filters with built in silencers shall be of dry reusable type located at the air intake connection to low pressure cylinder to remove any carried solid particles in air.
- iv. Crank case shall be of rugged construction and shall have openings for access to all crank case machinery. A level indicator shall be provided for all crank case oil sump.
- v. Each compressor shall be driven preferably by direct coupled electric motors or otherwise through 'V' belt drives. The drive shall be provided with a safety guard.
- vi. Flywheels shall be provided, if required, and shall be of adequate size to smoothen the effect of fluctuation of turning moment load during crank revolution.
- vii. Compressor valves shall have large effective areas permitting low velocities. In case of on lubricating type compressors, valves disc. Shall be either of stainless steel to AISI 316 or 15% chrome steel heat treated, tempered and ground. The valve seats and guards shall be case hardens and valve spring shall be of stainless steel. Self lubricating valve guides and wear strips shall be used for noiseless operation and long life. The tenderer shall offer his standard materials of construction for the valve for lubricated type of compressor.
- viii. To shut off cooling water flow through intercooler, compressor jacket and after coolers, operate lockable type gate valve (lockable in open position) shall be provided. These valves are to be shut off manually when required.
- ix. The crankshaft bearings shall be of antifricition type. A crankshaft driven positive displacement pump shall draw lubricating oil from the crankcase sump though a strained and shall provide for forced lubrication to all the bearings.
- x. The compressor lube oil pressure shall be built up with in a predetermined time (adjusted by a timer) failing which the compressor shall automatically trip.
- xi. Provision shall be made for lubricating the parts where ever necessary to ensure smooth operation and freedom from undue wear.
- xii. Gear boxes and oil bath shall be provided with filling and drain plug of adequate size and shall also be provided with visual level indicators. Provision shall be made for efficient lubrication of all bearings, including ball and roller bearings by the use of separate grease cups, self sealing nipples of oil baths. Housing of



**TECHNICAL
SPECIFICATION
COMPRESSED AIR SYSTEM**

SPECIFICATION NO. PE-SS-EPC-555-A-001

VOLUME II B

SECTION D

SUB-SECTION A8

REV. 0

SHEET 9 OF 14

ball and roller bearings shall be packed at the time of assembly. Necessary provision shall be made for preventing dust ingress into lubricated parts. A drawing showing all lubricant points and recommended lubrications to be used shall be supplied. The first fill of oil lubricant of correct grade shall be provided.

- xiii. All lubrication systems fittings on all equipment supplied shall wherever possible be standardised. The grease nipples shall be of button head type or approved equal and shall conform to IS:4009.
- xiv. The power ratings of the driver shall be selected such that the minimum margin of 15% is available over the power requirement to deliver rated capacity at rated pressure. When the drive is not directly coupled to the compressor, due account should be made for losses in power transmission in addition to the above margin. In case belt driven compressors, 5% belt loss should be considered over and above 15% spare margin in selecting the driven motor.

5.2.2

Inter Cooler, After Cooler and Moisture Separator

- i. The intercooler shall be provided between the low and high pressure stages of the compressor. The after coolers and moisture separator shall be located between the compressor discharge and air receiver. Volume bottles shall be provided at LP cylinder discharge end and HP cylinder suction and discharge ends to take care of the pulsation or air flow. Both intercooler and after cooler shall be water cooled complete with standard accessories, such as safety valves moisture separator and automatic drain trap, bypass arrangement for automatic drain trap. The equipment shall be complete with the instrument mentioned elsewhere in this specification included in the scope of work. The inter cooler and after cooler shall be designed with adequate margin in heat transfer area. For design purpose a cleanliness factor of 0.85 shall be used in both cases.
- ii. The after cooler shall be designed such that the temperature of air leaving is not more than 80 deg. C above the cooling water inlet temperature.
- iii. Following material of construction shall be used.
 - a) Shell: ASTM A-285 Gr. C or approved / Equal
 - b) Tubes: Copper as per BS-378 or admiralty brass to ASTM B-111 type B.
 - c) Moisture separator: Galvanised, to prevent corrosion Internal.
- iv. The lower portion of moisture separator shall be provided with the gauge glass. Pressure drop in intercooler, after-cooler & moisture separator, shall be kept to a minimum. Pressure parts shall be designed as per IS:2825 or as per ASME section VIII Div. 1 Design of coolers shall be as per TEMA class C.
- v. Both intercooler and after cooler shall preferably be standardised in regard to tube material, tube outside diameter & tube length.

5.2.3

Oil Separator

- i. In case compressed air is to be fed from the lubricated compressors to the pneumatic/control valves, then it would be desirable that the air is made oil free before it is fed to the pneumatic valves bypassing it through an air separator. (Please refer to data sheet A).
- ii. The oil separator shall be constructed from carbon steel in accordance with pressure vessel codes like ASME Section VIII Div. 1 or IS 2525. The design pressure of this same shall be indicated in Data Sheet A. The oil separator shall be able to remove the oil in the condensed form by impingement on a cartridge of synthetic wool to a degree as specified in Data Sheet A.
- iii. The design of the oil separator shall be such as to facilitate easy removal of the synthetic wool cartridge for cleaning. A drain valve shall also be provided.



**TECHNICAL
SPECIFICATION
COMPRESSED AIR SYSTEM**

SPECIFICATION NO. PE-SS-EPC-555-A-001

VOLUME II B

SECTION D

SUB-SECTION A8

REV. 0

SHEET 10 OF 14

- iv. The frequency at which the oil separator is to be drained and the time after which the synthetic wool should be either washed with a solvent or replaced shall be clearly indicated.

5.3 Control and Interlock Equipment

5.3.1 Compressor Capacity Control

- i. Control system for each compressor shall be to maintain receiver pressure within the specified limits by load unload Control” or on-off control” (i.e. dual control as per data sheet ‘A’ which are briefly described below:-
- ii. The loading/unloading of the compressor is to be actuated through pressure switches located on the outlet header of each compressor. The compressor(s), in this mode of control would run continuously at constant speed but would be loaded and unloaded in steps of 100, 50% and 0% by closing and opening of the respective suction valves. This is to be achieved by means of a selector switch, having two position viz “Auto” and ‘Mechanical’.
- iii. In the auto position the control will be through electro pneumatic means i.e. pressure switches while in the mechanical position, the control shall be through adjustable spring loaded mechanical governors.
- iv. Normally the selector switch for control for all the compressors will be in the ‘Auto’ position and the mechanical position is only a standby arrangement.
- v. Another selector switch is to be provided for selecting the duty of the compressor viz. ‘Main’ or ‘Standby’ Duty. Depending upon the position selected in this selector switch, the compressor will run as a main compressor or be a standby.
- vi. In the ON-OFF mode of capacity control the compressor will always be loaded except during starting. The compressor is started automatically when the discharge header pressure falls below the set value by the pressure switch. The compressor is stopped when the discharge header pressure reaches upper set limit on another pressure switch. The first start of compressor will however, be manual. In the event of tripping of compressor on fault or manually, the compressor will not start automatically until the fault is reset and started manually.

5.3.2 COMPRESSOR PROTECTION

The control panel shall house an audio visual alarm system for each compressor in order to ensure safe operation of the compressors and to bring their abnormal operation to the notice of the operator. The items to be annunciated for IA & SA compressors shall include but not be limited to the following:-

- a) Receiver pressure high alarm
- b) Receiver pressure very high trip
- c) Receiver pressure low alarm
- d) Compressor lube oil pressure low alarm
- e) Compressor lube oil pressure very low trip
- f) Air temperature after aftercooler high alarm
- g) Air temperature after after-cooler very high trip
- h) Compressor cylinder water outlet temperature high alarm
- i) Compressor cylinder water outlet temperature very high trip.

6. AIR RECEIVERS

Air receivers shall comply with the following requirements.



**TECHNICAL
SPECIFICATION
COMPRESSED AIR SYSTEM**

SPECIFICATION NO. PE-SS-EPC-555-A-001

VOLUME II B

SECTION D

SUB-SECTION A8

REV. 0

SHEET 11 OF 14

- 6.1.1 Design
- Design pressure & temperature : 10 Kg/cm² & 50 Deg.C.
 - Outdoor located, vertical cylindrical vessel.
 - Design code : ASME Sec. VIII Div 1 or IS:2825 & IS 7938.
 - Welded Construction : Longitudinal seam in adjacent sections shall not be in same line.
 - To provide gasketed inspection manhole of minimum 500 diameter.
Opening shall not pierce any seam & shall be as far as possible away from any welded seam.
- 6.1.2 Fabrication
- Welding as per relevant codes.
 - Filler material to have composition & structure as that of material welded.
 - Welding electrodes to be approved by Owner.
 - Electrodes to be dried before use.
- 6.1.3 Accessories
- To provide Relief valves to suit compressor capacity and set pressure of the same at least 10% above working pressure.
 - The spring in relief valve shall not reset for any pressure more than 10% above or below the design set pressure.
 - Drain connection with automatic trap stations.
- 6.1.4 Material
- Shell End plates & flanges --- IS:2002 or Equivalent.
- 7. AIR DRYING PLANTS**
- Air Drying plants shall comply with the following requirements:
- 7.1 Performance Requirements**
- 7.1.1 Normal flow rate: To match compressor capacity.
- 7.1.2 To be designed for continuous duty for dew point of outlet air at minus (-) 40 Deg.C at atmospheric pressure.
- 7.1.3 Quality of dry outlet air to conform to Instrument society of American standard S7.3 "Quality Standard for Instrument Air".
- 7.1.4 ADP to be placed upstream of the air receiver.
- 7.2 Quantity**
- 7.2.1 One ADP for each Instrument air compressor.
- 7.3 Type / Design**
- 7.3.1 "Heat of Compression type ADP" either "Conventional Type" or "Rotary Drum type".
- 7.3.2 Drying by absorption method.



**TECHNICAL
SPECIFICATION
COMPRESSED AIR SYSTEM**

SPECIFICATION NO. PE-SS-EPC-555-A-001

VOLUME II B

SECTION D

SUB-SECTION A8

REV. 0

SHEET 12 OF 14

7.4 Construction of Conventional heat of Compression type ADP


- 7.4.1 Reactivation shall be by "Heat of Compression" method without any air purge loss. Hot unsaturated compressed air shall be used for regeneration of exhausted dessicant in case of "Heat of compression type ADP".
- 7.4.2 With two absorber tower per ADP for conventional type (One for drying while the other is under regeneration / standby modes).
- 7.4.3 Design drying cycle: 8 Hours.
- 7.4.4 Design regeneration cycle: Less than 8 hours including cooling period.
- 7.4.5 Indoor located.
- 7.4.6 With (minimum) 3 steps de-pressurisation.
- 7.4.7 To provide automatic tower change over control with provision for manual take over.
- 7.4.8 All pressure vessels to be designed as per IS:2825 or equivalent code.
- 7.4.9 All vessels to include required manholes / harid holes.
- 7.4.10 All hot vessels & pipelines to be insulated to restrict the outside temperature within 60 Deg.C with mineral wool (or equivalent), GI wire netting and aluminium cladding / over.
- 7.4.11 Quantity of dessicant to be calculated taking into account residual moisture content at the end of regeneration cycle. Design calculation with curves shall be submitted for approval of Owner.
- 7.4.12 Absorption capacity and density to be considered for silica gel shall not be more than 10% and 550 Kg/M³ respectively. In case of activated alumina the same shall be 8% (max) and 900 Kg/M³ (max.) respectively.
- 7.4.13 Minimum 20% of dessicant depth shall be provided as free board in adsorber vessels.
- 7.4.14 Adsorber vessels to be provided with suitable number of inspection / sight windows of peresplex for observation of adsorbent condition.
- 7.4.15 Dessicant filling and removal connection shall be provided.
- 7.4.16 Non-lubricated two way three way / four way valves ball valves with pneumatic actuators be provided.
- 7.4.17 In case of Heat of compression type adsorbers shall be sized so that even when the compressor is operating at 50% capacity, complete regeneration shall be achieved within the cycle time.
- 7.4.18 Complete ADP equipments shall be preferably mounted on a skid.
- 7.4.19 Required sample connections in piping be provided for sampling of air at desired locations.

7.5 Accessories

- 7.5.1 Prefilters and After filters: 2x100% with automatic drain trap filter arrangement & with ceramic candle type elements.
- 7.5.2 Electric Heaters: 2x100% with thermostatic control for heater & facility for easy replacement of element.
- 7.5.3 To provide suitable solenoid valves for depressurisation and re pressurisation of towers.

7.6 Material

- 7.6.1 Absorber vessels & its internals: MS Vessels as per IS; 2062 & Internals SS 304

	TECHNICAL SPECIFICATION COMPRESSED AIR SYSTEM	SPECIFICATION NO. PE-SS-EPC-555-A-001	
		VOLUME II B	
		SECTION D	SUB-SECTION A8
		REV. 0	
		SHEET 14 OF 14	

- 8.1 All interconnecting compressed air piping shall conform to IS: 1239 (Heavy Grade) or IS: 3589 Gr. 410 and galvanised as per IS : 4736.
- 8.2 Fittings for air piping shall be conforming to IS: 1239/IS:1879 and Grade equivalent that of parent pipe Grade.
- 8.3 Compressed air piping from air compressor to after cooler and other lines handling hot air will be suitably insulated so as to restrict surface temperature to 60deg.C. The pipe joints will be screwed coupling type for sizes upto 50 NB and above 50 NB the same will be flanged.
- 8.4 All cooling water piping will be M.S. conforming to IS: 1239 (Part-I) (Heavy Grade).
- 8.5 For Air line Ball Valves with Stainless Steel internals with Teflon seat shall be provided. Ball valves upto 50 NB shall be of Forged Carbon Steel Body with screwed connections. Ball valves above 50 NB shall be of Cast Carbon Steel Body with flanged connections.
- 8.6 The check valves shall conform to IS: 3412.
- 8.7 For water line Gate valves shall be provided. For size 50 NB and smaller carrying water the same shall conform to IS:778 with gun metal body and trim and for above 50 NB with carbon steel body and internals.

9. INSTRUMENTATION (GENERAL)

- 9.1 Detailed specification for the Instrumentation shall be referred in the control and instrumentation section of this volume.
- 9.2 The bidder shall include instruments / controls to facilitate safe, reliable and efficient operation for the system offered. The instrumentation control system offered by the bidder shall be subjected to approval of the Employer during detailed engineering.
- 9.3 All Instrumentation and Control equipments required for Compressed air system such as primary and secondary instruments, control panels / cabinets, cable etc. shall meet the requirements specified in control and instrumentation section of the Volume.
- 9.4 The protection and interlock system shall be subject to the approval of the Employer.
- 9.5 All pressure and temperature conditions used for tripping the compressor shall be provided with pre-trip annunciation in the control panel.
- 9.6 Following general philosophy shall be followed regarding instrumentation.
- 9.6.1 Pressure Indicators / Vacuum gauge:
- i. At inlet outlet of each compression stage (air line).
 - ii. At inlet and outlet of cooling water header.
 - iii. At inlet and outlet of (air line) each heat exchangers of compressors & air drying plant (in air side).
 - iv. At inlet and outlet of each adsorber vessel.
 - v. At each air receiver and at outlet header of compressor & air drying plant.
 - vi. At inlet of each of the filters of compressors assembly and ADP system.



**TECHNICAL
SPECIFICATION
COMPRESSED AIR SYSTEM**

SPECIFICATION NO. PE-SS-EPC-555-A-001

VOLUME II B

SECTION D

SUB-SECTION A8

REV. 0

SHEET 15 OF 14

- 9.6.2 Pressure Switches (Individual for each function).
- i. At inlet/outlet of each compressor stage of the compressor (for annunciation / interlock).
 - ii. At each air receiver for:
 - a) High/Low pressure alarm, for start/stop control.
 - b) For load/unload control.
 - c) At common discharge outlet of compressor & air drying plant (for alarm)
 - iii. At discharge of each compressor.
- 9.6.3 Temperature Indicators
- i. At inlet and outlet of each heat exchangers / coolers of compressor and air-drying plant in the lube oil, air & cooling water circuits.
 - ii. At inlet and outlet of electric heaters & exhaust (atmosphere) of regeneration air (for open through type ADP).
 - iii. At inlet and outlet of each adsorber vessel.
 - iv. At common discharge outlet of compressor & ADP.
- 9.6.4 Temperature Switches / Temperature Controllers
- i. At inlet and outlet of each heat exchangers / coolers of compressor and air drying plant in the air & cooling water and lube oil circuits for low & high alarms, trip & interlock.
 - ii. At outlet of electric heaters & exhaust of regeneration air (open through type ADP) for alarm & interlock.
 - iii. At discharge of each compressors (before air receiver).
 - iv. At common discharge outlet of air compressors & air-drying plant.



