	7	Accessories	:	Thermo well (as specified below) and shall be spring loaded for positive contacts with the well.
	8	Standard	:	ANSI C 96.1 for Thermocouple and ASME PTC-19.3 for Thermo-well.

3.02.00 **Resistance Temperature Detector (RTD)**

Sr. No.	Features		Essential/Minimum Requirements
1	Type of RTD.	:	Four wire, Pt-100 (100 Ohms resistance at zero degree Centigrade).
2	No. of element	:	Duplex
3	Housing/Head	:	IP-55/Diecast Aluminium. Plug in connectors are to be provided for external signal cable connection.
4	Sheathing of RTD	:	Metal sheathed, ceramic packed
5	Calibration and accuracy	:	As per DIN-43760 Class-A for RTD
6	Characteristic	:	Linear with respect to temp, within ±1/2 percent of top range value.
7	Accessories	:	Thermo well (as specified below) and shall be spring loaded for positive contacts with the well.
8	Standard	:	DIN-43760 for RTD and ASME PTC-19.3 for Thermo-well.

3.03.00 **Metal Temperature Thermocouples**

Measuring Medium	Metal Temperature
Material of Thermocouple.	Chromel Alumel Type K
Type of Thermocouple	Duplex with separate hot junctions, ungrounded
Insulation	Mineral Insulation Magnesium Oxide.
Thermocouple wire gauge	16 AWG
Protective sheath	SS 321
Protective sheath dia	8 mm O.D
Characteristics of Thermocouple	Special limits of error as in ANSI thermocouple MC 96.01.1975
Mounting accessories	1/2" BSP SS sliding end connector, weld pad, clamps of heat resistant steel SS310.

	Cold end sealing	SS pot weal with colour coded PTFE headed sleeve Insulated flexible tails. Sealing compound- Epoxy resin.
	Minimum bending radius	30 mm
	Length of T/C	30 Mtr. (minimum)

3.04.00 **Thermo well (for all process temp. elements)**

(a) Shall be one piece solid bored type of 315 SS of step-less tapered design. (As per ASME PTC 19.3 1974)

(b) For Mill classifier outlet long life solid sintered tungsten carbide material of high abrasion resistance shall be provided.

(c) For Air & Flue gas 316 SS protecting tube with welded cap. (However contractor shall provide better material for Flue gas service if require based on the specify boiler design parameters).

(d) For furnace zone, impervious ceramic protecting tube of suitable material along with Incoloy supporting tubes and adjustable flanges.

4.00.00 TEMPERATURE TRANSMITTER

Following types of 2-wire temperature transmitter (directly powered from 4-20mA input cards of DDCMIS) shall be provided. The temperature transmitter shall be fully compatible with thermocouples and RTDs being provided by the contractor. Temperature compensation of the thermocouples shall be performed in the temperature transmitter itself.

a. Single Input Head mounted Temperature Transmitter

These shall be suitable for mounting in the head of temperature element itself. The protection class of head of thermo well along with its plug-in connector shall be min. IP65.

b. Single Input DIN-rail mounted Temperature Transmitter

These shall be especially designed for DIN-rail mounting in JBs. The specifications of the JBs shall be same as indicated in Subsection-IV:I7(INST CABLE) with additional DIN-rails and IP 65 Protection class. This temperature transmitter shall be the ones which are specially designed for DIN-rail mounting with IP 20 protection class. These shall have terminals for input/output provided on front side when mounted on DIN-rail. Head mounted temperature transmitter with clamps to make it suitable for DIN-rail mounting shall not be acceptable under this category.

c. Dual-input Temperature Transmitter With Indicator:

The dual-input TTs shall be suitable for mounting in enclosures/racks and shall be provided with clamps. Indicator shall be provided with these transmitters. These transmitters shall have bump less change over facility to second sensor in case first sensor fails .This change-over is to be alarmed. Protection class shall be IP65 minimum.

d. Common requirements for each of the above type of temperature transmitters

Output	:	2-wire (power supply from input card of Control System) with 4-20mA output with superimposed HART protocol signal.
Input	:	Same transmitter shall be capable to handle Pt-100 RTD , Thermocouples -K&R types (input type to be selectable at site through HART terminal)
Isolation	:	min. 500 V AC
EMC compatibility	:	as per EN 61326
Operating ambient temperature	:	0 to 85 deg C (without indicator) 0 to 70 deg C (with indicator)
Power supply		compatible with input module of Control System
Accessories		Mounting arrangements including clamps etc.
Composite Accuracy (Refer note 2)		(a) For head mounted and DIN-rail mounted types: RTD =<0.4% of 0-250 deg C span T/C-K type =<0.4% of 0-600 deg C span T/C-R type =<0.4% of 0-1000 deg C span CJC accuracy (for thermocouples) shall be =< 1 deg C (b) For dual-input type: RTD =<0.25% of 0-250 deg C span T/C-K type =<0.2% of 0-600 deg C span CJC accuracy (for thermocouples) shall be =< 1 deg C

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e. Field bus compatible temperature Transmitters (For Boiler Metal Temperature measurement applications)

Temperature transmitters *of this category shall be field mounting type* & *shall be capable of withstanding operating ambient temperature upto 85 deg C*. These modules shall be connected to DDCMIS through field bus such as Profibus, Foundation Field bus etc directly from the transmitter. *Maximum Number of inputs per such temperature transmitter shall be eight. These shall be mounted in cabinets in non-AC areas.*

As an alternate, these signals from temperature transmitters can be connected to DDCMIS through standard remote I/O modules of the DCS, in which case, the temperature transmitter signals will be acquired through 4-20mA input modules in the remote I/O cabinet for connecting to DDCMIS through remote I/O bus.

Notes:-***(Common for a to be above):-***

1. In case of failure (open or burn-out) of RTD/thermocouple, temp. Transmitter shall provide low temperature output.

2. Composite Accuracy is to be calculated as summation of all applicable accuracies of temp transmitter, for converting sensor input to output in 4-20 mA (e.g., basic accuracy, digital accuracy, D/A accuracy, etc.) and temperature effect on these accuracies at ambient temperature of 50 deg C, based on the figure/ formula given in the standard product catalogue for span as specified above for various types of Temperature Elements specified. All such accuracy/ temp effect figures in catalogue shall be first converted to deg C, and then percentage of this converted accuracy in specified span shall be calculated to compare with the specified composite accuracy figures.