**1 X 800 MW GSECL WANAKBORI TPS
COMPRESSED AIR SYSTEM
LIST OF MAKES OF SUB-VENDOR
ITEMS**

SPECIFICATION NO. PE-TS-408-555-A001

VOLUME : II B

SECTION : E

REV 00

DATE: 14.08.2015

ANNEXURE-I

LIST OF MAKES OF SUB-VENDOR ITEMS

SR. NO.	DETAILS OF EQUIPMENT/SYSTEM	FINAL APPROVED VENDOR
	MECHANICAL	
1	GATE/GLOBE/ CHECK VALVES	
	(A) CAST STEEL VALVES	FOURESS, L&T, LEADER, SAKHI,MACNEILL, MAGORE, CRESENT, GEETA , KBL, AV VALVE BOSS, AUDCO,WEIR BDK VALVES, WALTECH INDUSTRIE VALVES PVT. LTD., NSSL LIMITED, FLUIDLINE VALVES COMPANY PVT. LTD,INTERVALV (LTD.,STEEL STRONG VALVES (i) PVT.LTD., M/S GM ENGINEERING, VENUS PUMPS AND ENG WORKS, NITON VALVE INDUSTRIES PVT LTD,
	(B) FORGED STEEL VALVES	AUDCO, FOURESS, LEADER , KSB, BDK,HI -TECH, L&T,WEIR BDK VALVES, WALTECH INDUS V.K VALVES PVT. LTD., NSSL LIMITED, FLUIDLINE VALVES COMPANY PVT. LTD,INTERVALV INDIA) LTD.,STEEL STRONG VALVES (i) PVT.LTD., M/S GM ENGINEERING, VENUS PUMPS A ENGG. WORKS, NITON VALVE INDUSTRIES PVT LTD,
	(C) CAST IRON VALVES	FOURESS/ L&T/KIRLOSAR/BDK/LEADER/AV ENGG./VAAS/GALAXY/HAWA VALVES/LEVCON/BANKIM/I.M.ENGINEERS/H.SARKAR/AUDCO/SHIVA DURGA/UPADHYAY VA CRESCENT / OSCAR / AV VALVES/ SELTTEC/ GEETA/ IMET/ BOSS/LEADER VALVE
	(D) G. M.VALVES	LEADER / BOMBAY METAL / SANT / A.V. VALVES / GG / BDK/ AUDCO/ VAAS/ ILK / MIL/ FOURESS / JASH SCHUTTE, VALTECH INDUSTRIES, ATAM VALVES PVT LTD
	(E) SLEWING RING BEARING	FAG/SKF/ROTHERDE
	(F) BRONZE	LEADER, IMET, AV ENGG., BOSS
	(G) DUAL PLATE CHECK VALVE	ADVANCE, AUDCO, UPADHYAY, C&R, L&T
	(H) GENERAL (AS ABOVE)	SHANCO,BDK,H SARKAR,GALAXY, L&T
2	BALL VALVES	AKSONS, AKAY, CRESENT, BDK, FLUID LINE, AUDCO,KIRLOSAR,LEADER VALVES,KSB PUM L&T,MICROFINISH VALVES PVT LTD.,WEIR BDK VALVES-AUNIT OF WEIR INDIA PVT LTD.,A VALVES LTD, M/S GM ENGINEERING. ATAM VALVES PVT. LTD.
3	BUTTERFLY VALVE	FOURESS,GEETA,FLOVEL,L&T,CRESCENT,IL(PALGHAT),BARODA FLOWTECH,AUDCO,ADVANCE,KIRLOSAR,TYCO,KEYSTONE,MIL,FISHER SAN MAR,ISTRUMENTATION LTD,SUB VENDER --CRANE PROCESS,BDK,AUTAEM ,S.L, NEDFA WI TIELLING VALVES JOINT-STOCK CO. LTD.
4	SOLENOID VALVES	AVCON,ROTEX,ASCO,HERION,SIETZ,ADVANCE,BLUE STAR,NUCON,VELJAN HYDRAIR,SMC PNEUMATIC
5	MS PIPES / ERW(BLACK AND GALVANIZED)	ITC, SURYA ROSHNI, ZENITH, INDUS ,MAHARASHTRA TUBES, JINDAL, SAIL, AJANTA, HSL,GST,BST, JAIN TUBES, TATA, MAN INDUSTRIES,RATNAMANI
6	FORGE STEEL PIPES AND FITTINGS.	NITIN,TRUTEFORGE,TUBE PRODUCTS
7	STAINLESS STEEL PIPES	JINDAL, RATNAMANI, REMI
8	SITE FLOW INDICATOR	GREAVES COTTON , LEADER , MACMEIL , AV ENGG., LEVCON, AUTOMAT , ROTA INSTRUMENTS, EUREKA, FORBES MARSHALL, TRAC
9	PAINTING MATERIALS	BERGER ,SHALIMAR , ASIAN PAINTS, NEROLAC, JHONSON AND NICHOLSON,AKZO NOBEL
10	AIR DRYING PLANT	PACE, SABROE, ULTRATROC, INDCON, DHIR PNEUMATIC, MELLCON,ELGI / INGESSOLL RAND /KG KHOSLA/ CONSOLIDATED PNEUMATIC/ CHICAGO/DELAIR,TRIDENT,ACIL(MAKE SUBJECT TO CUSTOMER APPROVAL)
11	PRESSURE VESSELS, TANKS, AIR RECEIVERS.	SV ENGG. , PRAGATI ENGG., TEXMACO, ANUP , KANARA, VISHWAKARMA , SATGURU , VIRAT TRANS , HEAT TRANSFER,VIJAY FAB, BINNY ENG. LTD; TECHNOFAB, GMW, RAUNAQ
12	AUTO DRAIN VALVE IN AIR CIRCUIT	ULTRAFILTER,GREAVES
13	SB PR. REDUCING VALVE & CONTROL VALVE : HP	INSTRUMENTATION LTD; MIL CONTROLS LIMITED, FISHER SANMAR LIMITED, DRESSER VALVE INDIA PRIVATE LTD
	ELECTRICAL	
14	HT AC MOTORS	BHEL, CGL, GEC, ALSTOM,KIRLOSAR ELECTRIC CO; NGEF, SIEMENS, ABB, GE, HITACHI, TOSHIBA, LG,JYOTI LIMITED, MARATHON ELECTRICAL, ANSALOD (ITALY), MELCO (JAPAN)
15	LT AC MOTORS	ABB, CROMPTON GREAVES, ALSTOM INDUSTRIAL, GEC, KIRLOSAR ELECTRIC CO;NGEF, J SIEMENS, BHARAT BIJLEE LTD; LG , TOSHIBA, ANSALDO, GE, MELCO, MARATHON , BHEL
16	CABLE LUGS	DOWELLS,CHEटना ENGG,3D

17	CABLE GLAND	BRACO, COMET, CONTRACT, HARDWARE INDUSTRIES, ELECT ENG; LAPP
18	CABLE TRAYS	AV ENGINEERS, BARODA GALVANISERS, INDIANA, NIRMAL ENGG; PAREKH ENGINEERS, V. SADHNA, JAMNA METAL, RUKMANI ELECTRICAL & COMPONENTS PVT LTD, PATNY SYSTEMS LTD, PREMIER POWER PRODUCTS (CAL) PVT. LTD., RABI ENGINEERING WORKS PVT. LTD., UNITECH FABRICATORS and ENGINEERS PVT LTD, RATAN PROJECTS & ENGINEERING PVT. LTD., MAHESHWARI ELECTRICAL MFCS. PVT. LTD., INDIA ELECTRICALS SYNDICATE.
19	UPS	IL-JAIPUR, HI-REL-GANDHINAGAR, TATA, LIEBERT, DB ELECTRONICS, EMERSON, SOCOM GUTUR, FUJI / SIEMENS / APCARE, MERLIN GERIN, PTE/CHLORIDE-UK/GOUTOR/KELTRON
20	220 VOLT DC BATTERY	EMCO, EXIDE, SABMIFE, HBL-SABNIFE, FUJI LEAD AID -PLANTE BATTERY- EXCIDE. HOPPECKE BATTERIEN GMBH & CO.KG, NI-CD BATTERY, AMAR RAJA/HBL KNIFE/SAB KNIFE/FUJI/AMCO/SAFTSEALED MAINTENANCE FREE BATTERY, VRLA BATTERY.-EXCIDE./AMAR RAJA/HBL KNIFE/SAB KNIFE/FUJI/AMCO/SAFT
21	220 VOLT DC BATTERY CHARGER	CHHABI, MASS-TECH, AMARA RAJA POWER SYSTEM LTD., STATCON, SABNIFE, CALDYNE, KAYBEE, HBL, DUBAS, SABNIFE POWER SYSTEM, DB POWER ELECTRONICS, AUTOMATIC ELECTRIC LTD./ HBL-NIFE/ HIND RECTIFIES/ DUBAS ENGG. CHLORIDE POWER SYSTEM AND SOLUTION LTD, KOLKATA. JEMA ENERGY, LASARTE-ORIYA
22	MARSHALLING KIOSKS/JB	CONTROLS & SWITCHGEAR; ANDREW YULESPACEAGE SWITCHGEAR; BCH; ENTERPRISING ENGINEERS; MIKA ELECTROCONTROLS;
23	ACDB/DCDB/MLDB	L N T, HAVELLS/PYROTECH, MDS/INDU. SWGR./C&S/, SIEMENS/ALSTOM/GE POWER/CONTRC & SWITCHGEAR
CONTROL & INSTRUMENTATION		
24	PRESSURE SWITCHES	SWITZER, INDFOSS, DELTA, UK, DRESSER, USA., VASUTECH, DANFOSS, PYRO ELECTRIC, CHEMTROL, ASHCROFT, DWYER, SOR, E&H, GIC(MUMBAI), PRECISION (AHMEDABAD), TRAFAG(RANIF GENERAL INSTRUMENTS CONSORTIUM, GOA GIC(MUMBAI), PRECISION (AHMEDABAD), TRAFAG(RANIPET)
25	LEVEL INDICATOR	ENDRESS AND HAUSER- GERMANY, E.IP BULK CONTROLS, KISTLEMORSE, TROLEX,, EIP ENVIROLEVEL CONTROLS LTD DELHI, SB ELECTRIC MECHANICAL PVT. LTD PUNE, NIVO CONTROLS INDORE EIP ENVIROLEVEL CONTROLS LTD I SB ELECTRO MECHANICAL PVT. LTD PUNE, NIVO CONTROLS INDORE.
26	FLOW SWITCHES	SWITZER, INDFOSS, V. AUTOMAT, GENERAL INSTRUMENT /DELTA UK/ DRESSER USA/ E&H, KROHNE MARSHALL (PUNE)-CHEMTROLS INDUSTRIES LTD., MUMBAI / KROHNE MAR (PUNE)
27	PRESSURE GAUGES	BELLS CONTROLS, H.GURU, GENERAL INSTRUMENTS GIC, PYRO ELECTRIC, AN INSTRUMENTS, WIKA, INDFOSS, GLUCK(INDIA), WAAREE, MANOMETER(I), BUDENBERG, KONICS/KOREA, ASCHOFT,, FORBES MARSHALL (HYD), GIC (MUMBAI), ODIN (AHMEDABAD), KROHNE MARSHALL PVT LTD., PUNE / HIRLEKAR PRECISION ENGG. PVT. LTD.-FORBES MARSHALL PVT. LTD., PUNEFORBES MARSHALL (HYD), GIC (MUMBAI), ODIN (AHMEDABAD), KROHNE MARSHALL PVT LTD., PUNE / HIRLEKAR PRECISION ENGG. PVT. LTD.)
28	LEVEL GAUGES	LEVCON, TECHNOMATIC, TOSHNIWAL, MAGNETROL, KROHNE, E&H, V AUTOMAT, CHEMTROLS,, DK INST(KOLKATA), SBEM(PUNE), SIGMA INST (MUMBAI)
29	TEMPERATURE GAUGES.	BELLS CONTROLS, H.GURU, GENERAL INSTRUMENTS GIC, PYRO ELECTRIC, AN INSTRUMENTS, WIKA-GERMANY, DRESSER, INDFOSS, WAAREE, ASCHOFT, FORBES MARSHALL (HYD), GOA THERMOSTATIC INST(GOA), WIKA(INDIA)
30	TEMPERATURE SENSOR	PYRO ELECTRIC, DETRIV
31	MASS FLOW METER	MICROMOTION, KROHNE MARSHALL, ROSEMOUNT, ULTRA FILTER, ABB, YBL, DIELEN, E&H
32	ROTAMETER	INSTRUMENT ENGR. HYD. TRANSDUCER AND CONTROL, HYD., V. AUTOMAT, EUREKA (PUNE), FLUIDYNE INS(MUMBAI), PLACKA (CHENNAI), CHEMTROLS SAMIL (INDIA) PVT.LTD.
33	DEW POINT APPARATUS	ADP MANUFACTURER, WALKER (UK), ULTRAFILTER (GERMANY)

34	INSTRUMENT FITTINGS	AURA INCORPORATED,Arya Crafts & Engineering Pvt. Ltd.,Astec Valves & Fittings Pvt. Ltd,C Valve Pvt. Ltd.,FLUIDFIT ENGINEERS PVT. LTD.,Fluid Controls Pvt. Ltd.,HP VALVES & FITTING INDIA PVT. LTD.,PRECISION ENGINEERING INDUSTRIES,Panam Engineers,Perfect Instrument Control (India) Pvt. Ltd.,VIKAS INDUSTRIAL PRODUCTS,
35	FIBRE OPTIC CABLE	BIRLA ERICSSON,FINOLEX,AKSH FIBRE
36	TRANSDUCER	AE, SOUTHREN , MECO, SIEMENS, ABB,ADEPT(PUNE), ELSTER(MUMBAI), LECTROTEK (PUNE), MASIBUS(GANDHINAGAR), MECO(MUMBAI), PYROTECH(UDAIPUR), ADEPT(PUNE), ELSTER(MUMBAI), LECTROTEK (PUNE), MASIBUS(GANDHINAGAR), MECO(MUMBAI), PYROTECH(UDAIPUR)
37	ELECTRONIC TRANSMITTER	H&B, ROSEMOUNT, IL, FUJI MAKE,ABB, EMERSON, HONEYWELL, YOKOGAWAABB, EMERSON
38	LT XLPE POWER CABLES AND PVC CONTROL CABLES	HAVELLS, TORRENT, NICCO, FINOLAX, RAVIN, GOVIND , LAPP, INDUSTRIAL CABLES, KRISHI ELECTRIC, FINE CAB., SPL CABLES, RADIANT, SUYOG, PARAMOUNT, VIKAS CABLES, CORDS ALPHA, GEMS CAB. , TCL, ROLLEX, KEI, CRYSTAL, POLYCAB, DELTON, RELIANCE ENGINEERING RPG, ASSOCIATE CABLES, ELKAY TELELINKS, UNIVERSAL, FGI CCI/UNIVERSAL
39	PLC	ROCKWELL, GEFANUC, ABB, SIEMENS, HONEYWELL, GROUP SCHNEIDER, ALLEN BRADLEY, YOKOGAWA
40	PCS	HP / IBM/ DELL/ACER ,IBM,LENOVO
41	TFT MONITOR	HP / IBM/ DELL,NEC, Samsung, IBM,LENOVO,DIMOND,TLT,MIRCON TEK,TIPL
42	PRINTERS (LASER/INKJET)	HP,CANON,WIPRO,SAMSUNG
43	PLC CUM ENGINEERING STATION	PLC CUM ENGINEERING STATION SHALL BE SUPPLIED WITH RELIANT MAKE PLC



**1 X 800 MW GSECL WANAKBORI TPS
COMPRESSED AIR SYSTEM
MANDATORY SPARE LIST**

SPECIFICATION NO. PE-TS-408-555-A001

VOLUME : II B

SECTION : E

REV 00

DATE: 14.08.2015

**ANNEXURE-II
MANDATORY SPARE LIST**

Mandatory Spares for Compressed Air System

Sl. No.	Equipment/Package Name	Quantity
A. Mechanical		
SCREW COMPRESSOR		
1.1	HP Stages of Compressor	
	(i) HP element	One (1) Set
	(ii) Packing Set	Four (4) Sets
	(iii) Axial thrust brg.	Two (2) Sets
	(iv) Labyrinth oil seal or radial seals or double acting seals for drive shaft	Four (4) Sets
	v) Bearing for male & female rotors (DE & NDE)	Two (2) each
	vi) Timing Gears	One (1)
	vii) Suction & discharge valves	Two (2) each
1.2	LP Stages of Compressor	
	(i) LP element	One (1) Set
	(ii) Graphitic ring shaft seals for compressor chamber or whitemetal labyrinth seals	Four (4) Sets
	(iii) Packing Set	Four (4) Sets
	(iv) Axial thrust Bearing	Two (2) Sets
	v) Bearing for male & female rotors (DE & NDE)	Two (2) each
	vi) Timing Gears	One (1)
	vii) Suction & discharge valves	Two (2) each
1.3	Main Bearing	Two (2) each
1.4	Set up gear/pinion	One (1)
1.5	Air intake filter element with gaskets	Eight (8)
1.6	Oil filter element with gaskets & seals	Eight (8)
1.7	Safety valve springs & gaskets	Four (4)
1.8	One set of inbuilt automatic drain valve	Four (4)
1.9	Gearcase breather filterelemnt	One (1)
1.10	Drain valve kit	One (1)
1.11	Compressors Coolers	
	I) Gaskets & seals for inter cooler and after cooler	Four (4)
	ii) Inter cooler drain check valve	One (1)
1.12	Oil Pump/Motor	
	i) Oil pump complete assembly	One (1)
	ii) Pump impeller/rotor with shaft	One (1)
	iii) Set of bearings	Two (2) Sets
	iv) Oil pump motor bearing	Two (2)
1.13	Shaft driven oil pump	
	I) Drive gear with shaft	One (1)
	ii) Driven gear with shaft	One (1)
1.14	Drain tap elements	Four (4)
1.15	Moisture tap elements	Four (4)
1.16	Oil cooler gaskets and seals	Four (4)
1.17	Seal Washer	Two (2)
1.18	Mass flow Meter	One (1)
1.19	Air Drying Plant	
	i) Pre filter element (ceramic candle)	Two (2)
	ii) After filter element (ceramic candle)	Two (2)

DEVELOPMENT CONSULTANTS

(1x800 MW Wanakbori TPP - Mandatory Spares List.xls, Mechanical-1)

V.IIA/S-8 : 4

Sl. No.	Equipment/Package Name	Quantity
	iii) Heater element (if required)	Two (2)
	iv) Blower bearing (if required)	Two (2)
	v) Blower motor bearing (if required)	Two (2)
	vi) Valve actuators	Two (2)
	vii) Inlet & Outlet valve for Dryer	One (1) Set
	viii) Automatic drain valves (No air loss type)	One (1) Set
	ix) Expansion valves	One (1) Set
	x) Filter Dryer	One (1) Set
	xi) Air cooler condenser fan	One (1) Set
B. Electrical		
PMCC/MCC/ACDB (As applicable)		
2.1 Contactor		
2.1.1 Power Contactor (AC)		
2.1.1.1	Power Contactor Complete Assembly	4 Nos.for each type and rating
2.1.1.2	Power Contactor spare kits	10Sets for each type and rating
2.1.1.3	Power Contactor AC Coils	10Nos. Coils for each type and rating
2.1.2 Auxiliary Control Contactor (AC)		
2.1.2.1	Auxiliary Control Contactor Complete Assembly	30 Nos.for each type and rating
2.1.2.2	Auxiliary Control Contactor spare kits	40 Sets for each type and rating
2.1.2.3	Auxiliary Control Contactor AC Coils	35 Nos.for each type and rating
2.2	MCCB (Power Circuit)	5 Nos. for each type and rating
2.3	MCB (Control Circuit)	25 Nos.for each type and rating
2.4 Switch		
2.4.1	Local / Remote Selector Switch	10Nos.
2.4.2	MCCB Status (On/off) Monitoring Switch/Contact	5Nos.
2.4.3	Trial / Normal /MCC Selector Switch	15Nos.
2.4.4	MCC module Service Position Limit Switch	5Nos.
2.5	Thermal Overload Relay	5Nos. for each type and rating
2.6	Sliding Contact (Fixed & Moving)	25Sets
2.7	Bus bar to MCC module Lira Contact Assembly (Bus-end & MCC Module-end)	5Sets for each type and rating
2.8 Indicating Lamps complete assembly		
2.8.1	Red	30Sets
2.8.2	Amber	30Sets
2.8.3	Green	30Sets
2.9	Push Button (On/Off) Complete Assembly	20Sets
2.1 CT		
2.11	Ammeter	1No. for each type and rating
2.12	Control Transformer	1No. for each type and rating
2.13	Off Delay/ On Delay Timer	5Nos.for each type and rating
2.14	Switch Fuse Unit	5Nos.for each type and rating
2.15 Terminal Block		
2.15.1	Power Terminal Block	10% of total nos. for each type and rating used in the system or minimum one (1) no. whichever is more
2.15.2	Control Terminal Block	10% of total nos. for each type and rating used in the system or minimum one (1) no. whichever is more

Sl. No.	Equipment/Package Name	Quantity
2.15.3	End Plate for Power & Control Terminal Block	Each type 25Nos.
2.3	Energy Meter	1No. For each type & rating
2.4	Control Panel/Desk Mounted Items	
2.4.1	Push Button	
2.4.1.1	Complete assembly	5Nos for each colour
2.4.1.2	Contact Element (1NO + 1NC) Block	20Nos.
2.4.2	Selector Switch	10Nos. for each type and rating
2.4.3	Meter (Analog or Digital)	
2.4.1	Ammeter	10% for each type and range or minimum one (1) no. whichever is more
2.4.2	Voltmeter	10% for each type and range or minimum one (1) no. whichever is more
2.4.3	Frequency	10% for each type and range or minimum one (1) no. whichever is more
2.4.4	MW	10% for each type and range or minimum one (1) no. whichever is more
2.4.5	MVAR	10% for each type and range or minimum one (1) no. whichever is more
2.4.6	Power Factor	10% for each type and range or minimum one (1) no. whichever is more
2.4.7	Synchroscope	10% for each type and range or minimum one (1) no. whichever is more
2.5	Indicating Lamps complete assembly	10Nos. for each Colour and type
2.6	Mimic Lamps	10Nos. for each Colour and type
2.7	MCB	2Nos. for each type and rating
2.8	Door Limit Switch	2Nos.
2.9	Annunciation system	
2.9.1	Lamp Box with Facia & Lamps (LED type)	25Nos.
2.9.2	Hooter	1No.
2.9.3	Each type of PCB (for non-PLC driven system)	1(one) no.
2.1	Actuator	
2.10.1	Complete set of Actuator	1No. for each type and rating
2.10.2	Limit Switch	2 Nos each type and rating
2.10.3	Torque Switch	2 Nos each type and rating
2.10.4	Auxiliary Contact	1 no each type and rating
2.10.5	Motor	1 no each type and rating
2.10.6	Complete Seal kit	1Set for each type and rating
2.10.7	Complete O-Ring Set	1Set
B. C&I		
3.1	Field Instruments (Transmitters/temperature elements (TC / RTD) / Gauges / Switches etc. along with relevant accessories)	10 (ten) percent of total of each type or at least one (whichever is higher) of each type along with accessories.
3.2	Control System (DCS, PLC etc.)	

Sl. No.	Equipment/Package Name	Quantity
3.2.1	keyboard and cursor control devices.	2 (two) numbers each
3.2.2	LCD TFT (24") Monitors.	2 (two) numbers
3.2.3	Spare interface cables with connecting plugs	10 (ten) sets for each type of peripherals & I / O hardware.
3.2.4	Power supply modules	10 (ten) percent for each type or 4 (four) numbers, whichever is higher.
3.2.5	Electronic modules (I / O)	10 (ten) percent of the total qty. offered for each type or 5 (five) numbers of each electronic type of module, whichever is higher.
3.2.6	Bus couplers and communication interface cards	10 (ten) percent of total of each type or 2 (two) numbers of bus couplers and communication interface cards whichever is higher.
3.2.7	Controllers for DCS,Control panel ST,Boiler control system,Balance of plant system,PLC system/Sub-systems	10%of each type(at least 1 no. of each type) whichever is higher.
3.3	Valves, Actuators & Accessories	
3.3.1	Control Valves	
3.3.1.1	Control valve stem packing , as offered.	2 (two) sets for each of the control valves
3.3.1.2	of spare valve trim (including cage, plug, stem, seat rings, guide bushings etc.)	1 (one) set for both the units for each of the control valves, as offered.
3.4	Actuators	
3.4.1	Actuators with drive	1 (one) set of each type and rating.
3.4.2	Valve positioners	10 (ten) percent of each type.
3.4.3	Position transmitters	10 (ten) percent of each type.
3.4.4	Limit switches/torque switches	10 (ten) percent of each type.



**1 X 800 MW GSECL WANAKBORI TPS
COMPRESSED AIR SYSTEM
PAINTING & COLOUR SCHEME**

SPECIFICATION NO. PE-TS-408-555-A001

VOLUME : II B

SECTION : E

REV 00

DATE: 14.08.2015

**ANNEXURE-III
PAINTING & COLOUR SCHEME**

1.0 **GENERAL PAINTING REQUIREMENTS**

1.1 Painting of equipment shall be carried out as per the specifications indicated below and attached annexures and shall conform to the relevant IS specification/ international standards for the material and workmanship.

1.2 The following latest Indian Standards may be referred to for carrying out the painting job:

IS:5	:	Colours for ready mixed paints and enamels
IS:1303	:	Glossary of terms relating to paints
IS:2379	:	Colour code for identification of pipelines
IS:1477	:	Code of practice for painting of ferrous metals in Buildings (Parts I & II)
IS:2524	:	Code of practice for painting of non-ferrous metals in buildings (Parts I & II)
IS:158	:	Ready mixed paint, brushing, bituminous, black, lead free, acid, alkali, water and heat resisting
IS:2074	:	Ready mixed paint, air drying, red Oxide Zinc Chrome, priming
IS:104	:	Ready mixed paint, brushing, Zinc Chrome, priming
IS: 2932	:	Enamel, synthetic, exterior (a) undercoating (b) Finishing
IS :2933	:	Specification for enamel synthetic exterior type II
IS:2339	:	Specification for Aluminium paints for general purpose



1.3 **Preparation of Surfaces**

All surfaces to be painted shall be thoroughly cleaned of all grease, oil, loose mill scale, dust, rust and any other foreign matter. Mechanical cleaning by power tool and scrapping with steel wire brushes shall be adopted to clear the surfaces. However, in certain locations where power tool cleaning cannot be carried out sand scrapping may be permitted with steel wire brushes and /or abrasive paper. Cleaning with solvents shall be resorted to only in such areas where other methods specified above have not achieved the desired results. Cleaning with solvents shall be adopted only after written approval of the OWNER/OWNER REPRESENTATIVE.

The sheet steel of electrical and instrumentation panels shall be pre-treated through chemical cleaning (7 tank) process of rinsing, degreasing, rinsing, derusting, rinsing, phosphate and rinsing. However, in case mechanical cleaning is also required the Contractor shall carry out the same to get a smooth finish.

1.4 **Primer Paint**

After the surface is prepared one coat of Zinc Phosphate primer conforming to IS 2074 shall be applied.

1.5 **Tie Paint**

After the coat is dried up completely, second coat of Zinc Phosphate primer conforming to IS 2074 shall be applied by brushing, spray, roller as per manufacture recommendation to ensure a continuous film. The dry film thickness of each coat shall be as indicated in Ann-I & II enclosed. Insulated surfaces will have only primer coating and no finish painting.

1.6 **Finish Paint**

Synthetic enamel paint conforming to IS 2932 shall be used for finish coats. The colour /shade shall be as approved by the OWNER. After cleaning the dust on the dried up primer, first coat of synthetic enamel shall be applied. After this first coat dries up hard, the surface is wet scrubbed cutting down to a smooth finish and ensuring that at no place the first coat is completely removed. After allowing the water to get evaporated completely, the second finish coat of synthetic enamel paint shall be applied.



Note For structural painting, customer's specification V II/G2/8 CI 3.03.11 shall be followed however DFT and coating system shall be followed in line with paint manufacturer's recommendation.

1.7 **Painting and Corrosion Protection for Pipes & Fittings**

1.7.1 All uninsulated piping systems, hangers and supports shall have two coats of Zinc Phosphate Primer (conforming to IS 2074) (One primer coat and one tie coat) and finish paint using synthetic enamel paint to give a finish coat. Shades shall be as per IS 5 or as indicated by PURCHASER/OWNER. Service of the pipeline designations shall be painted on all pipes at visible locations.

1.7.2 Before application of paint, Contractor shall clean the pipes of all mill scale, dirt dust, soot grease, rust etc.

1.7.3 All pipe lines, piping components shall be adequately protected against corrosion during manufacture, fabrication, shipment and storage by appropriate protective paint.

- 1.7.4 Shop fabricated equipment/items shall be dispatched with final paint. Necessary touch up shall be done at site. Site fabricated equipment/items shall be dispatched with primer painting only and final painting shall be applied at site.

1.8 **Painting and Corrosion Protection for Valves & Specialties**



Primer of thickness as indicated in Ann-II shall be applied to all steel and cast iron exposed surfaces as required to prevent corrosion before dispatch. The use of grease or oil, other than light grade mineral oil, for corrosion protection is prohibited. Bores of all vales shall be covered immediately after testing, draining and drying with suitable plastic end covers to avoid ingress of foreign materials.

1.9 **Suggested Colour Codes for Painting**

Suggested colour codes shall be furnished by the successful bidder after award of contract. Colour codes for piping shall be as per IS 2379 with necessary modifications. Where band colour is specified for piping, same shall be provided at 30 metre intervals on long uninterrupted lines and also adjacent to valves and junctions.


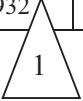
2.0 **Approved Paint Makes**

- | | |
|--------------------------------|------------------------------|
| i) Asian Paints (I) Ltd. | vii) Addison Paints Ltd |
| ii) Berger Paints India Ltd | viii) Grand Polycoat |
| iii) Goodlass Nerolac | ix) Bombay Paints |
| iv) Jenson & Nicholson (I) Ltd | x) Hemple Paints (Singapore) |
| v) CDC carboline (I) Ltd. | xi) Jotun Paints |
| vi) Shalimar Paints Ltd. | xii) Akzonobel coatings |

2.1 **PAINING SCHEDULES**

- 2.1 Painting schedules for various systems/ items are furnished as per enclosed Annexures-I and II. Vendors of different packages/ items will furnish detailed painting schedule for customer approval during detail engineering as per this guide specification.

Annexure-I

Paint Reference Scheme	Surface Preparation Grade / Surface Profile	Primer Coat			Intermediate Coat			Finish Coat			Total DFT in microns
		Premier Paint	No. of Coats	DFT in Microns	Intermediate Paint	No. of Coats	DFT in Microns	Finish Paint (See Note)	No. of Coats	DFT in Microns	
Various type of equipment/v alve, etc. (Temp. upto 90°C)	Degreasing and Mech. Cleaning with wire brushing/hand tool (Sa1/St2/St3 as applicable)	HB Zinc Phosphate (alkyd Medium) as per IS:2074	1	35-45 per coat	HB Zinc Phosphate (alkyd Medium) as per IS:2074	1	35-45 per coat	Synthetic enamel (alkyd med.) as per IS:2932	2	20 – 25 per coat	110 - 140
Structural 	- do -	Epoxy resin based HB Zinc phosphate (alkyd medium)	1	50 – 75 per coat	Epoxy based HB MIO pigmented polyamide cured paint	1	110-125 per coat	Polyamide cured epoxy finish coating + Polyurethane coat	1+1	50 – 60 per coat + 25 – 35 per coat	235 - 295
LP Piping/ Vessels, etc. (Temp. upto 90°)	- do -	HB Zinc Phosphate as per IS:2074 (alkyd medium)	1	35 – 45 per coat	HB Zinc Phosphate (alkyd Medium) as per IS:2074	1	35-45 per coat	Synthetic enamel (alkyd med.) as per IS:2932	2	20 – 25 per coat	110- 140
Equipment with (Temp. upto 250°)	- do -	Heat resistant Al – paint	2	20 per coat	- NA	-	-	NA	Insulated	NA	40
Equipment in corrosive areas like CPU (regeneration) Dosing skid, etc.	Blast clean to Sa 2 ^{1/2}	HB Epoxy resin based zinc phosphate primer	1	50 per coat	Epoxy based MIO pigmented paint	1	50 per coat	Polyamide cured Epoxy finish coat	2	25 – 35 per coat	150 - 170
Elect. / Control Panels, etc.	Seven tank process	HB Zinc phosphate (alkyd Medium) as per IS:2074	2	35 – 45 per coat	HB Zinc Phosphate (alkyd Medium) as per IS:2074	1	35-45 per coat	Synthetic enamel (alkyd med.) as per IS:2932	2	20 – 25 per coat	110 – 140
Large dia pipes	As per customer specification for Large diameter piping CI. No. 9.00.00 of VII-I/S-5										

Notes:

1. Surface preparation shown above is as per Swedish Standards SIS 05-5900. Degreasing will be as per Standard SSPC-SP1.
2. In case of insulated surfaces, only primer coats shall be applied.
3. GM/SS items with piping and G.I. pipes will not be painted. Further SS/GI piping shall be given necessary colour banding for identification as per colour scheme.
4. All instruments shall be painted as per manufacturer standard practice.
5. All structural steel items shall be painted at site. Piping shall go with primer coating & finish Paint shall be applied at site. Equipment shall be finish painted at shop.
6. Method of painting application shall be as per paint manufacturer's recommendation.
7. **Based on above painting schedule, detailed painting schedule will be prepared by respective Package supplier and approved painting schedule shall be submitted to GSECL/DCPL under information category.**
8. **This painting schedule is applicable for bought out equipment/packages of PEM. Painting specification for various piping/ equipment in scope of various other BHEL units like Power cycle piping, CW piping, LP piping, R.E. joints, Butterfly valves, Power cycle valve etc., shall be furnished by unit separately.**



ANNEXURE-III

SUGGESTED COLOUR CODES FOR PAINTING

SL. NO.	ITEM/SERVICE	COLOUR	IS-5	COLOUR (BAND)	IS-5
1.0	Structures, platforms, galleries, ladders and handrails	Dark Admiralty Grey	632	-	-
2.0	Fans, pumps, motors, compressors, Blowers	Light Grey	631	-	-
3.0	Tanks (without insulation and cladding)				
3.1	Outdoor, Stand pipes, vent pipes	Aluminum	-	-	-
3.2	Indoor	Aluminum	-	-	-
4.0	Vessels & all other proprietary equipment (without insulation & cladding)	Light grey	631	-	-
5.0	Switchgear	Light grey	631	-	-
6.0	Control & relay panels	Light grey	631/7078 of IS 1650	-	-
7.0	Transformers	Dark Admiralty Grey	632	-	-
8.0	Machinery guards	Signal red	537	-	-
9.0	Piping (without insulation and cladding)				
9.1	Water System				
a)	Boiler feed	Sea green	217	-	-
b)	Condensate	Sea green	217	Light brown	410
c)	D M Water	Sea Green	217	Light orange	557
d)	Soft water	Sea green	217	French blue	166
e)	Bearing cooling water	Sea green	217	French blue	166
f)	Potable & filtered water	Sea green	217	French blue	166
g)	Service & clarified water	Sea green	217	French blue	166
h)	Raw water	Sea green	217	White	-
i)	Cooling water	Sea green	217	French blue	166
9.2	Compressed Air System				
a)	Service air	Sky Blue	101	-	-
b)	Instrument air	blue	101	White	-
9.3	Oil system				
a)	Fuel oil	Light brown	410	French Blue	166
b)	Light oil	Dark Brown	412	Brilliant green	221
c)	Lubricating oil	Light brown	410	Light grey	631

SL. NO.	ITEM/SERVICE	COLOUR	IS-5	COLOUR (BAND)	IS-5
d)	Control oil	Light brown	410	Light orange	557
e)	Transformer oil	Light brown	410	Light orange	557
9.4	Gas system				
a)	Carbon dioxide	Canary yellow	309	Light grey	631
9.5	Fire services	Fire red	536	-	-
9.6	Drainage	Black	-	-	-
9.7	Stand pipes and all Vent pipes	Aluminum	-	-	-

Notes:

1. This color code basically refers to IS:2379 for piping with necessary modifications.
2. Where band color is specified, same shall be provided at 10 meter intervals on long uninterrupted lines and also adjacent to valves and junctions.

ANNEXURE-IV
LIST OF TOOLS & TACKLES



TITLE

**TECHNICAL SPECIFICATION FOR
COMPRESSED AIR SYSTEM**

SPECIFICATION NO. PE-TS-408-555-A001

REV 00

DATE

SHEET OF

LIST OF SPECIAL MAINTENANCE TOOLS & TACKLES*

S.No.	ITEM DESCRIPTION	QUANTITY
01		
02		
03		
04		
05		
06		
07		
08		
09		
10		

***Bidders need to fill this list ONLY IF the Tools are SPECIAL in nature.**

SIGNATURE: _____

NAME : _____

DESIGNATION: _____

COMPANY: _____

DATE: _____

COMPANY SEAL

ANNEXURE-V
DM WATER ANALYSIS

DM WATER ANALYSIS

Total Electrolyte	0.1 ppm, max.
Reactive SiO ₂	Less than 0.01 ppm as SiO ₂
Iron as Fe	Nil
Free CO ₂ ppm as CO ₂	Nil
Total Hardness	Nil
pH value at 25°C	8.5-9.0
Conductivity, micro mho/cm	< 0.1 at 25 °C

ANNEXURE-VI

**DRAWINGS / DOCUMENTS SUBMISSION
PROCEDURE
(COVERED UNDER SECTION C 2B)**

ANNEXURE-VII
INSPECTION AND TESTING



TITLE
INSPECTION AND TESTING

REV 00
SHEET 1 OF 2

- 1.00.00 **INSPECTION AND TESTING**
- 1.01.00 Inspection and Tests during Manufacture.
- 1.01.01 The method and techniques to be used by the Bidder for the control of quality during manufacture of all plant and equipment shall be agreed with the Owner.
- 1.01.02 The Owner's general requirements with respect to quality control and the required shop tests are set out elsewhere in this specification.
- 1.01.03 Before any item of plant or equipment leaves its place of manufacture the Owner shall be given the option of witnessing inspections and tests for compliance with the specification and related standards.
- 1.01.04 Advance notice shall be given to the Owner as agreed in the Contract, prior to the stage of manufacture being reached, and the piece of plant must be held at this stage until the Owner has inspected the piece, or has advised in writing that inspection is waived. If having consulted the Owner and given reasonable notice in writing of the date on which the piece of plant will be available for inspection, the Owner does not attend the Bidder may proceed with manufacture having forwarded to the Owner duly certified copies of his own inspection and test results.

The owner's representative shall have at all reasonable times access to bidder's or his sub-vendor's premises and shall have power to inspect/ examine materials and workmanship or equipment under manufacture.

The Bidder shall forthwith forward to the engineer duly certified copies of the Test Certificates in six copies (one to the Purchaser and five to the Consulting Engineer) for approval. Further nine (9) copies of Shop Test Certificates shall be bound with Instruction Manuals referred to elsewhere.

For electrical equipment, routine tests as per relevant IS spec are to be carried out on all equipment. Type tests are also to be carried out on selected equipment as detailed in the specs of concerned electrical equipment.
- 1.01.05 Under no circumstances any repair or welding of castings be carried out without the consent of the Engineer. Proof of the effectiveness of each repair by radiographic and/or other non-destructive testing technique, shall be provided to the Engineer.
- 1.01.06 All the individual and assembled rotating parts shall be statically and dynamically balanced in the works.
Where accurate alignment is necessary for component parts of machinery normally assembled on site, the Bidder shall allow for trial assembly prior to despatch from place of manufacture.
- 1.01.07 All materials used for the manufacture of equipment covered under this specification shall be of tested quality. Relevant test certificates shall be made available to the Purchaser. The certificates shall include tests for mechanical properties and chemical analysis of representative material. Equipment or parts coming under any statutory Regulations shall be certified by a Competent Authority under the regulations in the specified format.

ANNEXURE-VIII

**MASTER DRAWING LIST WITH SCHEDULE OF
SUBMISSION**

MDL FOR CAS PACKAGE FOR 1X800 MW GSECL,WANAKBORI TPP, UNIT NO. 8.