5.00.00 SPECIFICATION FOR FLOW ELEMENTS

5.01.00 **Orifice Plate**

Features	**Essential/Minimum Requirements**
Type	Concentric as per ASME PTC-19.5 (Part-II), ISA RP-3.2, 1960 or BS-1042
Material	316 SS
Thickness	3 mm for main pipe diameter up to 300 mm and6 mm for main pipe dia above300 mm.
Material of branch pipe	Same as main pipe
Root valve type	Globe
Root valve material	316 SS
Root valve size	1 inch
Impulse pipe of same material up to root valve	Required
Tappings	Flanged weld neck. 3 pairs. of tapping.
Beta Ratio	0.34 to 0.7
Beta Ratio calculation to be submitted	Yes
Assembly drg. and flow Vs DP Curves	Yes
Accessories	Root valves, flanges, Vent/drain hole (As required)

Contractor shall submit certified flow calculation and differential pressure vs. flow curves for each element for Employer's approval. Sizing calculation, precise flow calculation for all the flow elements, fabrication and assembly drawings and installation drawings shall be submitted for Employer's approval. One Flow element of each type shall be calibrated in the test laboratory for validation of computated flow calculations.

5.02.00 **Flow Nozzle**

Features	**Essential/Minimum Requirements**
Type	Long radius, welded type as per ASME PTC-19.5 (Part-III) or BS-1042
Material	316 SS
Thickness	Suitable for intended application.
Material of branch pipe	Same as main pipe
Root valve type	Globe
Root valve material	316 SS
Root valve size	1 inch
Impulse pipe of same material up to root valve	Required
Tapping	D and D/2 (3 Nos. of tappings)
Beta Ratio	Around 0.7
Beta Ratio calculation to be submitted	Yes
Assembly drg. and flow Vs DP Curves	Yes
Accessories	Root valves, vent and drain hole.

Contractor shall submit certified flow calculation and differential pressure vs. flow curves for each element for Employer's approval. Sizing calculation, precise flow calculation for all the flow elements, fabrication and assembly drawings and installation drawings shall be submitted for Employer's approval. One Flow element of each type shall be calibrated in the test laboratory for validation of computed flow calculations.

6.00.00 **SPECIFICATIONS FOR PR. GAUGE, D.P. GAUGE, TEMP. GAUGE AND LEVEL GAUGE.**

Sl.No	FEATURES	ESSENTIAL/MINIMUM REQUIREMENTS		
		Pr. Gauge/ DP Gauge/ Draught gauges	**Temperature Gauge**	**Level Gauge**
1	Sensing Element and material	Bourdon for high pressure, Diaphragm/ Bellow for low pr. Of 316 SS	Mercury in steel for below 450°C and inert gas actuated for above 450°C of SS bulb and capillary.	Tempered *toughened Borosilicate gauge glass steel armoured reflex or transparent type.
2	Body material	Die-cast aluminium	Die-cast aluminium	Forged carbon steel/304 SS
3	Dial size	150mm	150 mm	Tubular covering entire range
4	End connection	1/2 inch NPT (M)	3/4" NPT (M)	Process connection as per ASME PTC and drain/vent 15 NB
5	Accuracy	±1% of span	± 1% of span	± 2%
6	Scale	Linear, 270° arc graduated in metric units	Linear, 270° arc graduated in °C	Linear vertical
7	Range selection	Cover 125% of max. of scale	Cover 125% of max. of scale	Cover 125% of max. of scale
8	Over range test	Test pr. for the assembly shall be1.5 to the max. Design pr. at 38°C.		
9	Housing	Weather and dust proof as per IP-55	Weather and dust proof as per IP-55	CS/304 SS leak proof
10	Zero/span adjustment	Provided	Provided	--
11	Identification	Engraved with service legend or laminated phenolic name plate		
12	Accessories	Blow out disc, siphon, snubber, pulsation dampener, chemical seal (if required by process) gauge isolation valve	SS Thermowell	Gasket for all KEL-F shield for transparent type vent and drain valves of Steel/SS as per CS/ Alloy process Requirement.

13	Material of Bourdon/ movement	316 SS / 304 SS	316 SS / 304 SS

Notes:-

* Bicolour type level gauges will be provided for applications involving steam and water except for condensate and feed water services.

Length of gauge glass shall not be more than 1400 mm. If the vessel is higher, multiple gauge glasses with 50 mm overlapping shall be provided.

Where the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application.

7.00.00 PROCESS ACTUATED SWITCHES

FEATURES	ESSENTIAL / MINIMUM REQUIREMENTS		
1	2	3	4
	Pressure/ Draft Switches/ DP Switches	Temperature switches	Level switches
Sensing Element	Piston actuated for high pressure and diaphragm or bellows for low pr./ vacuum	Vapor pressure sensing, liquid filled bellow type with SS bulb and capillary (10 m minimum)	Capacitance types for oil and dirty medium, water, condensate application. Float type switches for applications as decided by Employer during detailed engineering. Capacitance/ Conductivity/ Ultrasonic type for acid and alkali application. Radio-frequency/ Ultrasonic type for ash hopper, ash slurry application.
Material	316 SS	Bulb 316 SS/ capillary 304 SS	316 SS
End connection	½ inch NPT (F)	½ inch NPT (F)	Manufacturer standard
Over range proof pressure	150% of max. design pr.	-	150% of max. design pressure

	Repeatability	+ 0.5% of full range		
	No. of contacts	2 No.+2NC. SPDT snap action dry contact		
	Rating of contacts	60 V DC, 6 VA- (or more if required by DDCMIS)		
	Elect. Connection	Plug in socket.		
	Set point/ dead band adjustment	Provided over full range.		
	Enclosure	Weather and dust proof as per IP-55		
	Accessories	Siphon, snubber, chemical seal, pulsation dampeners as required by process	Thermo well of 316 SS and packing glands	All mounting accessories
	Mounting	Suitable for enclosure/ rack mounting or direct mounting	Suitable for rack mounting or direct mounting	-
	Power Supply (wherever required)	24 V DC, to be arranged by Contractor except for Ash Level Switches, where the same shall be as per Contractor's Standard practice.		

Where the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application.

8.00.00 **POSITIVE DISPLACEMENT TYPE FLOW TRANSMITTERS**

The Bidder shall provide positive displacement type flow transmitters for fuel oil flow measurement, suitable for the fuel oil being used for the project, i.e., keeping in view the pressure, temperature and viscosity of the fuel oil.
The meter shall be a volumetric meter type consisting of two meshing oval wheels driven by the fluid. Each revolution of the oval wheels shall displace a precisely known volume of the fluid from inlet to outlet. The housing/measuring chamber and oval wheels shall be of 316 SS.

The measurement accuracy of the transmitter shall be better than +0.2%.

The transmitter shall provide suitable 4-20mA dc output signal for control and indication/recording. Converters if necessary shall be provided to generate the 4-20mA signal.

A local indicator of fuel oil flow shall also be provided. The instrument shall be calibrated in Tons/hr.

Suitable strainer shall be provided before the transmitter for the protection of oval wheel meters against foreign matter contained in the fuel oil.

The exact model no. and type of material being used, etc., shall be subject to Employer's approval during detailed engineering without any price repercussion to Employer.

9.00.00 OXYGEN ANALYSER INSTRUMENTS

Sl No	Specification Requirements system	Oxygen Analyser cum monitor (High temp.)	Low Temp. O2 Analyser cum monitor
1	Output signals a) Analog	4-20 mA DC galvanically isolated. If analyser provides superimposed HART signal on 4-20 mA DC output, It shall also be connected to PC based station.	
	b) Binary	2 NO + 2 NC for high alarm	
2	Zero & span Adjustment	To be provided with range selection facility.	
3	Ambient temp.	50°C	
4	Indication	Digital Alphanumeric Display. Display of reading in engineering units shall be provided	
5	Enclosure Type/Material	Weather & Dust proof (IP 55) Die cast Aluminium/SS.	
6	Type of Electronics	Microprocessor based with self diagnostic.	
7	Digital Signal transmission	HART / RS 485 Port Modbus Protocol / Ethernet TCP/IP protocol for communication with plant control system.	
8	Calibration	Auto & Manual (from Remote)	
9	Power Supply	To be arranged by Contractor subject to Employer's approval.	
10	Others	All interconnection tubing and cabling between probe and analyser / analyser panel and cabling from analyser/ analyser panel to local junction box are to be provided. All the calibration gases required for one year continuous operation shall be provided. The calibration gas container material shall not contaminate the calibration gas. The construction of the sensor shall be such that joints between dissimilar materials are avoided to prevent formation of cracks.	

Sl No	Specification Requirements system	Oxygen Analyser cum monitor (High temp.)	Low Temp. O2 Analyser cum monitor
11	Type of Instrument	Non-heated in-situ dry type	Heated type in-situ
12	Principle of Measurement	Partial-pressure using Zirconium Oxide Cell	Partial-pressure using zirconium oxide cell
13	Measurement Range	0.01% to 10% oxygen	0 to 25% oxygen programmable upto min 0.5% of O_2
14	Accuracy	+/-1% of F.S. or 0.5 % O_2, whichever is more	+/-1% of Full Scale
15	Linearity	+/- 1% of F.S.	+/- 1% of F.S.
16	Repeatability	$\leq$ 0.5% of Span	$\leq$ 0.5% of Span
17	Response time(up to 90% of full scale)	$\leq$ 5 secs	$\leq$ 5 secs
18	a) Temperature Drift	-	-
19	b) Zero Drift	-	< 1% span/week
20	c) Span Drift	Stability:- 1% deviation through out life of sensor	< 1% measured value/week
21	Operating Temperature Range	600-1600 deg.C	0-450 deg.C
22	Filter	Cell shall be protected using ceramic boot	Suitable filter to be provided
23	Accessories purging system	Not applicable	Not applicable
24	Temperature	Yes With R/B type thermocouples (to be finalised during detailed Engineering) required.	Automatic temperature control of heating circuit through thermostat.
25	Location	SH Zone	Air heater inlet

SUB-SECTION-III:E6

ELECTRICAL ACTUATORS WITH INTEGRAL STARTERS

ELECTRIC ACTUATORS WITH INTEGRAL STARTERS

1.01.00 **TYPE:**

1.01.01 The actuators shall have integral starters along with over load relays with built in SPP (Single Phasing Preventer). A 415, 3 phase 3 wire power supply shall be given to the actuator from vendor's/employer's switch board as applicable through a switch fuse unit. Control voltage of the motor starter shall be 110 V AC / 24 V DC, derived suitably from 415V power supply.

1.01.02 In case supplier's standard control voltage for Open/Close contactors is 110V AC, the same is acceptable if suitable Opto Isolation circuit is provided with coupling relays for 24 V DC command inputs.

1.02.00 **INTERFACES:**

1.02.01 Open/Close command termination logic with position & torque Limit Switches, positioner circuit shall be suitably built in the PCB inside the actuator.

(a) For Binary Drive (both ON-OFF and INCHING type) :- Open/Close command & status thereof and disturbance monitoring signal (common contact for Overload, Thermostat, control supply failure, L/R selector switch at local & other protections operated) shall be provided.

Interface with the control system shall be through hardware signal only. Inter posing relays provided (with coil burden 2.5 VA) in the actuator shall be energized to initiate opening and closing, by 24V DC signal from the external control system.

(b) For Modulating Drive:- the command to actuator shall be in form of 4-20mA signal. The necessary positioning circuit and motor protection shall be provided

(c) Open/close command termination logic shall be suitably built inside actuator.

1.03.00 **RATING :**

(a) Supply Voltage & frequency: 415V +/- 10%, 3 Phase, 3 Wire 50HZ +/-5%.

(b) Sizing:-

For Open/Close at rated speed against designed differential pressure at 90% of rated voltage.

For isolating service:- three successive open-close operations or 15 mins, whichever is higher. For regulating service 150 starts per hour or required cycles, whichever is higher.

1.04.00 **CONSTRUCTION :**

(a) Enclosure:

Totally enclosed weatherproof minimum IP-55 degree of protection.

(b) Gear Train :

Metal (Fibre gears are not acceptable)) self-locking to prevent drift under torque switch (where ever applicable) spring pressure when motor is de-energised.

(c) Manual Wheel:

Shall disengage automatically during motor operation.

1.05.00 **MOTOR :**

(a) Type :

Squirrel cage induction motor suitable for Direct On Line (DOL) starting.

(b) Enclosure:

Totally enclosed, self ventilated IP-55 degree of protection.

(c) Insulation

Class B or better. Temperature rise 70 Deg C. over 50 Deg C ambient

(d) Bearings:

Double shielded, grease lubricated antifriction.

(e) Earth Terminals:

Two

(f) Protection:

Single Phasing Protection, Over heating protection through Thermostat and wrong phase sequence protection shall be provided over and above other protection features standard to bidder's design Suitable means shall be provided to diagnose the type of fault locally.

1.06.00 **POSITION/TORQUE SWITCHES :**

1.06.01 Four nos. (2 each in open and close position) position limit switches and two nos. (one in open and other in close direction) torque switches each having two nos. NO and two nos. NC contacts shall be provided. A single shaft shall actuate all contacts of limit switches at each position.