PROJECT	SURATGARH STPS	PACKAGE-COMPRESSED AIR SYSTEM	NOA DATE				
"A" S NO	"B" VENDOR_DRG_NO.	"D" DRAWING TITLE	"E" PURPOSE	"G" NAME OF BOI	"H" SCHEDULED SUBMISSION (NO. OF WEEKS FROM LOA DATE/SCH PO DATE)(*)	"I" SCH_SUB_DATE (DD-MON-YYYY)	"J" SCH_APPL_DATE (DD-MON-YYYY)
1	PE-V0-408-555-A001	QUALITY PLAN OF AIR COMPRESSOR FOR COMPRESSED AIR SYSTEM	A-CUST	CAS	8		
2	PE-V0-408-555-A002	QUALITY PLAN OF AIR DRYING PLANT FOR COMPRESSED AIR SYSTEM	A-CUST	CAS	8		
3	PE-V0-408-555-A003	QUALITY PLAN OF AIR RECEIVER FOR COMPRESSED AIR SYSTEM	A-CUST	CAS	8		
4	PE-V0-408-555-A004	QUALITY PLAN OF MOTOR FOR COMPRESSED AIR SYSTEM	A-CUST	CAS	8		
5	PE-V0-408-555-A005	TDS OF INSTRUMENT AIR & SERVICE AIR COMPRESSORS	A-CUST	CAS	8		
6	PE-V0-408-555-A006	TDS OF AIR DRYING PLANT FOR COMPRESSED AIR SYSTEM	A-CUST	CAS	8		
7	PE-V0-408-555-A007	TDS & CHARACTERISTIC CURVES OF MOTOR FOR COMPRESSED AIR SYSTEM	A-CUST	CAS	12		
8	PE-V0-408-555-A008	TDS & GA OF VALVES FOR COMPRESSED AIR SYSTEM	I-CUST	CAS	12		
9	PE-V0-408-555-A009	TDS OF PIPES & FITTINGS FOR COMPRESSED AIR SYSTEM	I-CUST	CAS	10		
10	PE-V0-408-555-A010	TDS OF INSTRUMENTS FOR COMPRESSED AIR SYSTEM	I-CUST	CAS	12		
11	PE-V0-408-555-A011	GA DRAWING OF INSTRUMENT & SERVICE AIR COMPRESSOR	I-CUST	CAS	12		
12	PE-V0-408-555-A012	GA DRAWING OF AIR DRYER FOR COMPRESSED AIR SYSTEM	I-CUST	CAS	8		
13	PE-V0-408-555-A013	GA DRAWING OF MOTOR FOR COMPRESSED AIR SYSTEM	I-CUST	CAS	12		
14	PE-V0-408-555-A014	GA DRAWING OF AIR RECEIVER FOR COMPRESSED AIR SYSTEM	I-CUST	CAS	8		
15	PE-V0-408-555-A015	COMPRESSOR HOUSE LAYOUT	A-CUST	CAS	14		
16	PE-V0-408-555-A016	P & I DIAGRAM OF AIR COMPRESSOR FOR COMPRESSED AIR SYSTEM	I-CUST	CAS	10		
17	PE-V0-408-555-A017	P&I DIAGRAM OF AIR DRYER FOR COMPRESSED AIR SYSTEM	I-CUST	CAS	8		
18	PE-V0-408-555-A018	P&I DIAGRAM OF COMPRESSED AIR SYSTEM WITHIN COMPRESSOR HOUSE	A-CUST	CAS	8		
19	PE-V0-408-555-A019	OPERATION & CONTROL PHILOSOPHY OF COMPRESSED AIR SYSTEM	A-CUST	CAS	12		
20	PE-V0-408-555-A020	ELECTRICAL & INTERNAL WIRING DIAGRAM FOR COMPRESSOR PANEL FOR COMPRESSED AIR SYSTEM.	I-CUST	CAS	8		
21	PE-V0-408-555-A021	ELECTRICAL FEEDER LIST FOR COMPRESSED AIR SYSTEM	I-G-P	CAS	12		
22	PE-V0-408-555-A022	CONTROL CABLE SCHEDULE FOR COMPRESSED AIR SYSTEM	I-G-P	CAS	16		
23	PE-V0-408-555-A023	PG TEST PROCEDURE FOR COMPRESSED AIR SYSTEM	I-CUST	CAS	24		
24	PE-V0-408-555-A024	O&M MANUAL-COMP AIR SYSTEM	I-CUST	CAS	26		
25	PE-V0-408-555-A025	QUALITY PLAN OF INSTRUMENTS FOR COMPRESSED AIR SYSTEM	I-CUST	CAS	10		
26	PE-V0-408-555-A026	QUALITY PLAN OF PLC FOR COMPRESSED AIR SYSTEM	A-CUST	CAS	16		
27	PE-V0-408-555-A027	QUALITY PLAN OF BROUGHT OUT ITEMS (BOI) FOR COMPRESSED AIR SYSTEM	I-CUST	CAS	14		
28	PE-V0-408-555-A028	TDS OF COMMON SEQUENTIAL PANEL FOR COMPRESSED AIR SYSTEM	I-CUST	CAS	16		
29	PE-V0-408-555-A029	SUB-VENDOR LIST WITH INSPECTION CATEGORISATION PLAN FOR COMPRESSED AIR SYSTEM	A-CUST	CAS	4		
30	PE-V0-408-555-A029	SEA WORTHY PACKING OF EQUIPMENTS FOR COMPRESSED AIR SYSTEM	I-G-P	CAS	20		
31	PE-V0-408-555-A030	Data sheet Control Cable & screened control cables	I-G-P	CAS	16		

PROJECT	SURATGARH STPS	PACKAGE-COMPRESSED AIR SYSTEM	NOA DATE				
32	PE-V0-408-555-A031	QAP for Control Cable & screened control cables	I-G-P	CAS	16		
33	PE-V0-408-555-I001	TDS OF PLC FOR COMPRESSED AIR SYSTEM	A-CUST	CAS	16		
34	PE-V0-408-555-I002	SPARE	A-CUST	CAS			
35	PE-V0-408-555-I003	I/O LIST OF PLC FOR COMPRESSED AIR SYSTEM	A-CUST	CAS	16		

ANNEXURE-IX

**FORMAT FOR OPERATION AND MAINTENANCE
MANUAL**

Format for Operation & Maintenance Manual

Project name :

Project number :

Package Name :

PO reference :

Document number :

Revision number :

Sl.no. & Sections	Description	Tick (√)if included in Manual			Remarks
		Yes	No	Not Applicable	
1.	Cover page				
1.1	Project Name				
1.2	Customer/consultant Name				
1.3	Name of Package				
1.4	Supplier details with phone, FAX ,email address , Emergency Contact number				
1.5	Name and sign of prepared by , checked by & approved by				
1.6	Revision history with approval Details				
2.0	Index				
2.1	showing the sections & related page nos All the pages should be numbered section wise				
3.0	Description of Plant/System				
3.1	Description /write up of operating principle of system equipment/ associated sub-systems & accessories/controls system , operating conditions, performance parameters under normal , start up and special cases				
3.2	Equipment list and basic parameter with Tag numbers				
3.3	Data sheets approved by Customer/for information and catalogues provided by original manufacturer				
3.4	Associated other packages and Interface /terminal points				
3.5	P&ID & Process Diagrams				
3.6	GA Layout drawings, As-built drawings , Actual photograph of items/system (Drawings of A2 & bigger sizes are to be attached in the last)				
3.7	Single line/wiring diagrams				
3.8	Control philosophy /control write-ups				

4.0	Commissioning Activities (if not covered in separate document i.e. erection manual, commissioning manual)				
4.1	Pre-Commissioning Checks				
4.2	handling of items at site				
4.3	Storage at site				
4.4	Unpacking & Installation procedure				
5.0	Operation Guidelines for plant personal/user/operator				
5.1	Interlock & Protection logic along with the limiting values of protection settings for the equipment along with brief philosophy behind the logic, drawings etc. to be provided.				
5.2	Start up, normal operation and shut down procedure for equipments along with the associated systems in step by step mode. Valve sequence chart, step list, interlocks etc. with Equipment isolating procedures to be mentioned.				
5.3	Do's & Don't of the equipments.				
5.4	Safety precautions to be taken during normal operation. Safety symbols, Emergency instructions on total power failure condition/lubrication failure/any other condition				
5.5	Parameters to be monitored with normal values and limiting values				
5.6	Trouble shooting with causes and remedial measures				
5.7	Routine operational checks, recommended logs & records				
5.8	Changeover schedule if more than one auxiliary for the same purpose is given				
5.9	Painting requirement and schedule				
5.10	Inspection, repair , Testing and calibration procedures				
6.0	Maintenance guidelines for plant personal				
6.1	List of Special Tools and Tackles required for Overhaul/Trouble shooting including special testing equipment required for calibration etc.				
6.2	Stepwise dismantling and re-assembly procedure clearly specifying the tools to be used, checks to be made, records to be maintained, clearances etc. to be mentioned. Tolerances for fitment of various components to be given.				

6.3	Preventive Maintenance & Overhauling schedules linked with running hours/calendar period along with checks to be given				
6.4	Long term maintenance schedules especially for structural, foundations etc.				
6.5	Consumable list along with the estimated quantity required during commissioning, normal running and during maintenance like Preventive Maintenances and Overhaul. Storage/handling requirement of consumables/self-life.				
6.6	List of lubricants with their Indian equivalent, Lubrication Schedule, Quantity required for each equipment for complete replacement is to be given				
6.7	List of vendors & Sub-vendors with their latest addresses, service centres ,Telephone Nos., Fax Nos., Mobile Nos., e-mail IDs etc.				
6.8	List of mandatory and recommended spare parts list				
6.9	Tentative Lead time required for ordering of spares from the equipment supplier				
6.10	Guarantee and warranty clauses				
7.0	Statutory and other specific requirements considerations.				
8.0	List of reference documents				
9.0	Binding as per requirement				



**1 X 800 MW GSECL WANAKBORI TPS
COMPRESSED AIR SYSTEM
SITE STORAGE AND PRESERVATION**

SPECIFICATION NO. PE-TS-408-555-A001

VOLUME : II B

SECTION : E

REV 00

DATE: 14.08.2015

ANNEXURE-X

SITE STORAGE AND PRESERVATION

CONTENT

- 1 SCOPE OF THE DOCUMENT
- 2 PURPOSE OF STORAGE & PRESERVATION
- 3 MEASURES TO BE TAKEN FOR STORAGE AND PRESERVATION
 - a) GENERAL STORAGE REQUIREMENTS
 - b) GENERAL PRESERVATION REQUIREMENTS
 - c) GENERAL INSPECTION REQUIREMENTS
- 4 TYPE OF STORAGE FOR VARIOUS EQUIPMENT
5. CONCLUSION
6. STACKING ARRANGEMENT FOR PLATES AND STRUCTURAL STEEL

1. SCOPE OF THE DOCUMENT

This guideline is prepared in intent to provide proper site storage and preservation of the Mechanical, Electrical and C & I items / equipment supplied under various bought out packages/items. This storage procedure shall be followed at different power plant sites by concerned agency for storage and preservation from the date of equipment received at site until the same are erected and handed over to the customer.

2. PURPOSE OF STORAGE & PRESERVATION

Many of the items may be required to be kept in stores for long period. It shall therefore be essential that proper methods of storage and preservation be applied so that items do not deteriorate, loose some of their properties and become unusable due to atmospheric conditions and biological elements.

3. MEASURES TO BE TAKEN FOR STORAGE, HANDLING & PRESERVATION

a) GENERAL STORAGE REQUIREMENTS

1. To the extent feasible, materials should be stored near the point of erection. The storage areas should have adequate unloading and handling facilities with adequate passage space for movement of material handling equipment such as cranes, fork lift trucks, etc. The storage of materials shall be properly planned to minimise time loss during retrieval of items required for erection.
2. The outdoor storage areas as well as semi-closed stores shall be provided with adequate drainage facilities to prevent water logging. Adequacy of these facilities shall be checked prior to monsoon.
3. The storage sheds shall be built in conformity with fire safety requirements. The stores shall be provided with adequate lights and fire extinguishers. 'No smoking' signs shall be placed at strategic locations. Safety precautions shall be strictly enforced.
4. Adequate lighting facility shall be provided in storage areas and storage sheds and security personnel positioned to ensure enforcement of security measures to prevent theft and loss of materials.
5. Adequate number of competent stores personnel and security staff shall be deployed to efficiently store and maintain the equipment / material.
7. The equipment shall be stored in an orderly manner, preserving their identification slips, tags and instruction booklets, etc., required during erection. The storage of materials shall be equipment-wise. Loose parts shall be stored in sheds on racks,

preserving the identification marks and tags in good condition. The group codes shall be displayed on the racks

6. At no time shall any materials be stored directly on ground. All materials shall be stored minimum 200 mm above the ground preferably on wooden sleepers

b) GENERAL PRESERVATION REQUIREMENTS

1. All special measures to prevent corrosion shall be taken like keeping material in dry condition, avoiding the equipment coming in contact with corrosive fluid like water, acid etc.
2. Materials which carry protective coating shall not be wrapped in paper, cloth, etc., as these are liable to absorb and retain moisture. The material shall be inspected and in case of signs of wear or damages to protective coating, that portion shall be cleaned with approved solution and coated with an approved protective paint. Complete record of all such observations and protective measures taken shall be maintained.
3. Generally equipment supplied at site are properly greased or rust protective oil is applied on machined/ fabricated components. However periodic inspection shall be carried out to ensure that protection offered is intact.
4. While handling the equipment, no dragging on the ground is permitted. Avoid using wire rope for lifting coated components. Use polyester slings (if possible) otherwise protective material (e.g. clothes, wood block etc.) should be used while handling the components with rope / slings
5. For Equipment supplied with finished paint, touch paint shall be done in case any surface paint gets peeled off during handling. Otherwise such surfaces shall necessarily be wrapped with polythene to avoid any corrosion. Further for equipment wherein finish coat is to be applied at site, site to ensure that equipment is received with primer coat applied.
6. It shall be ensured by periodic inspection that plastic inserts are intact in tapped holes, wherever applicable.
7. Pipes shall be blown with air periodically and it shall be ensured that there is no obstruction.
8. Silica gel or approved equivalent moisture absorbing material in small cotton bags shall be placed and tied at various points on the equipment, wherever necessary.
9. Heavy rotating parts in assembled conditions shall be periodically rotated to prevent corrosion/jamming due to prolonged storage.

10. All the electrical equipment such as motors, generators, etc. shall be tested for insulation resistance at least once in three months and a record of such measured insulation values shall be maintained.
11. Following preservatives/preservation methods can be used depending upon type of equipment
 - a. Rust preventive fluid (RPF)
 - b. Rust protective paints
 - c. Tarpaulin covers, in case of outdoor storage
 - d. De-oxy aluminate for weld-ments

c) GENERAL INSPECTION REQUIREMENTS

1. Period inspection of materials with specific reference to –
 - Ingress of moisture and corrosion damages.
 - Damage to protective coating.
 - Open ends in pipes, vessels and equipment -
 - In case any open ends are noticed, same shall be capped.
2. Any damages to equipment / materials.
 - In case of any damages, these shall be promptly notified and in all cases, the repairs / rectification shall be carried out.
 - Any items found damaged or not suitable as per project requirements shall be removed from site. If required to store temporarily, they shall be clearly marked and stored separately to prevent any inadvertent use.

4. TYPE OF STORAGE FOR VARIOUS EQUIPMENT

The types of storage are broadly classified under the following heads:

i **Closed storage with dry and dust free atmosphere. (C)**

The closed shed can be constructed by using cold-rolled / tubular components for structure and corrugated asbestos sheets / galvanised iron sheets for roofing. Brick walls / asbestos sheets can be used to cover all the sides. The floor of the shed can be finished with plain cement concrete suitably glazed. The shed shall be provided with proper ventilation and illumination.



ii **Semi-closed storage. (S)**

The semi closed shed can be constructed by using cold-rolled / tubular components for structure and corrugated / asbestos sheets for roofing. The floor shall be brick paved. If required a small portion of sides can be covered to protect components from rainwater splashing onto the components.





iii Open storage (O)

The open yard shall be levelled, well consolidated to achieve raised ground with the provision of feeder roads for crane approach along with access roads running all sides. One part of the open yard shall be stone pitched, levelled and consolidated with raised ground suitable for storing / stacking heavier and critical components with due space to handle them by cranes etc . Adequate number of sleepers, concrete block etc. to be provided to make raised platforms to stack critical materials.

A separate yard to be identified as “scrap yard” slightly away from main open yard to store wooden/steel scraps, which are to be disposed off. This is required to avoid mix up with regular components as well as to avoid fire hazard.

Some of the components, which are having both machined & un-machined surfaces and are bulky, shall be stored in open storage area on a raised ground and suitably covered with water proof / fire retardant tarpaulin.



The equipment listed below shall be stored and inspected as per requirement mentioned in the table below.

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
Raw material /mechanical items like pipes, plates, structure sections etc.)				
1.	Steel pipes (lined/unlined)	S	Damage , paint, corrosion, rubber lining peeling	Provide end cap
2.	MS Plates	S	Damage, paint, corrosion	
3.	SS Plates	S	Damage	
4.	Non-metallic pipes	S	Damage, cracks	Provide end cap
5.	Stainless steel pipes	S	Damage ,	Provide end cap
6.	MS sections, beams	S	Damage, paint, corrosion	
7.	Cable trays	S	Damage, condition of preservations	
8.	Insulation sheets	S	Damage	
9.	Insulation	C	Damage, packing	
10.	Hangers Rods	S	Damage, paint, packing	
11.	Tubes	S	Damage, paint , packing	Provide end cap
12.	Hume pipes	O	Damage	
13.	Castings	O	Damage, paint, corrosion	
Fabricated mechanical items (pressure vessels, tanks etc.)				
14.	Pressure vessels (unlined)	O	Damage, paint, corrosion,	Covered nozzles
15.	Atmospheric storage tanks (unlined)	O	Damage, paint, corrosion	Covered nozzles

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
16.	Pressure vessels (lined)	S	Damage, paint, corrosion, rubber lining	
17.	Atmospheric storage tanks(lined)	S	Damage, paint, corrosion, rubber lining	
18.	Support structures	O	Damage , paint, corrosion	
19.	Flanges	C	Damage , paint, corrosion	
20.	Fabricated pipes	S	Damage , paint, corrosion	Provide end cap
21.	Vessels internals	C	Damage , paint, corrosion ,packing	
22.	Grills	S	Damage , paint, corrosion	
23.	Angles	S	Damage , paint, corrosion	
24.	Bridge mechanism/clarifier mechanism	O	Damage , paint, corrosion	
25.	Cranes, rails	S	Damage , paint, corrosion	
26.	Stair cases	O	Damage , paint, corrosion	
27.	Ladders/handrails	O	Damage , paint, corrosion	
28.	Fabricated ducts	S	Damage , paint, corrosion	
29.	Isolation Gates	O	Damage , paint, corrosion	
30.	Fabricated boxes/panels	S	Damage , paint, corrosion	
Mechanical components like valves, fittings, cables glands, spares etc.)				
31.	Valves	S	Damage , packing	

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
32.	Fittings	S	Damage , packing	Provide end cap
33.	Cable glands	C	Damage , packing	
34.	Tools & tackles	C	Damage , packing	
35.	Nut , bolts, washers,	C	Damage , packing	
36.	Gasket & Packings	C	Damage , packing	
37.	Copper tubes	C	Damage , packing, corrosion	Provide end cap
38.	SS tubing	C	Damage , packing	Provide end cap
Rotating assemblies (pumps, blowers, stirrers, fans, compressors etc.)				
39.	Pumps	S	Damage , packing, corrosion	Shaft rotation
40.	Blowers/Compressors	S	Damage , packing, corrosion	Shaft rotation
41.	Agitators/stirrers/radial launders	C	Damage , packing, corrosion	Shaft rotation
42.	Rollers for chlorine tonner mounting	C	Damage , packing, corrosion	
43.	Centrifuge	S	Damage , packing,	
44.	Gear box	C	Damage , packing, corrosion	
45.	Bearings	C	Damage , packing, corrosion	
46.	Fans	S	Damage , packing, corrosion	
47.	Dosing skids	S	Damage , packing, corrosion	
48.	Pump assemblies	S	Damage , packing, corrosion	
49.	Air washers(INTERNALS)	S	Damage , packing	
50.	Air conditioners (split)	C	Damage , packing	