Limit switch and disturbance signals shall be available to DCS even when the power supply to the actuators is not available.

Torque switches shall be bypassed in both the end positions with the other end Limit switches.

Limit switches

Limit switches shall be Silver plated with high conductivity and non -corrosive type. Contact rating shall be sufficient to meet the requirement of Control System subject to a minimum of 60 V, 6 VA rating. Protection class shall be IP-55.

1.07.00 **LOCAL OPERATION:**

1.07.01 It shall be possible to operate the actuator locally also. Lockable local/remote selection shall be provided on the actuator.

BHEL	**SPECIFICATION FOR MOTORISED VALVE ACTUATOR**	SPECIFICATION NO.: PE-SS-387-145-I007 VOLUME SECTION REV. NO. 00 DATE: 17.07.2012 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)
GENERAL	* PROJECT	**2x660 MW MAUDA STPP STAGE II**
	OFFER REFERENCE	
	* TAG NO. SERVICE	
	* DUTY	☐ ON / OFF ☐ INCHING
	* LINE SIZE (inlet/outlet): MATERIAL	
	* VALVE TYPE	☐ GLOBE ☐ GATE ☐ REG. GLOBE ☐ 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, IP: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(REGULATING) SERVICE 150 STARTS/HR MINIMUM
HANDWHEEL	* REQUIRED	■ YES ☐ NO
	* ORIENTATION	☐ TOP MOUNTED ☐ 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.
	ACTUATOR APPLICABLE WIRING DIAGRAM	■ ENCLOSED (BIDDER TO CONFIRM) A: ☐ DRG. NO. 3-V-MISC-24227 R00 B: ☐ DRG. NO. 3-V-MISC-24550 R00 C: ■ DRG. NO. 3-V-MISC-24283 R00 D: ☐ DRG. NO. 4-V-MISC-90271 R11
	COLOUR SHADE	■ BLUE (RAL 5012) ENAMEL ☐ …….
	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
	@ PWR SUPP TO MTR / STARTER Type	415V, 3PH, AC
	@ CONTROL VOLTAGE REQUIREMENT	TO BE DERIVED FROM THE POWER SUPPLY TO THE STARTER ☐ 24 VDC ☐ 110 V
	@ ENCLOSURE CLASS OF MOTOR	☐ IP 65 ☐ IP 67 ☐ FLAME PROOF ■ IP 55, TOTALLY ENCL, SELF VENTILATED.
	@ INSULATION CLASS	■ CLASS-B ☐ CLASS-F
	@ WINDING TEMP PROTECTION	■ THERMOSTAT (3 Nos.,1 IN EACH PHASE) ☐ ----------

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Data Sheet A & B

		DATA SHEET-A (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
	SINGLE PHASE / WRONG PHASE SEQUENCE PROTECTION	REQUIRED	
INTEGRAL STARTER	INTEGRAL STARTER	■ REQUIRED ☐ NOT REQUIRED	
	TYPE OF SWITCHING DEVICE	■ CONTACTORS ☐ THYRISTORS	
	TYPE	■ CONVENTIONAL ☐ SMART (NON-INTRUSIVE)	
	STEP DOWN CONT. TRANSFORMER	■ REQUIRED	
	OPEN / CLOSE PB	■ REQUIRED ☐ NOT REQUIRED	
	STOP PB	■ REQUIRED ☐ NOT REQUIRED	
	INDICATING LAMPS	■ REQUIRED ☐ NOT REQUIRED	
	LOCAL REMOTE S/S	■ REQUIRED ☐ NOT REQUIRED	
	STATUS CONTACTS FOR MONITORING	■ REQUIRED ☐ 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 (Applicable for integral Starter)	INTERPOSING RELAYS	REQUIRED	
	INTERPOSING RELAY (QUANTITY)	■ 2 NOs. ☐ 3 NOs.	
	DRIVING VOLTAGE	■ 20.5 – 24V DC ☐ _____V DC	
	DRIVING CURRENT	■ 125mA MAX ☐ _____mA MAX	
	LOAD RESISTANCE	■ > 192 ohms - <25 k ohms ☐ > _____ohms - < _____ohms	
TORQUE SWITCH	MFR & MODEL NO.	BIDDER TO SPECIFY	
	OPEN / CLOSE	■1 No. ☐2Nos. / ■1 No. ☐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	
LIMIT SWITCH	MFR & MODEL NO.	BIDDER TO SPECIFY	
	OPEN : INT : CLOSE	■1 No ☐2 Nos. / 2 Nos. (ADJ.) / ■1 No. ☐2Nos.	
	CONTACT TYPE	2 NO + 2 NC	
	RATING (AC / DC)	5A 240V AC AND 0.5A 220V DC	

	SPECIFICATION FOR MOTORISED VALVE ACTUATOR	SPECIFICATION NO.: PE-SS-387-145-I007
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Data Sheet A & B

	DATA SHEET-A (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
POSITION TRANSMITTER	POSITION TRANSMITTER (For inching duty)	■ REQUIRED ☐ NOT REQUIRED	
	MFR & MODEL NO.	BIDDER TO SPECIFY	
	TYPE	☐ ELECTRONIC (2 WIRE) R/I CONVERTER ■ ELECTRONIC (2 WIRE) CONTACTLESS	
	SUPPLY	■ 24V DC ☐ ……	
	OUTPUT	■ 4-20mA	
	ACCURACY	± 1% FS	
SPACE HEATER	@SPACE HEATER	REQUIRED	
	@ POWER SUPPLY		
	@ RATING	415v, 3PH, AC FOR RATING > 0.2KW; SINGLE PHASE FOR RATING < 0.2KW	
TERMINAL BOX	MOTOR TERMINAL BOX	REQUIRED	
	ACTUATOR TERMINAL BOX	REQUIRED	
	ENCL CLASS MTR T.B. / ACTUATOR T.B.	@☐ IP 65 @☐……. ■ IP65 ☐…….	
	@ EARTHING TERMINAL	REQUIRED	
	PLUG & SOCKET(9 PIN) (FOR COMMD, LS/TS FEED BACK, PoT)	■ REQUIRED ☐ NOT REQUIRED☐ ■ 2 NOS. ☐ ----------	
CABLE GLANDS	@ POWER CABLE GLAND	SIZE:--DURING DETAIL ENGINERING	
	@ SPACE HEATER CABLE GLAND	SIZE: 2C x 2.5 sq. mm	
	OTHER CONTROL CABLE GLANDS-1	■ APPLICABLE	
	OTHER CONTROL CABLE GLANDS-2	■ APPLICABLE	
WEIGHT	TOTAL WEIGHT (ACTUATOR + ACCESSORIES)	BIDDER TO SPECIFY	_____ Kg.

NOTES:

1. **SCOPE**: DESIGN, MANUFACTURE, INSPECTION, TESTING AND DELIVERY TO SITE OF ELECTRIC ACTUATOR FOR INCHING OR OPEN / CLOSE DUTY.
2. **CODES & STANDARDS**: DESIGN AND MATERIALS USED SHALL COMPLY WITH THE RELEVANT LATEST NATIONAL AND INTERNATION 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
3. TEMPERATURE RISE SHALL BE RESTRICTED TO 70 DEG. C FOR AMBIENT TEMPERATURE OF 50 DEG C.
4. CABLE GLANDS OF DOUBLE COMPRESSION TYPE, BRASS MATERIAL SHALL BE PROVIDED.
5. 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.
6. 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%.
7. THE MOTOR SHALL BE SUITABLE FOR DIRECT ON LINE STARTING.

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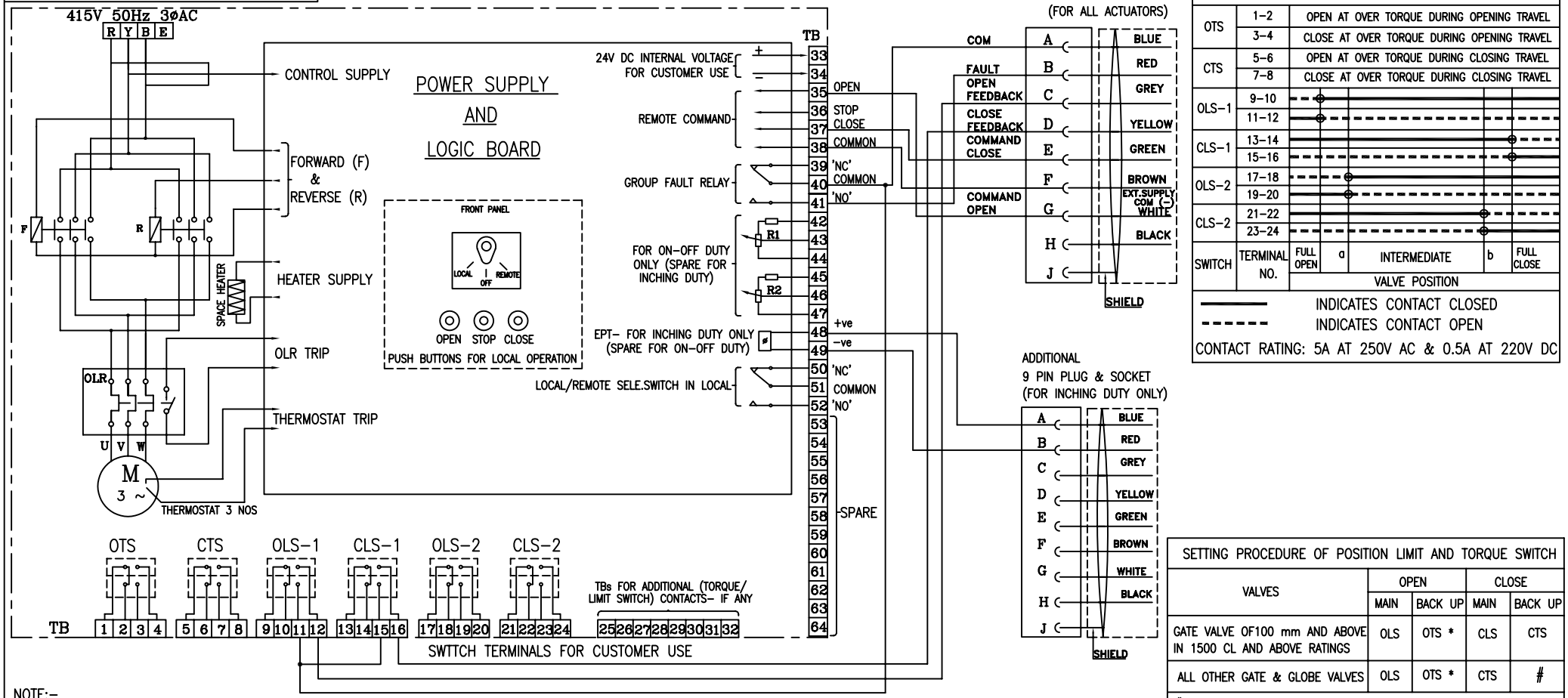
NOTES* = TO BE FILLED BY MPL (LEAD AGENCY). @= TO BE FILLED BY ES

ALL DIMENSIONS ARE IN MILLIMETRES. FOR TOLERANCES OF UNTOLERANCED DIMENSIONS DURING MANUFACTURE REFER RELEVANT QCP / QP.

DRAWING NO. 3-V-MISC-24283



CONTACT DEVELOPMENT DIAGRAM

OTS	1-2	OPEN AT OVER TORQUE DURING OPENING TRAVEL
	3-4	CLOSE AT OVER TORQUE DURING OPENING TRAVEL
CTS	5-6	OPEN AT OVER TORQUE DURING CLOSING TRAVEL
	7-8	CLOSE AT OVER TORQUE DURING CLOSING TRAVEL
OLS-1	9-10	
	11-12	
CLS-1	13-14	
	15-16	
OLS-2	17-18	
	19-20	
CLS-2	21-22	
	23-24	

INDICATES CONTACT CLOSED

INDICATES CONTACT OPEN

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

SETTING PROCEDURE OF POSITION LIMIT AND TORQUE SWITCH

VALVES	OPEN		CLOSE	
	MAIN	BACK UP	MAIN	BACK UP
GATE VALVE OF100 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

* - BYPASS OTS FOR INITIAL 5% OF TRAVEL(FOR GATE VALVES ONLY)

NOTE:-

1. ALL TORQUE AND LIMIT SWITCHES (OTS,CTS,OLS1&2, CLS1&2) ARE WITH 2NO+2NC CONTACTS '1NO+1NC' IS TERMINATED IN TBS 1-24, REMAINING CONTACTS ARE FOR INTERNAL USE. ANY SPARE CONTACTS WHICH ARE NOT USED INTERNALLY ARE TO BE TERMINATED IN TBS 25-32
2. CTS - TORQUE SWITCHES FOR CW ROTATION (CLOSE)
3. OTS - TORQUE SWITCHES FOR CCW ROTATION (OPEN)
4. OLS-1, OLS-2 - LIMITSWITCHES FOR POSITION OPEN
5. CLS-1, CLS-2 - LIMITSWITCHES FOR POSITION CLOSE
6. EPT - ELECTRONIC POSITION TRAMSMITTER (CONTACTLESS TYPE, FOR INCHING DUTY)
7. R1-R2-POTENTIOMETER 2 x 100 OHMS (FOR ON-OFF DUTY)
8. FOR COMMANDS & EPT EITHER INTERNALLY GENERATED 24 VDC OR EXTERNAL SUPPLY OF 24VDC CAN BE USED
9. M - MOTOR 3ø 415V 50 Hz AC SUPPLY
10. TORQUE SWITCH BYPASS WITH LIMITSWITCH BOTH ON OPEN & CLOSE DIRECTION TO BE DONE INTERNALLY.