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
51.	Elevators(CONTAINERIZED)	O	Damage , packing, corrosion	
52.	Chillers/VA machines	S	Damage , packing	
53.	Air handling Unit/Package unit	S	Damage , packing	
54.	Chlorinators & Evaporators	C	Damage , packing	
55.	Ejectors	C	Damage , packing	
56.	Electrolyser	C	Damage , packing	
Miscellaneous items like chain pulley blocks, hoists etc.				
57.	Chain pulley blocks	S	Damage, Packing	
58.	Electric hoists	S	Damage, Packing	
59.	Fire extinguishers	C	Damage, expiry date	
60.	Fork Lift Truck	S	Damage, Packing	
61.	Hydraulic Mobile Crane	O	Damage, Packing	
62.	Mobile Pick Up & Carry Crane	O	Damage, Packing	
63.	Motor boats	O	Damage, Packing	
64.	Safety showers	S	Damage, Packing	
65.	Diffusers/dampers	S	Damage, Packing	
Chemicals and consumables (acid, alkali, paints, oils, reagents and special chemicals)				
66.	Hydro Chloric Acid (HCl)	Store in canes/ storage tank in dyke area	Date of production/ leakage/fumes	hazardous chemical
67.	Sulphuric acid (H ₂ SO ₄)	Store in canes/ storage tank in dyke area	Date of production/ leakage/fumes	hazardous chemical

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
68.	Sodium hydroxide (NaOH)	Store in canes/ storage tank in dyke area	Date of production/ leakage/ fumes/ breather	hazardous chemical ,breather to be checked for air ingress
69.	Sodium hypo chlorite	To be stored under shed	Date of production/ leakage/ fumes	hazardous chemical ,self-life normally 15-30 days after which strength of chemical decays
70.	Ammonia	S	Date of production/ leakage/ fumes	Store in closed storage tanks, hazardous chemical
71.	CW treatment chemicals	S	Date of production , Self-life	Store in closed canes
72.	RO/UF cleaning chemicals	S	Date of production , Self-life	Store in closed canes
73.	Lime	C	Damage to packing , seepage	Prevent moisture, rain
74.	Alum bricks	C	Damage to packing	Prevent moisture, rain
75.	Poly electrolyte	S		Store in closed storage tanks
76.	Laboratory chemicals(powder)	C	Damage, Packing self- life	
77.	Laboratory chemicals(liquid)	C	Damage, Packing self- life	
78.	Lubrication oils	C	Leakage	
79.	Paints	S	Leakage ,air tightness	
80.	Sand	O	Damage of packing	No hooks
81.	Salt (NaCl)	C	Damage of packing, water ingress	Prevent moisture, rain
82.	Anthracite	S	Damage of packing	
83.	Activated carbon	S	Damage of packing	

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
84.	Thermal insulation	S	Damage of packing	
85.	Cement	C	Damage of packing	Prevent moisture, rain
86.	Gravels	O	Damage of packing	
87.	ION exchange resins	C	Damage , packing	Refer manufacturer guidelines
88.	RO membranes	C	Damage , packing	Refer manufacturer guidelines
89.	UF membranes	C	Damage , packing	Refer manufacturer guidelines
90.	Cleaning chemicals	C	Damage , packing	Refer manufacturer guidelines
91.	Chemicals for analysers/calibration	C	Damage , packing	Refer manufacturer guidelines
Electrical and C & I items (motors, cables etc.)				
92.	Motors	C	Damage , packing	
93.	Cable drums	O	Damage	
94.	Control Panel /control desk, UPS ,JB	S	Damage, Packing	
95.	Instruments(gauges/analysers)	C	Damage	
Special items		As per Manufacturer's item, like Hydrogen cylinders, Ozonator, Analyser, Chlorine dioxide generators etc.		

5. CONCLUSION

Concerned storage agency at site should make sure that loss in equipment performance and wear & tear are minimised through proper storage and preservation. The above are broad guidelines and cover major equipment / materials. However specific storage practices shall be followed as per manufacturer recommendation. All the necessary measures even in addition to the ones mentioned above, if found necessary, should be taken to achieve the objective.

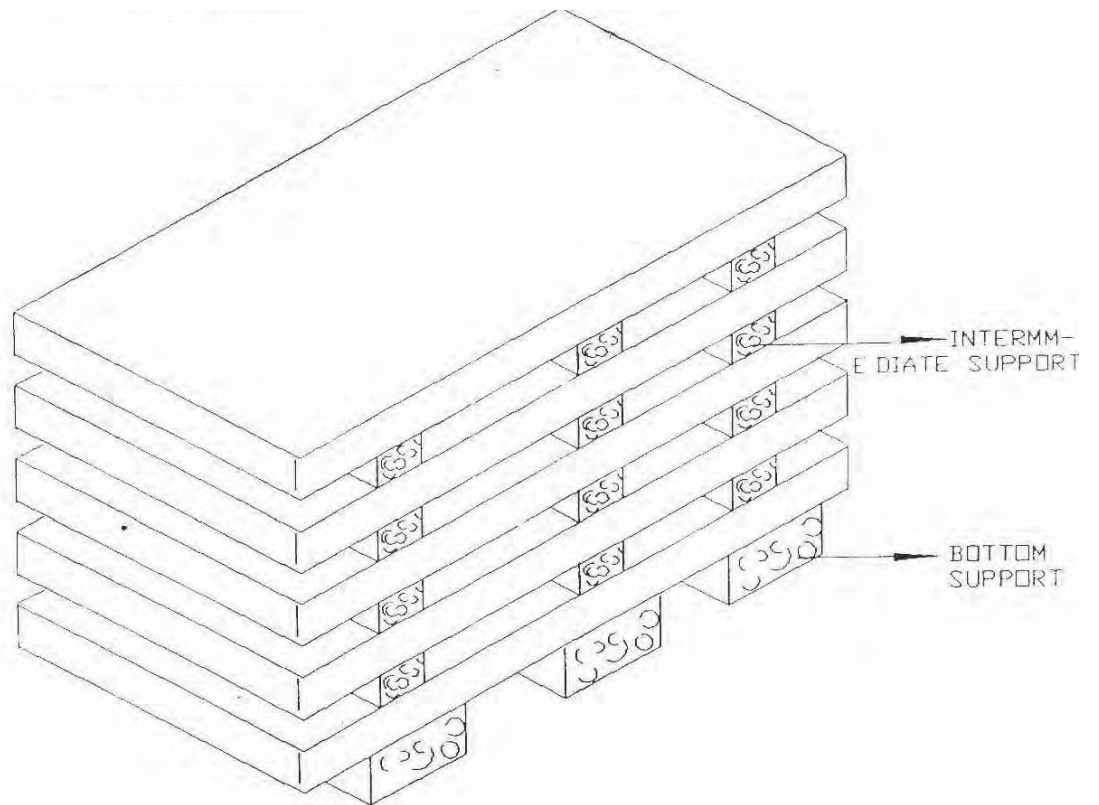


Figure – 1 – PLATE STACKING ARRANGEMENT

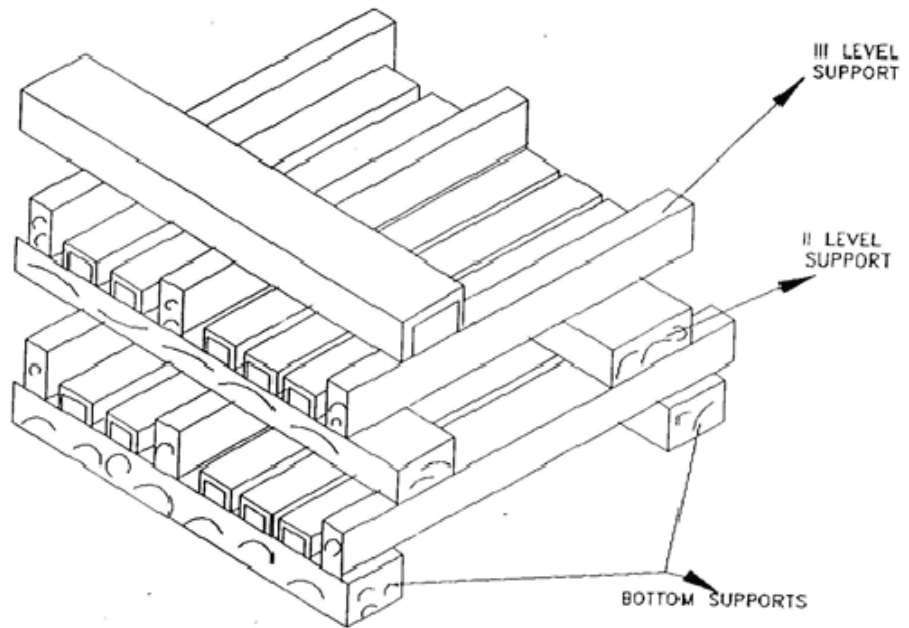


Figure – 2 – STRUCTURAL STEEL STACKING ARRANGEMENT

ANNEXURE-XI

PACKING PROCEDURE
(COVERED UNDER SECTION C 2B)

ANNEXURE-XII
LIST OF COMMISSIONING SPARES

ANNEXURE- XII

1 X 800 MW GSECL WANAKBORI TPP, UNIT NO-8

LIST OF COMMISSIONING SPARES (Required for Commissioning of Compressed Air System)

Break up price for COMMISSIONING SPARES

Sl. no	Description	Qty.	Unit	Unit price	Total Ex-Works Prices duly packed	ED	CST	FREIGHT Inclusive Service Tax	Total price FOR SITE
	TC (K type)	2 Nos							
	RTD (Pt 100)	2 Nos							
	Presssure Transmitters	3 Nos							
	Diff Pressure Transmitters	3 Nos							
	DIN type Temp transmitters	4 Nos							
	Contol Valve								
	a. One pair of gaskets for each valve								
	a. One set of packing for each valve								
	Oil (To be supplied for all 6 compressor)	1 Lot							
	Lube Oil Filter (1 set for each compressors)	5 Sets							
	Air Filters (1 set for each compressors)	5 Sets							
	Total (Rs)								

NOTE -

1. The items indicated in the above list are minimum. Any other spares if required shall be included by bidder in the above list.
2. Bidder shall furnish unit price of commissioning spares in above format alongwith the Bid. Any part even though not mentioned in list furnished but required at later date shall be supplied free of cost.
3. Bidder to note that the items indicated in the above list shall be provided prior to commissioning of the Compressed air System. Further, items indicated in the list shall be supplied over and above the consummables that is supplied along with the compressors/compressed air system prior to start up.

VOLUME : III
SECTION : 1

**LIST OF DOCUMENTS TO BE SUBMITTED
WITH BID**

CHECK LIST TO BE SUBMITTED BY BIDDER ALONG WITH THE BID

SI No.	Item Description	Yes/No
1	Schedules to be submitted dully filled up with bidder's signature and stamp. 1) Technical Deviation Schedule (Volume III-Section-4) 2) List of Mandatory Spares (Volume II-Annexure-II) 3) List of Maintenance Tool & Tackles (Volume II-Annexure-IV) 4) List of commissioning spares (Volume II-Annexure-XII) 5) Guaranteed Power Consumption For Air Compressor System (Volume III-Section-6) 6) Compliance and Confirmation certificate (Volume III-Section-2) 7) List of recommended spares (Volume III-Section-9)	
2	Resolution to pre-bid clarifications, if any, duly stamped and signed by the bidder enclosed with the bid	
3		
4	Un-priced bid- clearly indicating 'QUOTED' and 'NOT-QUOTED' against each item.	
5	'Compressor House Layout (Document no.PE-DG-408-555-SK002)-(Volume III-Section-8) of technical specification' duly stamped and signed by bidder to be enclosed with the bid.	
6	Electrical load List (Volume III-section-5) of technical specification duly filled, stamped and signed by bidder to be enclosed with the bid	
7	Supporting Documents meeting PQR requirements (if Applicable)	
8	Offered model of compressor matching FAD calculation along with the catalogue of the offered model to justify selection.	

Please note that all the schedules shall be submitted even though they may not be applicable. Under such circumstances it shall be clearly mentioned across such schedules that these are not applicable.(e.g. in case of there are no technical deviation, it shall be mentioned in the deviation schedule that ' THERE ARE NO DEVIATIONES TO THE TECHNICAL SPECIFICATION').

Name: _____

Signature: _____

Designation: _____

Company: _____

Date: _____

Bidder Stamp

VOLUME-III
SECTION 2
COMPLIANCE CUM CONFIRMATION CERTIFICATE



TITLE: TECHNICAL SPECIFICATION 1X800 MW WANAKBORI TPS COMPLIANCE CUM CONFIRMATION CERTIFICATE	SPEC. NO.: PE-TS-408-555-A001
	VOLUME: III
	SECTION:
	REV. NO. 0 DATE
	SHEET 1 OF 2

COMPLIANCE CUM CONFIRMATION CERTIFICATE

The bidder shall confirm compliance with following by signing/ stamping this compliance certificate (every sheet) and furnish same with the offer.

- a) The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusions other than those mentioned under “exclusion” and those resolved as per ‘Schedule of Deviations’, if applicable, with regard to same.
- b) There are no other deviations w.r.t. specifications other than those furnished in the ‘Schedule of Deviations’. Any other deviation, stated or implied, taken elsewhere in the offer stands withdrawn unless specifically brought out in the ‘Schedule of Deviations’.
- c) Bidder shall submit QP in the event of order based on the guidelines given in the specification & QP enclosed therein. QP will be subject to BHEL/ CUSTOMER approval & customer hold points for inspection/ testing shall be marked in the QP at the contract stage. Inspection/ testing shall be witnessed as per same apart from review of various test certificates/ Inspection records etc. This shall be within the contracted price with no extra implications to BHEL after award of the contract.
- d) All drawings/ data-sheets/ calculations etc. submitted along with the offer shall be considered for reference only, same shall be subject to BHEL/ CUSTOMER approval in the event of order.

- e) The offered materials shall be either equivalent or superior to those specified in the specification & shall meet the specified/ intended duty requirements. In case the material specified in the specifications is not compatible for intended duty requirements then same shall be resolved by the bidder with BHEL during the pre - bid discussions, otherwise BHEL/ Customer’s decision shall be binding on the bidder whenever the deficiency is pointed out.

For components where materials are not specified, same shall be suitable for intended duty, all materials shall be subject to approval in the event of order.

- f) The commissioning spares shall be supplied on ‘As Required Basis’ & prices for same included in the base price itself.
- g) All sub vendors shall be subject to BHEL/ CUSTOMER approval in the event of order.
- h) Guarantee for plant/equipment as applicable, shall be as per relevant clause of GCC /SCC /Other Commercial Terms & Conditions.
- i) In the event of order, all the material required for completing the job at site shall be supplied by the bidder within the ordered price even if the same are additional to approved billing break up, approved drawing or approved Bill of quantities. This clause will apply in case during site commissioning additional requirements emerges due to customer and/ or consultant’s comments. No extra claims shall be put on this account.
- j) Schedule of drawings submissions, comment incorporations & approval shall be as stipulated in the specifications. The successful bidder shall depute his design personnel to BHEL’s/ Customer’s/ Consultant’s office for across the table resolution of issues and to get documents approved in the stipulated time.



TITLE:
TECHNICAL SPECIFICATION
1X800 MW WANAKBORI TPS
COMPLIANCE CUM CONFIRMATION
CERTIFICATE

SPEC. NO.: PE-TS-408-555-A001
VOLUME: III
SECTION:
REV. NO. 0 DATE
SHEET 2 OF 2

- k) As built drawings shall be submitted as and when required during the project execution.
- l) The bidder has not tempered with this compliance cum confirmation certificate and if at any stage any tempering in the signed copy of this document is noticed then same shall be treated as breach of contract and suitable actions shall be taken against the bidder.

SIGNATURE: _____

NAME : _____

DESIGNATION: _____

COMPANY: _____

DATE: _____

COMPANY SEAL



PRE-BID CLARIFICATION SCHEDULE

SPECIFICATION No: PE-TS-408-555-A001

VOLUME: III

SECTION : 3

REV. 00

DATE: 22.08.15

**VOLUME: III
SECTION: 3
PRE-BID CLARIFICATION SCHEDULE**

VOLUME-III
SECTION 4
SCHEDULE OF TECHNICAL DEVIATION

DEVIATION SHEET (COST OF WITHDRAWL)



PROJECT:- 1X800 MW WANAKBORI TPS

PACKAGE:- COMPRESSED AIR SYSTEM

TENDER ENQUIRY REFERENCE:-

NAME OF VENDOR:-

SL NO	VOULME/ SECTION	PAGE NO.	CLAUSE NO.	TECHNICAL SPECIFICATION/ TENDER DOCUMENT	COMPLETE DESCRIPTION OF DEVIATION	COST OF WITHDRAWL OF DEVIATION	REFERENCE OF PRICE SCHEDULE ON WHICH COST OF WITHDRAWL OF DEVIATION IS APPLICABLE	NATURE OF COST OF WITHDRAWL OF DEVIATION (POSITIVE/ NEGATIVE)	REASON FOR QUOTING DEVIATION
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TECHNICAL DEVIATIONS

COMMERCIAL DEVIATIONS

PARTICULARS OF BIDDERS/ AUTHORISED REPRESENTATIVE

NAME	DESIGNATIONS	SIGN & DATE

NOTES:

- For self manufactured items of bidder, cost of withdrawal of deviation will be applicable on the basic price (i.e. excluding taxes, duties & freight) only.
- For directly dispatchable items, cost of withdrawal of deviation will be applicable on the basic price including taxes, duties & freight.
- All the bidders have to list out all their Technical & Commercial Deviations (if any) in detail in the above format.
- Any deviation not mentioned above and shown separately or found hidden in offer, will not be taken cognizance of.
- Bidder shall submit duly filled unpriced copy of above format indicating "quoted" in "cost of withdrawal of deviation" column of the schedule above along with their Techno-commercial offer, wherever applicable.
- Bidder shall furnish price copy of above format along with price bid.
- The final decision of acceptance/ rejection of the deviations quoted by the bidder shall be at discretion of the Purchaser.
- Bidders to note that any deviation (technical/commercial) not listed in above and asked after Part-I opening shall not be considered.
- For deviations w.r.t. Payment terms, Liquidated damages, Firm prices and submission of E1/ E2 forms before claiming 10% payment, if a bidder chooses not to give any cost of withdrawal of deviation loading as per Annexure-VIII of GCC, Rev-06 will apply. For any other deviation mentioned in un-priced copy of this format submitted with Part-I bid but not mentioned in priced copy of this format submitted with Priced bid, the cost of withdrawal of deviation shall be taken as NIL.
- Any deviation mentioned in priced copy of this format, but not mentioned in the un-priced copy, shall not be accepted.
- All techno-commercial terms and conditions of NIT shall be deemed to have been accepted by the bidder, other than those listed in unpriced copy of this format.
- Cost of withdrawal is to be given separately for each deviation. In no event bidder should club cost of withdrawal of more than one deviation else cost of withdrawal of such deviations which have been clubbed together shall be considered as NIL.
- In case nature of cost of withdrawal (positive/negative) is not specified it shall be assumed as positive.
- In case of discrepancy in the nature of impact (positive/ negative), positive will be considered for evaluation and negative for ordering.