REV	DATE	ALTERED
		CHD & APPD

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT: ELECTRICAL VALVE ACTUATORS (AC) WITH INTEGRAL STARTERS FOR NTPC PROJECTS (DRAWN FOR INTERMEDIATE POSITION OF VALVES)

365-121

BHARAT HEAVY ELECTRICALS LTD.,
UNIT: HIGH PRESSURE BOILER PLANT.
TIRUCHIRAPALLI-620014.

	NAME	SIGN	DATE	NO.OF VAR.
DRN	N.P.ESWAR	N.P	17.03.05	-
CHD	D.DINAKARAN	D.D	17.03.05	
APPD	K.ARUNACHALAM	K.A	17.03.05	

DEPT	SCALE	WEIGHT (KG).	REFERENCE INFORMATIONS	NO. OF ITEMS
VL	NTS	-		-
CODE	-			

TITLE: WIRING DIAGRAM (TERMINAL PLAN) FOR ACTUATOR WITH INTEGRAL STARTER WITH PLUG & SOCKET FOR NTPC PROJECTS

CARD CODE: U 01

DRAWING NO.: 3-V-MISC-24283

REV: 0

Size A3

SUB-SECTION-IV: I6

PROCESS CONNECTION AND PIPING

PROCESS CONNECTION AND PIPING

1.00.00 PROCESS CONNECTION PIPING

1.01.00 The Contractor shall provide, install and test all required material for completeness of Impulse Piping System and Air Piping System as per the requirements of this Sub-section enclosed installation drawings and source connection drawings on as required basis for the connection of instruments and control equipment to the process and make the system complete. The installation & source connection of various items shall generally as per installation drawings (drawing no. 0000-999-POI-A-022 to 034) and source correction drawings (drawing nos. 0000-999-POI-A-035), however, the Contractor shall furnish during detailed engineering all relevant drawings, material and tech. specifications of various items service wise for Employer's approval.

1.01.01 All materials supplied under this Sub-section shall be suitable for intended service, process, operating conditions and type of instruments used and shall fully conform to the requirements of this specification. The material offered by the Bidder shall be from reputed, experienced manufacturer whose guaranteed and trouble free operation has been proven at least for two years in not less than two pulverized coal fired utility stations.

1.02.00 IMPULSE PIPING, TUBING, FITTINGS, VALVES AND VALVE MANIFOLDS

1.02.01 All impulse pipe shall be of seamless type conforming to ANSI B36.10 for schedule numbers, sizes and dimensions etc. The material of the impulse pipe shall be same as that of main process pipe. For various applications specification of impulse pipe materials and associated fittings and valves shall be as given in Table PCP. For protection against sea environment all impulse pipes fittings etc. shall be provided with durable epoxy coating with poly urethane finish.

1.02.02 Stainless steel tube shall be provided inside enclosures & racks from tee connection to valve manifold and then to instrument. For high pressure/temperature applications (piping class A, B, C &D of the table no. PCP) the material shall be ASTM A 213 TP 316H and for other applications material shall be ASTM A 213 TP 316L. The wall thickness of the tube shall be in accordance with the ANSI B31.1 standard.

1.02.03 All fittings shall be forged steel and shall conform to ANSI B16.11. The material of forged tube fittings for shaped application (e.g. Tee, elbow etc.) shall be ASTMA 182 Gr. 316 H for high pressure/ temperature applications (as defined above) and ASTMA 182 Gr. 316L for other applications. The material for bar stock tube fitting (for straight application) shall be 316 SS. Metal thickness in the fittings shall be adequate to provide actual bursting strength equal to or greater than those of the impulse pipe or SS tube, with which they are to be used.

1.02.04 The source shut-off (primary process root valve) and blow down valve shall be of 1/2 inch size globe valve type for all applications except for air and flue gas service wherein no source shut-off valves are to be provided. The disc and seat ring materials of carbon steel and alloy steel valves be ASTM A-105 and ASTM A-182, Gr. F22, hard faced with stellite (minimum hardness - 350 BHN.) The surface finish of 16 RMS or greater is required in the area of stem packing. The valve design shall be such that the seats can be reconditioned and stem and disc may be replaced without removing the valve body from the line.

1.02.05 The valve manifolds shall be of 316 stainless steel with pressure rating suitable for intended application. 2 valve manifold and 3 valve manifold shall be used for pressure measurements using pressure transmitters/ pressure switches and diff. pressure transmitter/ switches respectively. 5-valve manifold shall be used for remaining applications like DP, flow and level measurements.

1.02.06	For Pr./D.P gauges in fluid application two-way globe valve on each impulse line to the instrument and in A/F application two-way gate valve on each impulse line to the instrument shall be provided near the instrument. These shall be in addition to the three ways gauge cock provided along with the pressure /D.P gauges.
2.00.00	**AIR SUPPLY PIPING**
2.01.00	All pneumatic piping, fittings, valves, air filter cum regulator and other accessories required for instrument air for the various pneumatic devices/ instruments shall be provided.
2.01.01	This will include as a minimum air supply to pneumatically operated control valves, actuators, instruments, continuous and intermittent purging requirements of etc.
2.02.00	For individual supply line and control signal line to control valve, 1/4-inch size light drawn tempered copper tubing conforming to ASTM B75 shall be used. The thickness of cu-tubing shall not be less than 0.065 inch and shall be PVC coated. The fittings to be used with copper tubes shall be of cast brass, screwed type.
2.03.00	All other air supply lines of 1/2 inch to 2 inch shall be of mild steel hot dipped galvanized inside and outside as per IS-1239, heavy duty with threaded ends. The threads shall be as per ASA B.2.1. Fittings material shall be of forged carbon steel A234 Gr. WPB galvanized inside and outside, screwed as per ASA B2.1. Dimensions of fittings shall be as per ASA B16.11 of rating 3000 lbs.
2.04.00	For air supply to various devices mentioned above, the bidder shall provide 2 inch size GI pipe header with isolation valve from the instrument air and service air terminal points. In the boiler area the 2 inch head shall be provided upto top most elevation of boiler floor and from this 2 inch header, 1 inch sub-header shall be branched off at each floor with isolation valve. From this 1 inch sub-header, branch line of 1/2 inch, with isolation valve shall be provided upto various devices. Similar system is to be followed for service air required for intermittent purging in the Local Instrument Enclosures (LIEs) etc.
2.05.00	All instrument air filters cum regulator set with mounting accessories shall be provided for each pneumatic device requiring air supply. The filter regulators shall be suitable for 10-kg/ sq.cm max. Inlet pressure. The filter shall be of size 5 microns and of material sintered bronze. The air set shall have 2-inch size pressure gauge and built in filter housing blowdown valve. The end connection shall be as per the requirement to be finalized during detailed engineering.
2.06.00	All the isolation valves in the air supply line shall be gate valves as per ASTM B62 inside screw rising stem, screwed female ends as per ASA B2.1. Valve bonnet shall be union type & trim material shall be stainless steel, body rating 150 pounds ASA. The valve sizes shall be ½ inch to 2 inch.
2.07.00	Purge Air Connection for Air and Flue gas Applications The continuous purging with instrument air shall be done, for all air and flue gas measurements excepting instrument air and service air instruments, at the process source connection end. Necessary arrangements required for continuous purging shall be provided inside all the Air and Flue gas enclosures as per enclosed drawing no. 0000-999-POI-A-034. For intermittent purging with service air, necessary arrangements inside all the air and Flue gas enclosures shall be provided. The SS three way valve provided in the SS tubing shall be used for isolating the transmitter & connecting the service air quick disconnect line.

	Purging arrangement is not required for Instrument air and service air measurement applications.
3.00.00	**INSTALLATION AND ROUTING**
3.01.00	Instrument Piping System
3.01.01	For steam and liquid measurements, the impulse pipe should preferably slope downward from source connection to instrument and instrument shall be installed below the source point. If due to any reason instrument is installed above the source point, the impulse pipe should slope upwards continuously and a 'pigtail' should be provided at the instrument to assure water seal for temperature protection. For vacuum measurements instrument shall be installed above source point and impulse pipe should slope upwards.
3.01.02	Impulse piping for air and flue gas shall slope upwards and instrument shall be installed above source point. If this requirement cannot be met special venting or drain provision shall be provided with vent & drain lines along with isolation valves and other accessories including drainpipes. This drain is to be connected to plant drain through open funnel also.
3.01.03	All impulse piping shall be installed to permit free movement due to thermal expansion. Wherever required expansion loops shall be provided.
3.01.04	Special accessories such as condensing pots/ reservoirs shall be provided and installed wherever required. In any case condensing pots shall be provided for all level measurements in steam and water services, all flow measurement in steam services and flow measurements water services above 120 Deg.C. For drum/ separator level measurement required balancing chamber shall be provided.
3.01.05	Color coding of all impulse pipes shall be done by the bidder in line with the colour coding being followed for the parent pipes.
3.02.00	Instrument Air & Service Air Piping/ Tubing System
3.02.01	Instrument air & service air headers and their branches with all associated fittings & accessories shall be provided for giving supply to all consumers, as per the requirements. Air piping shall be installed always with a slope of over 1/20 to prevent accumulation of water within the pipe.
3.02.02	Single and multi tubes shall run with the minimum number of changes in direction. Suitable identification tags shall be provided for easy checkup and for connections.
4.00.00	**PIPING/TUBING SUPPORT**
4.01.00	Impulse piping and sample piping shall be supported at an interval not exceeding 1.5 meters. Each pipe shall be supported individually using slotted angle mounted clamps with necessary fixtures. Tubing shall run in proper perforated trays with proper cover. Tubing shall be supported inside the trays by aluminium supports. Hangers and other fixtures required for support of piping and trays shall be provided, either by welding or by bolting on walls, ceilings and structures. Hanger clamps and other fastening hardware shall be of corrosion resistant metals and hot-dip galvanized.

5.00.00	**SHOP AND SITE TESTS**
5.01.00	General Requirements
5.01.01	The equipment and work performed as per this Sub-section shall be subject to shop and site test as per requirements of Sub-section-Q (Quality Assurance & Inspection) other applicable clauses of this Sub-section and Employer approved quality assurance plan.
5.01.02	Hydrostatic and pneumatic tests shall be performed on all pipes, tubing and systems and shall conform to ANSI B31.1.
5.02.00	Hydrostatic Testing
5.02.01	All instrument piping/ tubing shall be hydrostatically tested upon completion of erection. The test pressure shall be 1.5 times the maximum process pressure. The test shall be performed either with the testing of associated process piping or without the associated process piping (by closing the root valve). In both the cases the instrument shall be isolated by closing the shut-off valve.
5.03.00	Air Testing
5.03.01	All air headers & branch pipes shall be air tested by pressure decay method as per ANSI B31.1. Flexible hoses and short signal tubing shall be tested at normal pressure for leakage. Long signal tubing shall be tested by charging each tube with air at 2 kg/ sq. cm. through a bubbler sight glass. The boiler draft and vacuum piping shall be air tested by the same method as long signal tubing.
6.00.00	**LOCAL INSTRUMENT ENCLOSURE AND RACKS**
	Transmitters, switches, devices ,temperature transmitters etc. (except for all fuel oil applications which shall be mounted close to be tapping points) mounted in the field shall be suitably grouped together and mounted (i) local instruments enclosure in case of open areas of the plant like boiler area, etc. and (ii) In local instrument racks in case of covered areas. Gauges are to be mounted on a channel or a frame or a rack (Gauges shall not be mounted directly on process pipe). These local instrument enclosures and racks shall be furnished as per the actual requirements finalized during detailed engineering stage. The exact grouping of instruments in a particular instrument enclosure/instrument rack shall be as finalized during detailed engineering stage subject to Employer's approval. For mounting of PT/DPT/LT/FT, LIEs / LIRs shall be of three types depending on the number of transmitters located in it as elaborated in the typical GA of the LIE/LIR, drawing no. 0000-999-POI-A-064 (Sh Nos. 1 to 3 of 5). For mounting of Temperature Transmitters, LIEs / LIRs shall be as elaborated in the, drawing no. 0000-999-POI-A-064 (Sh No. 4 and 5 of 4). These dimensions and number of instruments indicated therein are only indicative and the exact dimensions along with the number of instruments shall be as finalized during detailed engineering stage without any price repercussions. The internal layout shall be such that the impulse piping/ blow down lines are accessible from back side of the enclosure / rack and the transmitters etc. are accessible from front side for easy maintenance. Bulkheads, especially designed to provide isolation from process line vibration shall be installed on instrument enclosures/racks to meet the process sensing line connection requirement.