**VOLUME-III
SECTION 5
ELECTRICAL LOAD DATA**

LOAD TITLE	RATING (KW / A)		UNIT (U)/STN (S)	Nos.		VOLTAGE CODE*	FEEDER CODE**	EMER. LOAD (Y)	CONT.(C)/ INTT.(I)	STARTING TIME >5 SEC (Y)	LOCATION	BOARD NO.	CABLE		BLOCK CABLE DRG. No.	CONTRO L CODE	REMARKS	LOAD No.
	NAME PLATE	MAX. CONT. DEMAND (MCR)		RUNNING	STANDBY								SIZE CODE	NOs				
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19

INSTRUMENT AIR COMPRESSORS	300 KW		S	2	1	C	U	N	C		Compressor House							
SERVICE AIR COMPRESSORS	300 KW		S	2	1	C	U	N	C		Compressor House							
INSTRUMENT AIR COMPRESSOR FAN MOTOR (IF REQUIRED SEPARATE POWER SUPPLY)	2.2 KW		S	2	1	D	U	N	C		Compressor House							
SERVICE AIR COMPRESSOR FAN MOTOR (IF REQUIRED SEPARATE POWER SUPPLY)	2.2 KW		S	2	1	D	U	N	C		Compressor House							
INSTRUMENT AIR COMPRESSOR PANEL	3 KW		S	2	1	E	S	N	C		Compressor House							
SERVICE AIR COMPRESSOR PANEL	3 KW		S	2	1	E	S	N	C		Compressor House							
INSTRUMENT AIR COMPRESSORS MOTOR SPACE HEATER	0.15 KW		S	2	1	E	D	N	I		Compressor House							
INSTRUMENT AIR COMPRESSORS MOTOR SPACE HEATER	0.15 KW		S	2	1	E	D	N	I		Compressor House							
AIR DRYER PLANT PANEL	2 KW		S	2	1	D	S	N	C		Compressor House							
AIR DRYER PLANT MOTOR	9 KW		S	2	1	D	U	N	C		Compressor House							
UPS LOAD REQUIRED FOR PLC & ACCESSORIES	6KVA		S	1	-	E	-	-	C		Compressor House							

NOTES: 1. COLUMN 1 TO 12 & 18 SHALL BE FILLED BY THE REQUISITIONER (ORIGINATING AGENCY); REMAINING COLUMNS ARE TO BE FILLED UP BY PEM (ELECTRICAL)/ CUSTOMER
2. ABBREVIATIONS : * VOLTAGE CODE (7):- (ac) A=11 KV, B=6.6 KV, C=3.3 KV, D=415 V, E=240 V (1 PH), F=110 V (cc): G=220 V, H=110 V, J=48 V, K=+24V, L=-24 V
: ** FEEDER CODE (8):- U=UNIDIRECTIONAL STARTER, B=BI-DIRECTIONAL STARTER, S=SUPPLY FEEDER, D=SUPPLY FEEDER (CONTACTER CONTROLLED)

LOAD DATA (ELECTRICAL)	JOB NO.	408		ORIGINATING AGENCY		PEM (ELECTRICAL)	
	PROJECT TITLE	1X800 MW WANAKBORI TPS		NAME			DATA FILLED UP ON
	SYSTEM	COMPRESSED AIR SYSTEM		SIGN.			DATA ENTERED ON
	DEPTT. / SECTION	MAX		SHEET 1 OF 2	REV. 00	DE'S SIGN. & DATE	

LOAD TITLE	RATING (KW / A)		UNIT (U)/STN (S)	Nos.		VOLTAGE CODE*	FEEDER CODE**	EMER. LOAD (Y)	CONT.(C)/ INTT.(I)	STARTING TIME >5 SEC (Y)	LOCATION	BOARD NO.	CABLE		BLOCK CABLE DRG. No.	CONTRO L CODE	REMARKS	LOAD No.
	NAME PLATE	MAX. CONT. DEMAND (MCR)		RUNNING	STANDBY								SIZE CODE	NOs				
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
AUTO DRAIN TRAP	0.02 KW		S	8	-	E	S	N	I		8 nos. at Compressor House							
Any other power supply as required by bidder	To be filled by bidder																	

Note:

- Bidder to confirm that the system provided by them would be catered by the above loads considered by BHEL. In case there is any variation, the same should be clearly stated in the technical offer. No changes would be admissible during detailed engineering stage.
- Bidder to note that for the system being supplied by them, only the above loads will be provided. In case any other load is required the same would be derived / multiplied by bidder on their own from these feeders only.
- Any change in the electrical load list shall be entertained only subject to its feasibility, and BHEL reserves the right to debit the vendor cost of any changes necessitated in the switch gear /MCC on account of changed loads.

NOTES: 1. COLUMN 1 TO 12 & 18 SHALL BE FILLED BY THE REQUISITIONER (ORIGINATING AGENCY); REMAINING COLUMNS ARE TO BE FILLED UP BY PEM (ELECTRICAL)/ CUSTOMER
2. ABBREVIATIONS : * VOLTAGE CODE (7):- (ac) A=11 KV, B=6.6 KV, C=3.3 KV, D=415 V, E=240 V (1 PH), F=110 V (cc): G=220 V, H=110 V, J=48 V, K=+24V, L=-24 V
: ** FEEDER CODE (8):- U=UNIDIRECTIONAL STARTER, B=BI-DIRECTIONAL STARTER, S=SUPPLY FEEDER, D=SUPPLY FEEDER (CONTACTER CONTROLLED)

LOAD DATA (ELECTRICAL)	JOB NO.	408		ORIGINATING AGENCY		PEM (ELECTRICAL)		
	PROJECT TITLE	1X800 MW WANAKBORI TPS		NAME			DATA FILLED UP ON	
	SYSTEM	COMPRESSED AIR SYSTEM		SIGN.			DATA ENTERED ON	
	DEPTT. / SECTION	MAX		SHEET 2 OF 2	REV. 00			DE'S SIGN. & DATE

VOLUME-III
SECTION 6
GUARANTEED POWER CONSUMPTION

1 X 800 MW WANAKBORI TPP

GUARANTEED POWER CONSUMPTION - COMPRESSED AIR SYSTEM PACKAGE

Guaranteed Power Consumption For Air Compressor System Shall be as per Following :

S.No. (1)	Description of Equipments (2)	Nos. of Equipments (3)		Total Guaranteed Power Consumption for Each Equipment at Motor Input Terminals & control Panel (4)	Duty Factor (5)	Total (KW) (6) = (3A)*(4)*(5)
		Working (3A)	Standby (3B)			
1	Serive Air Compressor (Oil free Screw type) 30 NM3/min at 8.5 Kg/cm2 pressure	2	1		1	
2	Instrument Air Compressor (Oil free Screw type) 30 NM3/min at 8.5 Kg/cm2	2	1		1	
3	Air Drying Plant Unit (Refrigerant type)	2	1		1	
					TOTAL	
Note :						
1	Estimated Power Consumption Figure for the compressed air system (For Working Drives Only) considered is 1100 KW (For station)					
2	Bidders Guaranteed power consumption at motor input terminals (Not Shaft Power) including power for control panel as furnished in guaranteed schedule shall be demonstrated by the successful bidder during performance testing at works/site.					
3	The price quoted by the bidder shall be loaded @ (INR)200000/- for every additional kW increase in consumption from the base figure indicated at Note no. 1.0 above.					
4	In case the successful bidder fails to establish / prove the guaranteed values of power consumption (base figure of auxiliary power consumption) on actual performance testing at the manufacturing works / site, penalty @ (INR)200000/- per kW increase in power consumption figure shall be levied.					

SECTION: 7

SUGGESTIVE PRICE FORMAT

PRICE SCHEDULE - COMPRESSED AIR SYSTEM PACKAGE

Sl.No	DESCRIPTION OF EQUIPMENT / ITEM	Ex-works price	ED	CST / VAT	FREIGHT	E&C Charges	Service tax on E & C	Total
1	2	3	4	5	6	7	8	9 (3 to 8)
1.0.0	Total lumpsum firm prices for the supply of equipment & services as specified, Comprising Design, Engineering, Manufacture, Inspection & Testing at Manufacturer's Works, Painting at Manufacturer's Works, Duly packed for Transportation, Delivery to Site, loading, unloading & storage at site, supply of erection materials, consumables, start-up & commissioning spares, and mandatory spares as required to complete the compressed air system including service part for unloading, storage & handling at site, erection, commissioning, trial run, carrying out performance tests at site, handing over to customer in line with drawings/ documents/ test procedures approved by BHEL/ customer, for the total scope defined in technical specification (spec.No. PE-TS-408-555-A001) and terms & conditions of tender, taking into account all clarifications, confirmations and agreements till date for Compressed Air System for 1 X 800 MW WANAKBORI TPS.							
NOTES	<i>Bidder to note that total price indicated above at 1.0.0 shall be considered for evaluation and hence should be complete in all respect for the full scope defined and considering all terms and conditions agreed.</i>							
a	<i>Any item not included in the price quoted above and shown separately will not be taken cognizance of and the offer shall be liable for rejection.</i>							
b	<i>Total Lumpsum price in column-9 should match with summation of total prices as in [Column (12) of 1.0.0 of Annexure- I + Column (9) of A of Annexure - II + Column (5) of 1.0.0 of Annexure- III .</i>							
c	<i>As per cl. no. 3.0 of GCC Rev-06, Total erection & commissioning charges including service tax should be minimum 20% (or as specified in NIT) of the total quoted package price (excluding mandatory spares but including all taxes and freight), failing which the break-up of prices shall be adjusted accordingly for ordering.</i>							
d	<i>All deviations should be marked in Cost of withdrawal sheet (Annexure-VI) only. Deviations marked elsewhere other than schedule of deviation shall not be taken into cognizance.</i>							
e	<i>Bidder to fill import content in Annexure-IV. However,any benefits w.r.t taxes and duties will be governed by the commercial terms and conditions in this tender.</i>							
f	<i>Bidder must submit prices in the Pro Forma duly filled in signed and stamped on every page without any ambiguity. The price shall be written against each item. Term such as "refer covering letter" etc. are not acceptable. Price format shall not be changed by the bidder as the bidder may get disqualified by doing so.</i>							
	Bidder's / bidder's representative signature				Company seal			

PRICE SCHEDULE													Rev 00	02.09.15
1 X 800 MW KOTHAGUDAM TPP														
ANNEXURE-I														
MAIN SUPPLY - PRICE SCHEDULE FOR COMPRESSED AIR SYSTEM PACKAGE														
Sl.No	DESCRIPTION OF EQUIPMENT / ITEM	QUANTITY	UNIT PRICE				TOTAL PRICE					REMARKS		
			Ex-works price	ED	CST / VAT	FREIGHT	Ex-works price	ED	CST / VAT	FREIGHT	FOR SITE			
1	2	3	4	5	6	7	8	9	10	11	12 (8 to 11)			
1.0.0	Total lumpsum firm prices for the supply of equipment & services as specified, Comprising Design, Engineering, Manufacture, Inspection & Testing at Manufacturer's Works, Painting at Manufacturer's Works, Duly packed for Transportation, Delivery to Site, loading, unloading & storage at site, supply of erection materials, consumables, start-up & commissioning spares, and mandatory spares as required to complete the compressed air system for the total scope defined in technical specification (spec.No. PE-TS-408-555-A001) and terms & conditions of tender, taking into account all clarifications, confirmations and agreements till date for Compressed Air System for 1 X 800 MW Wanakbori TPS.													
2.0.0	Break up prices for items covered in clause 1.0 above. Prices for design, manufacture,													
2.1.0	Instrument Air Compressor (oil free Screw) Each of 30 NM3/Minute capacity at 8.5 kg/cm2 (g) consisting Electric motor to drive the compressor with accessories, Suction filter and silencer, Inter Cooler, After Cooler with moisture separators, automatic drain traps, instruments, Control panel etc.	3	Nos									Column (12) of this clause shall be within 30-33 % of Total price at column 12 of 1.0.0		
2.2.0	Service Air Compressor (oil free Screw) Each of 30 NM3/Minute capacity at 8.5 kg/cm2 (g) consisting Electric motor to drive the compressor with accessories, Suction filter and silencer, Inter Cooler, After Cooler with moisture separators, automatic drain traps, instruments, Control panel etc.	3	Nos									Column (12) of this clause shall be within 30-33 % of Total price at column 12 of 1.0.0		
2.3.0	Air Dryer (Refrigerant Type) Air Drying Plant of 33 NM ³ /min and to match instrument air compressor with all instruments and controls including Electronic Dew point meter as specified.	3	Nos									Column (12) of this clause shall be within 10-17 % of Total price at column 12 of 1.0.0		
2.4.0	Air receivers Air receiver at Compressor house of 16 M3 capacity with each having Pressure gauges, Temperature gauges, Relief valve, Drain connection with zero purge type automatic trap stations and other accessories as specified.	8	Nos									Column (12) of this clause shall be within 6-8 % of Total price at column 12 of 1.0.0		
2.5.0	Pipes & fittings Inter connecting cooling water, compressed air piping & Drain piping up to the nearest common drain point outside compressor house as specified including fittings and valves, etc. for complete compressed air system.	1	Lot									Column (12) of this clause shall be within 10-12 % of Total price at column 12 of 1.0.0		
2.6.0	Field instruments including temperature scanners , sequential panel, PLC interface module for the overall control of the compressed air system through DDCMIS as specified.	1	Lot									Column (12) of this clause shall be within 3-5 % of Total price at column 12 of 1.0.0		
2.7.0	Cable, Cable lugs, glands, junction box etc for Compressed Air System equipment as required.	1	Lot											
2.8.0	Total lump sum prices for Maintenance Tool & Tackles (as specified in the Annexure-IV , Volume-II of the technical specification PE-TS-408-555-A001)	1	Lot									Column (12) of this clause shall be within 1-2 % of Total price at column 12 of 1.0.0		
2.9.0	Total lump sum prices for Start-Up & commissioning spares (as specified in the Annexure-XII , Volume-II of the technical specification PE-TS-408-555-A001)													
3.0.0	Total of 2.0 (Total of 2.1 to 2.9) (Should match with 1.0). However , the break up prices indicated under this head are for internal use only & NOT for any comparison purpose & or making adjustment for scope variation.)											Column (12) of this clause shall be 100 % of Total price at column 12 of 1.0.0		
	Bidder's / bidder's representative signature											Company seal		

PRICE SCHEDULE									
				Rev 00	31.08.2015				
1 X 800 MW WANAKBORI TPS									
ANNEXURE II									
PRICE SCHEDULE FOR MANDATORY SPARES OF COMPRESSED AIR SYSTEM PACKAGE									
Sl.no	Description	Qty.	Qty. Offered	Unit Ex-works price	Total ex-works price	ED	CST	FREIGHT	FOR SITE
1	2		3	4	5	6	7	8	9
X. Mechanical									
SCREW COMPRESSOR									
1.1	HP Stages of Compressor								
	(i) HP element	One (1) Set							
	(ii) Packing Set	Four (4) Sets							
	(iii) Axial thrust brg.	Two (2) Sets							
	(iv) Labyrinth oil seal or radial seals or double acting seals for drive shaft	Four (4) Sets							
	v) Bearing for male & female rotors (DE & NDE)	Two (2) each							
	vi) Timing Gears	One (1)							
	vii) Suction & discharge valves	Two (2) each							
1.2	LP Stages of Compressor								
	(i) LP element	One (1) Set							
	(ii) Graphitic ring shaft seals for compressor chamber or whitemetal labyrinth seals	Four (4) Sets							
	(iii) Packing Set	Four (4) Sets							
	(iv) Axial thrust Bearing	Two (2) Sets							
	v) Bearing for male & female rotors (DE & NDE)	Two (2) each							
	vi) Timing Gears	One (1)							
	vii) Suction & discharge valves	Two (2) each							
1.3	Main Bearing	Two (2) each							
1.4	Set up gear/pinion	One (1)							
1.5	Air intake filter element with gaskets	Eight (8)							
1.6	Oil filter element with gaskets & seals	Eight (8)							
1.7	Safety valve springs & gaskets	Four (4)							
1.8	One set of inbuilt automatic drain valve	Four (4)							
1.9	Gearcase breather filterelemnt	One (1)							
1.10	Drain valve kit	One (1)							
1.11	Compressors Coolers								

PRICE SCHEDULE									
				Rev 00	31.08.2015				
1 X 800 MW WANAKBORI TPS									
ANNEXURE II									
PRICE SCHEDULE FOR MANDATORY SPARES OF COMPRESSED AIR SYSTEM PACKAGE									
Sl.no	Description	Qty.	Qty. Offered	Unit Ex-works price	Total ex-works price	ED	CST	FREIGHT	FOR SITE
1	2		3	4	5	6	7	8	9
	i) Gaskets & seals for inter cooler and after cooler	Four (4)							
	ii) Inter cooler drain check valve	One (1)							
1.12	Oil Pump/Motor								
	i) Oil pump complete assembly	One (1)							
	ii) Pump impeller/rotor with shaft	One (1)							
	iii) Set of bearings	Two (2) Sets							
	iv) Oil pump motor bearing	Two (2)							
1.13	Shaft driven oil pump								
	i) Drive gear with shaft	One (1)							
	ii) Driven gear with shaft	One (1)							
1.14	Drain tap elements	Four (4)							
1.15	Moisture tap elements	Four (4)							
1.16	Oil cooler gaskets and seals	Four (4)							
1.17	Seal Washer	Two (2)							
1.18	Mass flow Meter	One (1)							
1.19	Air Drying Plant								
	i) Pre filter element (ceramic candle)	Two (2)							
	ii) After filter element (ceramic candle)	Two (2)							
	iii) Heater element (if required)	Two (2)							
	iv) Blower bearing (if required)	Two (2)							
	v) Blower motor bearing (if required)	Two (2)							
	vi) Valve actuators	Two (2)							
	vii) Inlet & Outlet valve for Dryer	One (1) Set							
	viii) Automatic drain valves (No air loss type)	One (1) Set							
	ix) Expansion valves	One (1) Set							
	x) Filter Dryer	One (1) Set							
	xi) Air cooler condenser fan	One (1) Set							
	Y. Electrical								
	PMCC/MCC/ACDB (As applicable)								
	2.1 Contactor								
2.1.1	Power Contactor (AC)								
2.1.1.1	Power Contactor Complete Assembly	4 Nos.for each type and rating							
2.1.1.2	Power Contactor spare kits	10Sets for each type and rating							
2.1.1.3	Power Contactor AC Coils	10Nos. Coils for each type and rating							
2.1.2	Auxiliary Control Contactor (AC)								

PRICE SCHEDULE									
				Rev 00	31.08.2015				
1 X 800 MW WANAKBORI TPS									
ANNEXURE II									
PRICE SCHEDULE FOR MANDATORY SPARES OF COMPRESSED AIR SYSTEM PACKAGE									
Sl.no	Description	Qty.	Qty. Offered	Unit Ex-works price	Total ex-works price	ED	CST	FREIGHT	FOR SITE
1	2		3	4	5	6	7	8	9
2.1.2.1	Auxiliary Control Contactor Complete Assembly	30 Nos.for each type and rating							
2.1.2.2	Auxiliary Control Contactor spare kits	40 Sets for each type and rating							
2.1.2.3	Auxiliary Control Contactor AC Coils	35 Nos.for each type and rating							
2.2	MCCB (Power Circuit)	5 Nos. for each type and rating							
2.3	MCB (Control Circuit)	25 Nos.for each type and rating							
2.4	Switch								
2.4.1	Local / Remote Selector Switch	10Nos.							
2.4.2	MCCB Status (On/off) Monitoring Switch/Contact	5Nos.							
2.4.3	Trial / Normal /MCC Selector Switch	15Nos.							
2.4.4	MCC module Service Position Limit Switch	5Nos.							
2.5	Thermal Overload Relay	5Nos. for each type and rating							
2.6	Sliding Contact (Fixed & Moving)	25Sets							
2.7	Bus bar to MCC module Lira Contact Assembly (Bus-end & MCC Module end)	5Sets for each type and rating							
2.8	Indicating Lamps complete assembly								
2.8.1	Red	30Sets							
2.8.2	Amber	30Sets							
2.8.3	Green	30Sets							
2.9	Push Button (On/Off) Complete	20Sets							
2.1	CT	1No.for each type and rating							
2.11	Ammeter	1No. for each type and rating							
2.12	Control Transformer	1No. for each type and rating							
2.13	Off Delay/ On Delay Timer	5Nos.for each type and rating							
2.14	Switch Fuse Unit	5Nos.for each type and rating							
2.15	Terminal Block								
2.15.1	Power Terminal Block	10% of total nos. for each type and rating used in the system or minimum one (1) no. whichever is more							
2.15.2	Control Terminal Block	10% of total nos. for each type and rating used in the system or minimum one (1) no. whichever is more							
2.15.3	End Plate for Power & Control Terminal Block	Each type 25Nos.							
2.3	Energy Meter	1No. For each type &rating							
2.4	Control Panel/Desk Mounted Items								
2.4.1	Push Button								
2.4.1.1	Complete assembly	5Nos for each colour							
2.4.1.2	Contact Element (1NO + 1NC) Block	20Nos.							
2.4.2	Selector Switch	10Nos. for each type and rating							
2.4.3	Meter (Analog or Digital)								
2.4.1	Ammeter	10% for each type and range or minimum one (1) no. whichever is more							

PRICE SCHEDULE									
				Rev 00	31.08.2015				
1 X 800 MW WANAKBORI TPS									
ANNEXURE II									
PRICE SCHEDULE FOR MANDATORY SPARES OF COMPRESSED AIR SYSTEM PACKAGE									
Sl.no	Description	Qty.	Qty. Offered	Unit Ex-works price	Total ex-works price	ED	CST	FREIGHT	FOR SITE
1	2		3	4	5	6	7	8	9
2.4.2	Voltmeter	10% for each type and range or minimum one (1) no. whichever is more							
2.4.3	Frequency	10% for each type and range or minimum one (1) no. whichever is more							
2.4.4	MW	10% for each type and range or minimum one (1) no. whichever is more							
2.4.5	MVAR	10% for each type and range or minimum one (1) no. whichever is more							
2.4.6	Power Factor	10% for each type and range or minimum one (1) no. whichever is more							
2.4.7	Synchroscope	10% for each type and range or minimum one (1) no. whichever is more							
2.5	Indicating Lamps complete assembly	10Nos. for each Colour and type							
2.6	Mimic Lamps	10Nos. for each Colour and type							
2.7	MCB	2Nos. for each type and rating							
2.8	Door Limit Switch	2Nos.							
2.9	Annunciation system								
2.9.1	Lamp Box with Facia & Lamps (LED type)	25Nos.							
2.9.2	Hooter	1No.							
2.9.3	Each type of PCB (for non-PLC driven system)	1(one) no.							
2.1	Actuator								
2.10.1	Complete set of Actuator	1No. for each type and rating							
2.10.2	Limit Switch	2 Nos each type and rating							
2.10.3	Torque Switch	2 Nos each type and rating							
2.10.4	Auxiliary Contact	1 no each type and rating							
2.10.5	Motor	1 no each type and rating							
2.10.6	Complete Seal kit	1Set for each type and rating							
2.10.7	Complete O-Ring Set	1Set							
Z.	C&I								
3.1	Field Instruments (Transmitters/temperature elements (TC / RTD) / Gauges / Switches etc. along with relevant accessories)	10 (ten) percent of total of each type or at least one (whichever is higher) of each type along with accessories.							
3.2	Control System (DCS, PLC etc.)								
3.2.1	keyboard and cursor control devices.	2 (two) numbers each							
3.2.2	LCD TFT (24") Monitors.	2 (two) numbers							
3.2.3	Spare interface cables with connecting plugs	10 (ten) sets for each type of peripherals & I / O hardware.							
3.2.4	Power supply modules	10 (ten) percent for each type or 4 (four) numbers, whichever is higher.							
3.2.5	Electronic modules (I / O)	10 (ten) percent of the total qty. offered for each type or 5 (five) numbers of each							
3.2.6	Bus couplers and communication interface cards	10 (ten) percent of total of each type or 2 (two) numbers of bus couplers and							
3.2.7	Controllers for DCS,Control panel ST,Boiler control system,Balance	10%of each type(at least 1 no. of each type) whichever is higher.							

PRICE SCHEDULE									
				Rev 00	31.08.2015				
1 X 800 MW WANAKBORI TPS									
ANNEXURE II									
PRICE SCHEDULE FOR MANDATORY SPARES OF COMPRESSED AIR SYSTEM PACKAGE									
Sl.no	Description	Qty.	Qty. Offered	Unit Ex-works price	Total ex-works price	ED	CST	FREIGHT	FOR SITE
1	2		3	4	5	6	7	8	9
3.3	Valves, Actuators & Accessories								
3.3.1	Control Valves								
3.3.1.1	Control valve stem packing , as offered.	2 (two) sets for each of the control valves							
3.3.1.2	of spare valve trim (including cage, plug, stem, seat rings,	1 (one) set for both the units for each of the control valves, as offered.							
3.4	Actuators								
3.4.1	Actuators with drive	1 (one) set of each type and rating.							
3.4.2	Valve positioners	10 (ten) percent of each type.							
3.4.3	Position transmitters	10 (ten) percent of each type.							
3.4.4	Limit switches/torque switches	10 (ten) percent of each type.							
A	Total Lumpsum price of Mandatory Spares								
Notes									
a)	Unless stated otherwise, a 'set' means item or sub-items required for each type/ size, range of assembly/ sub- assembly required for complete replacement in one equipment system; it is further intended that the assembly/ sub-assembly which have different orientation (like left hand or right hand, top or bottom), different direction of rotation or mirror image positioning or any other reasons which result in marinating two different sets of spares to be used for subject assembly/ sub assembly, these shall be considered as different type of assembly/ sub assembly.								
b)	Wherever quantity has been specified as percentage(%), the quantity of mandatory spares to be provided by the vendor shall be the specified percentage (%) of total population required to meet the specification requirements. In case the quantity of mandatory spares so calculated happens to be in fraction, the same shall be rounded off to next higher whole number.								
c)	Wherever the quantities have been indicated for each type, size, thickness, material, radius , range etc, these shall cover all the items supplied and installed and the breakup of these shall be furnished by the vendor during detail engineering.								
d)	In case spares indicated in the list are not applicable to the particular design offered by the bidder, the bidder should offer spares applicable to the offered design with quantities genaerally in line with the approach followed in the above list.								
e)	Wherever bidder has indicated an item as not applicable, the same will have to be supplied free of cost, incase it is found applicable during detail engineering.								
Bidder's / bidder's representative signature							Company seal		

PRICE SCHEDULE					Rev 00	31.08.2015
1 X 800 MW WANAKBORI TPS						
ANNEXURE-III						
ERECTION & COMMISSIONING - PRICE SCHEDULE FOR COMPRESSED AIR SYSTEM PACKAGE						
Sl.No	DESCRIPTION OF EQUIPMENT / ITEM	E&C Charges	Service tax on E & C	Total		
1	2	3	4	5 (3 to 4)		
1.0.0	Total lumpsum firm prices for the services as specified, comprising of service part for unloading, storage & handling at site, erection, commissioning, trial run, carrying out performance tests at site, handing over to customer in line with drawings/ documents/ test procedures approved by BHEL/ customer, for the total scope defined in technical specification (spec.No. PE-TS-408-555-A001) and terms & conditions of tender, taking into account all clarifications, confirmations and agreements till date for Compressed Air System for 1 X 800 MW WANAKBORI TPS.					
NOTE:						
1	As per cl. no. 3.0 of GCC Rev-06, Total erection & commissioning charges including service tax should be minimum 20% (or as specified in NIT) of the total quoted package price (excluding mandatory spares but including all taxes and freight), failing which the break-up of prices shall be adjusted accordingly for ordering.					
	Bidder's / bidder's representative signature		Company seal			

PRICE SCHEDULE		Rev 00	31.08.2015
1 X 800 MW WANAKBORI TPS			
ANNEXURE-IV			
IMPORT CONTENT - PRICE SCHEDULE FOR COMPRESSED AIR SYSTEM PACKAGE			
SL NO	DESCRIPTION OF EQUIPMENT/ ITEM	ALL INCLUSIVE PRICE (As per tender)	
1.0	Total price (in terms of `Euro/US \$' and correspondingly in INR as on date) for supply of import content, as required, for total scope defined as per technical specification and terms & conditions of tender taking into account all clarifications, confirmations and agreements till date. (Bidder shall furnish item-wise break-up in a separate sheet)		
1.1.1	In Euro.		
1.1.2	In INR (Corresponding to 1.1.1).		
1.2.1	In US \$.		
1.2.2	In INR (Corresponding to 1.2.1).		
1.3	Total in INR (1.1.2 + 1.2.2).		
NOTE			
1.0	Bidder's quoted price in various schedules shall be inclusive of above total price for import component at sl no 1.3 above.		
2.0	Bidder shall furnish item-wise break-up of imported items.		

PRICE SCHEDULE		Rev 00	31.08.2015			
1 X 800 MW WANAKBORI TPP						
ANNEXURE-V						
GUARANTEED POWER CONSUMPTION - PRICE SCHEDULE FOR COMPRESSED AIR SYSTEM PACKAGE						
Guaranteed Power Consumption For Air Compressor System Shall be as per Following :						
S.No. (1)	Description of Equipments (2)	Nos. of Equipments (3)		Total Guaranteed Power Consumption for Each Equipment at Motor Input Terminals & control Panel (4)	Duty Factor (5)	Total (KW) (6) = (3A)*(4)*(5)
		Working (3A)	Standby (3B)			
1	Serve Air Compressor (Oil free Screw type) 30 NM3/min at 8.5 Kg/cm2 pressure	2	1		1	
2	Instrument Air Compressor (Oil free Screw type) 30 NM3/min at 8.5 Kg/cm2	2	1		1	
3	Air Drying Plant Unit (Refrigerant type)	2	1		1	
					TOTAL	
Note :						
1	Estimated Power Consumption Figure for the compressed air system (For Working Drives Only) considered is 1100 KW (For station)					
2	Bidders Guaranteed power consumption at motor input terminals (Not Shaft Power) including power for control panel as furnished in guranteed schedule shall be demonstrated by the successful bidder during performance testing at works/site.					
3	The price quoted by the bidder shall be loaded @ (INR)200000/- for every additional kW increase in consumption from the base figure indicated at Note no. 1.0 above.					
4	In case the successful bidder fails to establish / prove the guaranteed values of power consumption (base figure of auxiliary power consumption) on actual performance testing at the manufacturing works / site, penalty @ (INR)200000/- per kW increase in power consumption figure shall be levied.					

DEVIATION SHEET (COST OF WITHDRAWL)

ANNEXURE-VI

PROJECT:- 1 X 800 MW WANAKBORI TPS

PACKAGE:- COMPRESSED AIR SYSTEM PACKAGE

TENDER ENQUIRY REFERENCE:-

NAME OF VENDOR:-

SL NO	VOULME/ SECTION	PAGE NO.	CLAUSE NO.	TECHNICAL SPECIFICATIO N/ TENDER DOCUMENT	COMPLETE DESCRIPTION OF DEVIATION	COST OF WITHDRAWL OF DEVIATION	REFERENCE OF PRICE SCHEDULE ON WHICH COST OF WITHDRAWL OF DEVIATION IS APPLICABLE	NATURE OF COST OF WITHDRAWL OF DEVIATION (POSITIVE/ NEGATIVE)	REASON FOR QUOTING DEVIATION
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TECHNICAL DEVIATIONS

COMMERCIAL DEVIATIONS

PARTICULARS OF BIDDERS/ AUTHORISED REPRESENTATIVE

NAME	DESIGNATIONS	SIGN & DATE
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NOTES:

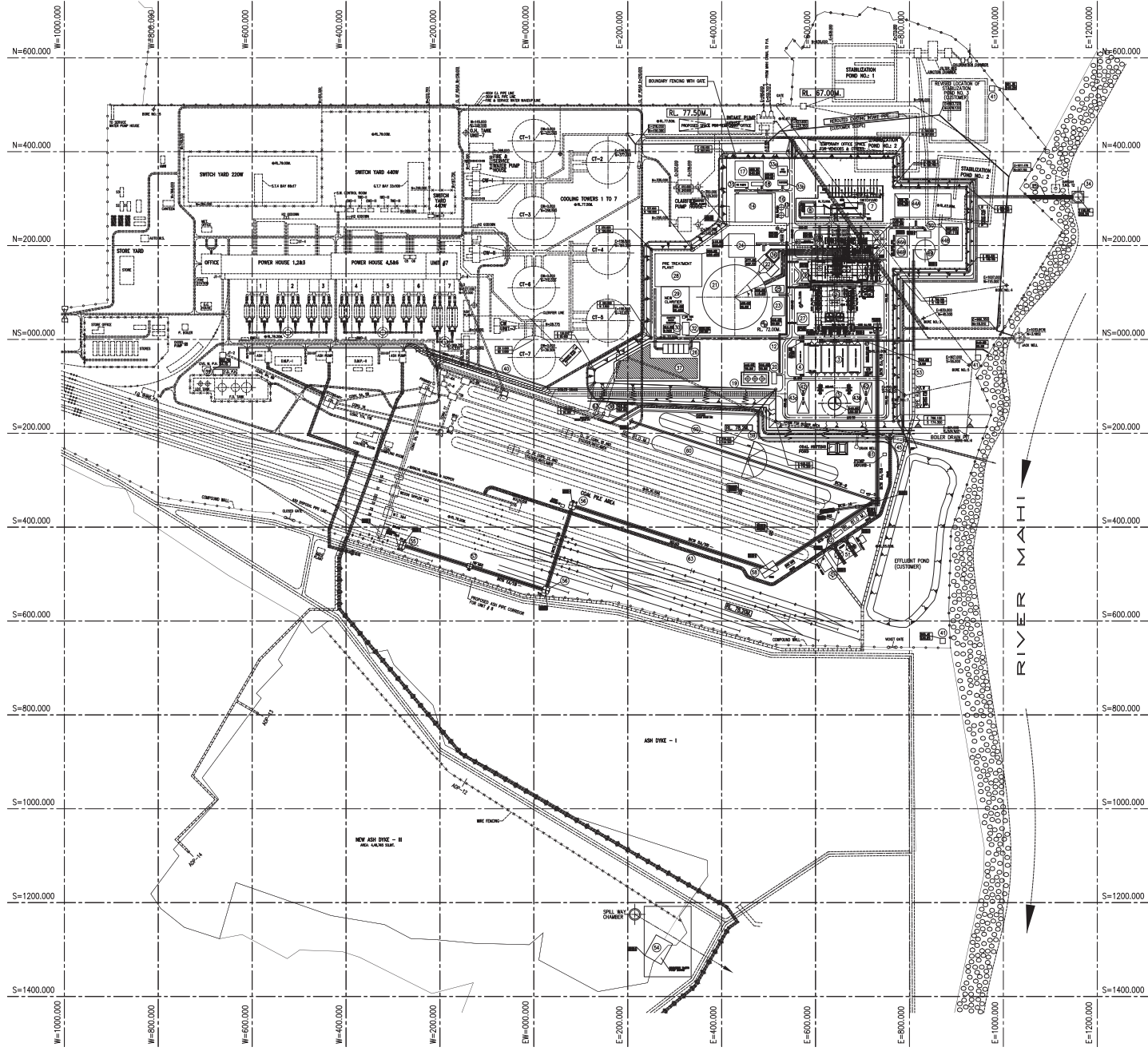
1. For self manufactured items of bidder, cost of withdrawl of deviation will be applicable on the basic price (i.e. excluding taxes, duties & freight) only.
2. For directly dispatchable items, cost of withdrawl of deviation will be applicable on the basic price including taxes, duties & freight.
3. All the bidders have to list out all their Technical & Commercial Deviations (if any) in detail in the above format.
4. Any deviation not mentioned above and shown separately or found hidden in offer, will not be taken cognizance of.
5. Bidder shall submit duly filled unpriced copy of above format indicating "quoted" in "cost of withdrawl of deviation" column of the schedule above along with their Techno-commercial offer, wherever applicable.
6. Bidder shall furnish price copy of above format along with price bid.
7. The final decision of acceptance/ rejection of the deviations quoted by the bidder shall be at discretion of the Purchaser.
8. Bidders to note that any deviation (technical/commercial) not listed in above and asked after Part-I opening shall not be considered.
9. For deviations w.r.t. Payment terms, Liquidated damages, Firm prices and submission of E1/ E2 forms before claiming 10% payment, if a bidder chooses not to give any cost of withdrawl of deviation loading as per Annexure-VIII of GCC, Rev-06 will apply. For any other deviation mentioned in un-priced copy of this format submitted with Part-I bid but not mentioned in priced copy of this format submitted with Priced bid, the cost of withdrawl of deviation shall be taken as NIL.
10. Any deviation mentioned in priced copy of this format, but not mentioned in the un-priced copy, shall not be accepted.
11. All techno-commercial terms and conditions of NIT shall be deemed to have been accepted by the bidder, other than those listed in unpriced copy of this format.
12. Cost of withdrawl is to be given seperately for each deviation. In no event bidder should club cost of withdrawl of more than one deviation else cost of withdrawl of such deviations which have been clubbed together shall be considered as NIL.
13. In case nature of cost of withdrawl (positive/negative) is not specified it shall be assumed as positive.
14. In case of discrepancy in the nature of impact (positive/ negative), positive will be considered for evaluation and negative for ordering.

SECTION 8
DRAWINGS ATTACHED

100N-001-809-01-31

FIRST ANGLE PROJECTION ALL DIMENSIONS ARE IN MM

SCALE 1:3000



AS INFORMED BY BHIL SITE, PROPOSED SPACE FOR FABRICATION WOULD BE BETWEEN GRID 2005 TO 4004 & ROAD TO ROAD.

LEGEND

- ① STS BUILDING (1400MM UNIT)
- ② BOILER
- ③ ELECTROSTATIC PRECIPITATOR
- ④ ESP CONTROL ROOM
- ⑤ CHIMNEY
- ⑥ TRANSFORMER YARD
- ⑦ SWITCH YARD (DS)
- ⑧ SWITCH YARD CONT. ROOM
- ⑨ SERVICE & TECHNICAL BUILDING
- ⑩ 1A/5A/MS COMPRESSOR BUILDING
- ⑪ DG SET
- ⑫ PIPE RACK
- ⑬ CST AND SPACE FOR CST PUMP
- ⑭ SPACE FOR DM PLANT, CHEM. HOUSE & CPU REGENERATION AREA
- ⑮ SPACE FOR DM PUMPS
- ⑯ DMW STILLWATER
- ⑰ CLARIFIED CUM FINE WATER STORAGE TANK
- ⑱ SPACE FOR CLARIFIED WATER PUMPS
- ⑲ LFO / HFO DRY TANK
- ⑳ FO PRESSURIZING PUMP HOUSE
- ㉑ NO COOLING TOWER
- ㉒ DM PUMP HOUSE
- ㉓ CW CHLORINATION PLANT
- ㉔ SIDE STREAM FILTER
- ㉕ DM TREATMENT PLANT
- ㉖ STORES
- ㉗ AUXILIARY BOILER
- ㉘ PRE TREATMENT PLANT
- ㉙ NEW CLARIFIER
- ㉚ CLARIFIED WATER RESERVOIR
- ㉛ SPACE FOR FINE WATER PUMPS
- ㉜ SPACE FOR SERVICE WATER PUMPS & NEW CLARIFIER PUMPS
- ㉝ SITE OFFICE
- ㉞ GARDEN
- ㉟ NEW JACK WELL PUMP HOUSE
- ⓪ PIPE CUM PASSAGE TO JACKWELL
- ① DM PIPE CORRIDOR
- ② EQUIPMENT LAYOUT SPACE
- ③ RETURNING WALL
- ④ FO TRANSFER PUMP HOUSE
- ⑤ LFO / HFO PIPE CORRIDOR
- ⑥ WATCH TOWER
- ⑦ PROPOSED SPACE FOR FGD
- ⑧ PREDESIGNED LAYOUT SPACE
- ⑨ EFFLUENT TREATMENT PLANT
- ⑩ GUARD FENCE
- ⑪ BOILER DRAIN PIT
- ⑫ S.A. SLURRY PIT & PUMP HOUSE
- ⑬ ASH WATER PUMP HOUSE
- ⑭ AHP COMPRESSOR CUM VACUUM PUMP HOUSE
- ⑮ ASH HANDLING PLANT MCC-1 CUM CONTROL ROOM
- ⑯ AHP CLARIFIER
- ⑰ CHEMICAL HOUSE
- ⑱ FLY ASH SLO
- ⓪ SLAG UTILITY / HISS SHED
- ① ASH PIPE CORRIDOR
- ② MCC ROOM CUM ASH WATER RECOVERY SYSTEM PUMP HOUSE
- ③ WAGON TIPPLER
- ④ TRANSFER POINT
- ⑤ FERT HOUSE
- ⑥ CRUSHER HOUSE
- ⑦ SHOWER/RECLAMER
- ⑧ CRUSHED COAL STOCK PILE
- ⑨ COAL CONVEYER
- ⑩ CWP MAIN CONTROL ROOM CUM S/S
- ⑪ ROAD FROM ASH SLO UTILITY TO EXISTING BRICK PLANT
- ⑫ WEDGE BRIDGE
- ⑬ FLY ASH EXTRACTION TOWER
- ⑭ FACILITIES FROM SL. No. 10 @ TO RETURN TO EG (DWP & CWP)

NOTE:-

1. ALL DIMENSIONS AND CO-ORDINATES ARE IN METERS UNLESS NOTED OTHERWISE.
2. THE FINISHED GRADE LEVEL OF POWER BLOCK AREA IS RL. 72.00M.
3. THE FINISHED FLOOR LEVEL OF POWER HOUSE GROUND FLOOR EL. 0.00M WHICH CORRESPONDS TO RL. 72.3M.
4. EXISTING FACILITIES WITHIN 800 MM PLANT AREA SHALL BE RE-LOCATED TO SUIT AT SITE CONSIDER.
5. ANY BUILDING/ HEAVY STRUCTURE SHALL NOT BE LOCATED WITHIN 200.00M OF MAIN RIVER BANK AS PER GOVERNOR'S ORDER.
6. READ THIS DRAWING IN CONNECTION WITH CUSTOMER DWG. NO. - WTPS. SEC.19.

REFERENCE DWG.

1. PLOT PLAN K0129-000-00-002 REV-05 (DSF)
2. MAIN PLANT EQUIPMENT LAYOUT PLAN AT EL. 0.00M FC-05-408-100-0002

CUSTOMER:	GUJARAT STATE ELECTRICITY CORPORATION LTD VADODARA, GUJARAT						
PROJECT:	1x800 MW Washambet Thermal Power Station Extn. Unit-8						
CONSULTANT:	DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA MUMBAI CHENNAI NEW DELHI						
CLIENT:	BHARAT HEAVY ELECTRICALS LTD POWER SECTION NUGDA						
JOB NO.:	010						
STATUS:	CONTRACT						
DISTRIBUTION:							
REV. DATE:	ALT.1	CHG.	APPD.	REV. DATE:	ALT.2	CHG.	APPD.
<p>THE INFORMATION ON THIS DRAWING IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LIMITED & MUST NOT BE USED OR REPRODUCED IN ANY MANNER WITHOUT THE WRITTEN PERMISSION OF THE COMPANY.</p>							
<p>TITLE: PLOT PLAN</p>				<p>DEPT. SCALE 1:3000 DRAWING NO. FE-05-408-100-0001</p>			
<p>REV. DATE: ALT.1 CHG. APPD.</p>				<p>DEPT. SCALE 1:3000 DRAWING NO. FE-05-408-100-0001</p>			
<p>REV. DATE: ALT.2 CHG. APPD.</p>				<p>DEPT. SCALE 1:3000 DRAWING NO. FE-05-408-100-0001</p>			

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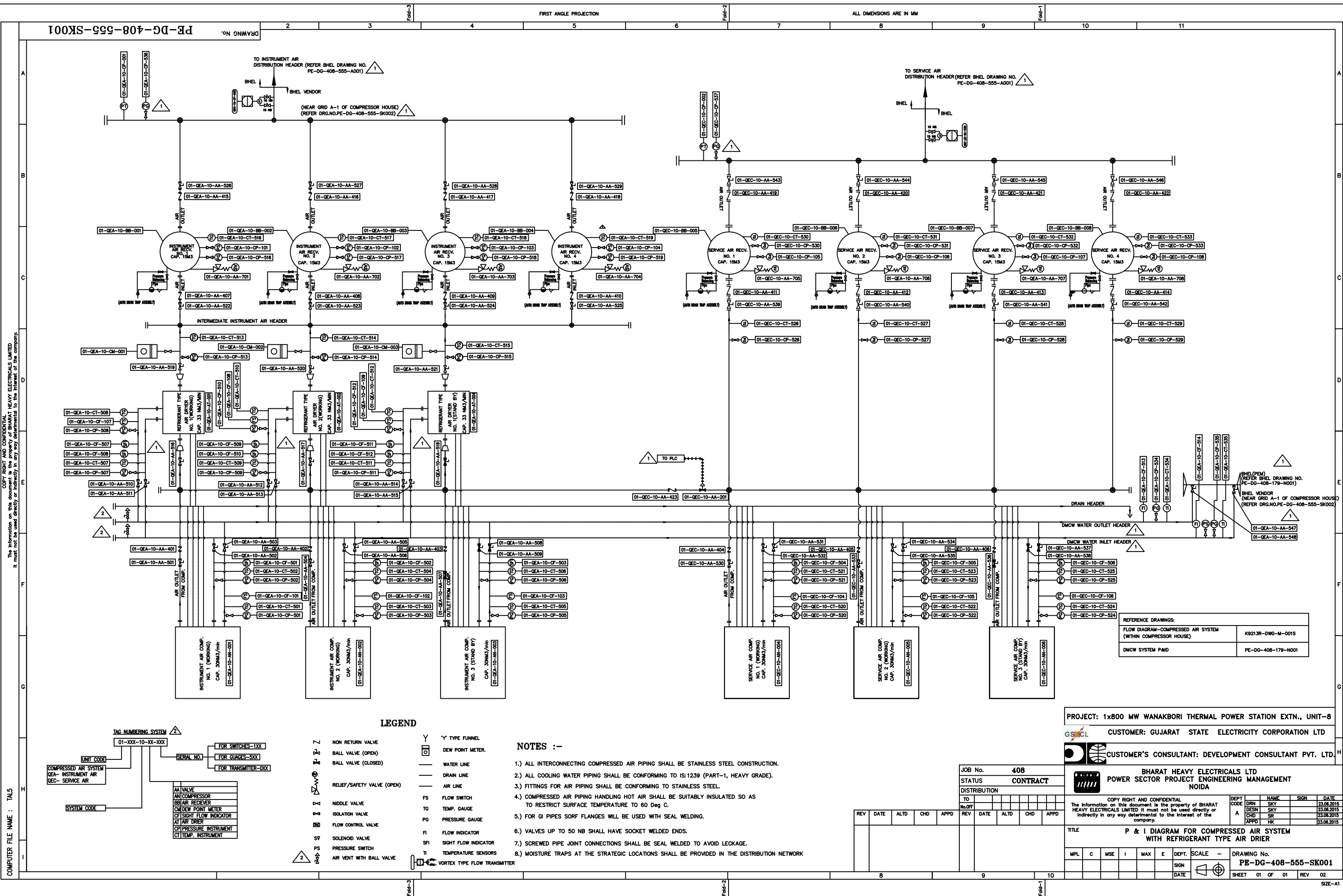
PRODUCED BY AN AUTODESK EDUCATIONAL PRODUCT

PRODUCED BY AN AUTODESK EDUCATIONAL PRODUCT

PE-DG-408-555-SK001

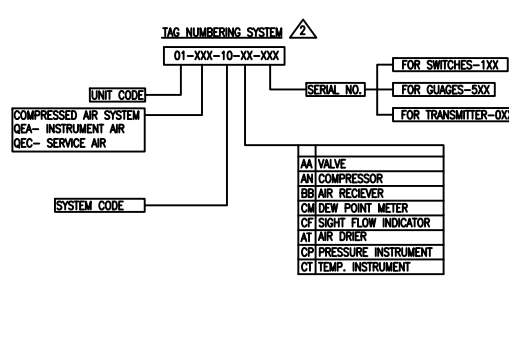
FIRST ANGLE PROJECTION

ALL DIMENSIONS ARE IN MM



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COMPUTER FILE NAME : TAL5



LEGEND

- NON RETURN VALVE
- BALL VALVE (OPEN)
- BALL VALVE (CLOSED)
- RELIEF/SAFETY VALVE (OPEN)
- MIDDLE VALVE
- ISOLATION VALVE
- FLOW CONTROL VALVE
- SOLENOID VALVE
- PRESSURE SWITCH
- AIR VENT WITH BALL VALVE
- Y TYPE FUNNEL
- DEW POINT METER
- WATER LINE
- DRAIN LINE
- AIR LINE
- FS FLOW SWITCH
- TG TEMP. GAUGE
- PG PRESSURE GAUGE
- FI FLOW INDICATOR
- SFI SIGHT FLOW INDICATOR
- TI TEMPERATURE SENSORS
- VORTEX TYPE FLOW TRANSMITTER

NOTES :-

- ALL INTERCONNECTING COMPRESSED AIR PIPING SHALL BE STAINLESS STEEL CONSTRUCTION.
- ALL COOLING WATER PIPING SHALL BE CONFORMING TO IS:1239 (PART-1, HEAVY GRADE).
- FITTINGS FOR AIR PIPING SHALL BE CONFORMING TO STAINLESS STEEL.
- COMPRESSED AIR PIPING HANDLING HOT AIR SHALL BE SUITABLY INSULATED SO AS TO RESTRICT SURFACE TEMPERATURE TO 60 Deg C.
- FOR GI PIPES SORF FLANGES WILL BE USED WITH SEAL WELDING.
- VALVES UP TO 50 NB SHALL HAVE SOCKET WELDED ENDS.
- SCREWED PIPE JOINT CONNECTIONS SHALL BE SEAL WELDED TO AVOID LEAKAGE.
- MOISTURE TRAPS AT THE STRATEGIC LOCATIONS SHALL BE PROVIDED IN THE DISTRIBUTION NETWORK

REFERENCE DRAWINGS:

FLOW DIAGRAM-COMPRESSED AIR SYSTEM (WITHIN COMPRESSOR HOUSE)	K9213R-DWG-M-001S
DMCW SYSTEM P&ID	PE-DG-408-179-N001

PROJECT: 1x800 MW WANAKBORI THERMAL POWER STATION EXTN., UNIT-8

CUSTOMER: GUJARAT STATE ELECTRICITY CORPORATION LTD

CUSTOMER'S CONSULTANT: DEVELOPMENT CONSULTANT PVT. LTD.

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR PROJECT ENGINEERING MANAGEMENT
NOIDA

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DEPT CODE	DRN	NAME	SIGN	DATE
A	SKY			23.08.2015
	SKY			23.08.2015
	SR			23.08.2015
	HK			23.08.2015

TITLE: P & I DIAGRAM FOR COMPRESSED AIR SYSTEM WITH REFRIGERANT TYPE AIR DRIER

MPL	C	MSE	I	MAX	E	DEPT.	SCALE	DRAWING No.
								PE-DG-408-555-SK001

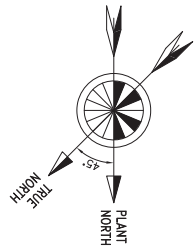
SHEET 01 OF 01 REV 02

JOB No. 408

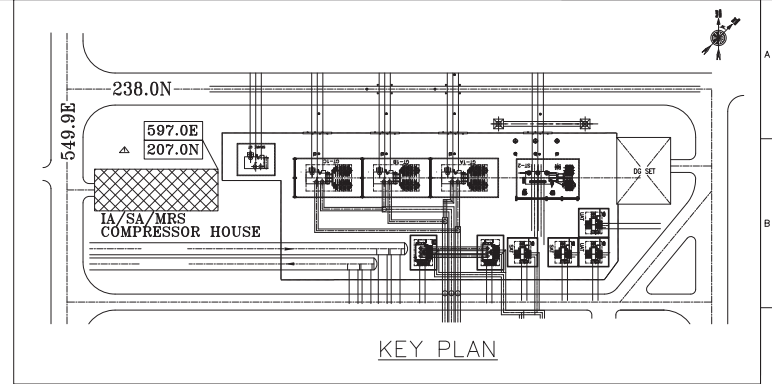
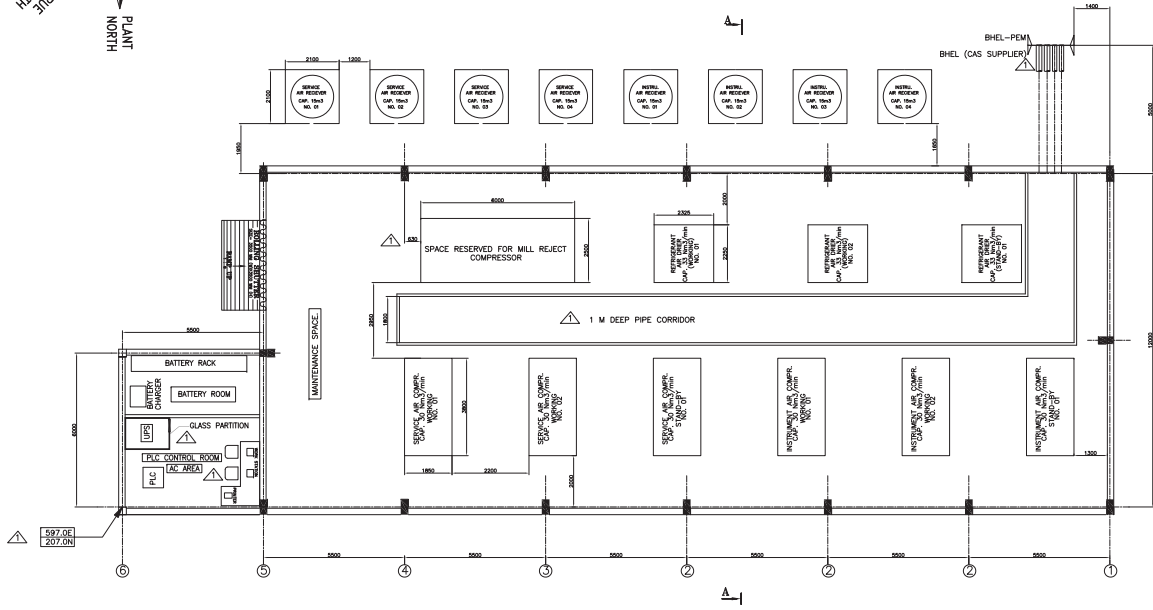
STATUS CONTRACT

DISTRIBUTION

REV	DATE	ALTD	CHD	APPD	REV	DATE	ALTD	CHD	APPD



PLANT NORTH
TRUE NORTH
4.5°



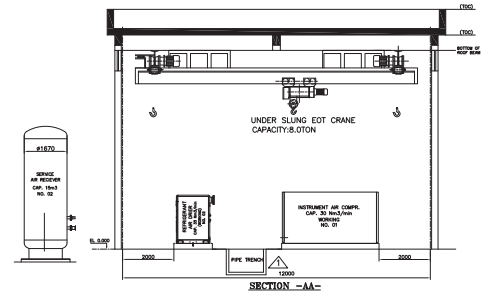
KEY PLAN

REFERENCE DRAWING :-

(1) PLOT PLAN	PE-DG-408-100-M001
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NOTES :-

- 1) ALL DIMENSIONS ARE IN MM & LEVELS ARE IN METERS. EL(+). 0.000 M CORRESPONDS TO RL(+). 72.30 M.
- 2) DIMENSION FOR EQUIPMENT LOCATED IN COMPRESSOR HOUSE HAVE BEEN CONSIDERED WORST/MAXIMUM WRT ALL PROSPECTIVE BIDDERS AND WILL NOT CHANGE BUILDING DIMENSIONS AT LATER DATE.
- 3) EQUIPMENT FOUNDATION, PIPING, VALVES, PIPE AND CABLE SLIT DETAILS SHALL BE INDICATED IN A SEPARATE DRAWING.
- 4) ALL PIPE TRENCHES SHALL BE COVERED WITH CHEQUERED PLATES.



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COMPUTER FILE NAME:

PRODUCED BY AN AUTODESK EDUCATIONAL PRODUCT

CUSTOMER GSECL		GUJARAT STATE ELECTRICITY CORPORATION LIMITED VADODARA, GUJARAT	
CUSTOMER'S CONSULTANT DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA MUMBAI CHENNAI NEW DELHI		1x800 MW Wanakbori Thermal Power Station Extn. Unit-8	
JOB No. 018		STATUS CONTRACT	
DISTRIBUTION		BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA	
REV. DATE. ALO. CHD. APPR.		SIGN. DATE. ALO. CHD. APPR.	
TTLX		COMPRESSOR HOUSE LAYOUT	
MPL. CH. MEE. MUX. ELEC. CIVIL.	SCALE 1:400	DRAWING No. PE-V0-408-555-SK002	
DATE		SHEET 1 OF 1 REV. 1	



COMPRESSED AIR SYSTEM

1X800MW GSECL WANAKBORI TPP, UNIT 8

SPECIFICATION NO. PE-TS-408-555-A001

VOLUME : III

SECTION : 9

REV: 00

DATE: 14.08.2015

SHEET 1 OF 1

VOLUME-III

SECTION 9

LIST OF RECOMMENDED SPARES