Vibration dampeners shall be installed for each enclosure / rack.

The enclosures shall be constructed of 3 mm sheet plate and shall be of modular construction with one or more modules and two end assemblies bolted together to form an enclosure. Double inter locking doors shall be provided. The doors shall be the three-point locking type constructed of not less than 1.6 mm thick steel. Doors shall have concealed quick removal type pinned hinges and locking handles. Door locks shall accept the same key.

Gaskets shall be used between all mating sections to achieve protection class of IP-55.

The instrument racks shall be free standing type constructed of suitable 5 mm thick channel frame of steel and shall be provided with a canopy to protect the equipment mounted in racks from falling objects, water etc. The canopy shall not be less than 3 mm thick steel, and extended beyond the ends of the rack. Bulk heads, especially designed to provide isolation from process line vibration shall be provided. Exact fabrication details shall be as finalized during detailed engineering stage. The junction box for racks also shall conform to IP 55 protection class.

Enclosures/racks shall be reinforced as required to ensure true surface and to provide adequate support for instruments and equipment mounted therein. Centre posts or any member which would reduce access shall not be provided.

Each transmitter enclosure housing instruments requiring **purge air** for continuous air purging, shall be provided with common purge air header, redundant air filter regulators of sufficient capacity, required pressure gauges, valves, fittings, SS tubing and individual purge meters for each purge line etc. as required and indicated in Instrument Installation drawings enclosed herewith.

A 15 mm NB **service air** header shall be furnished in each instrument enclosure housing air & flue gas and coal mill instruments. The header shall be furnished complete with a pressure regulating valve, pressure gauge, and quick disconnect connections. A hose for connecting each header to the draft instrument line four-way valves shall be furnished. The hose shall be self-storing nylon tubing having a burst pressure of 15 kg/sq. cm. The size of the hose shall be 1/2" minimum. The service air header shall originate at a bulkhead penetration or fitting located on one of the bulkhead plates.

The contractor shall prepare the piping drawings and the general arrangement layout drawings for each of the enclosures and racks. Special attention shall be given in the piping layout to avoid air traps in liquid filled piping or water pockets in piping intended to be dry. Drawings shall indicate the arrangement of all equipment, piping, valves and fittings within, the enclosure/racks and shall be subject to Employer's approval.

All liquid filled blow down lines, except those measuring vacuum shall be connected to a two inch header which is extended through one end of the enclosure and turned downward for directing the blow down into a drain. The material of the blow down header shall be carbon steel as per ASTM A 106 Gr. C.

The Contractor shall submit to the Employer with his proposal a copy of his welding procedure specification together with proof of his compliance with the latest applicable welding ANSI code. Prior to any welding being performed, the Contractor shall submit the qualifications of the craftsmen who will perform the work.

7.00.00 TABLE PCP

System/Line Description	Piping Class	Impulse Pipe Material	Schedule (Size)	Materials for Fitting/Valve Body	Valve Stem Material	Rating of Piping/ Fittings	Pr. Class of Valve
Main Steam/ Upstream of HP bypass and Auxiliary Steam Pressure reducing valve, Drum Level	A	ASTM-A335 Gr.P-91/22 (Note-2)	XXS (1/2 inch)	(Note-3)	(Note-3)	9000 lb	3000 SPL
BFP disch, superheater attemperator, spray to PRDS, Phosphate dozing pp disch, BCW pump	B	ASTM-A106 Gr. C	160 (1/2 inch)	ASTM-A105	ASTM-A-182 Gr.F6a	6000 lb	2500
Reheater attemperator	C	ASTM-A106 Gr. C	160 (1/2 inch)	ASTM-A105	-do-	6000 lb	1500
Hot Reheat/ down stream of Aux. Steam press. Reducing valve upto desuper heater/ Flash tank drain manifold, HP heater level.	D	ASTM-A335 Gr. P-91/22 (Note-2)	160 (1/2 inch)	ASTM-A182 Gr.F-22	(Note-3)	3000 lb	900
Cold reheat upto Tee-off for HP Bypass / Extraction steam to HPH	E	ASTM-A335 Gr.P-22	80 (1/2 inch)	ASTM-A182 Gr.F-22	ASTM-A-182 Gr.F6a	3000 lb	800
Cold reheat down steam of Tee-off (HP Bypass)	F	ASTM-A106 Gr. C	80 (1/2 inch)	ASTM-A105	-do-	3000 lb	800
BFP suction, Condensate System/ Extraction to LPH/ Ext-4 to BFPT, Deaerator/ auxiliary steam, service air, inst air, ECW pump, ACW pump and other low pr water services	G	ASTM-A106 Gr. B	80 (1/2 inch)	ASTM-A105	-do-	3000 lb	800
Air/ Flue gas outside furnace	M	ASTM-A106 Gr. B/C	80 (3/4 inch)	ASTM-A105	-do-	3000 lb	800
Air/ Flue gas inside furnace	N	ASTM-A335 Gr.P22	80 (3/4 inch)	ASTM-A182 Gr. F-22	-do-	3000 lb	800

NOTE:

1 Rating of piping/fittings/valves etc. is subjected to the final design pressure & temperature during the detailed engineering.

2 In case temperature is more than 540 deg C, the material shall be P-91 only.

3 Material shall be compatible with that of the impulse pipe material and design parameter.

4 Separator related impulse piping material shall be as per main process pipe/tank material

SUB-SECTION-IV: I7

INSTRUMENTATION AND POWER SUPPLY CABLE

INSTRUMENTATION AND POWER SUPPLY CABLE

1.00.00 **INSTRUMENTATION CABLE, POWER SUPPLY CABLE, INTERNAL WIRING AND ELECTRICAL FIELD CONSTRUCTION MATERIAL**

1.01.00 **General Requirements**

1.01.01 All cables including special cables, internal wiring and electrical field construction material shall conform to this specification, Employer approved detail engineering drawings & documents and the latest edition of the relevant standards & guidelines. The Bidder shall furnish all material and services required for the completeness of the work identified in his scope as per this specification.

1.01.01 The Contractor shall supply, erect, terminate and test all instrumentation cables for control and instrumentation equipment/devices/systems included under Contractor's scope as illustrated in the enclosed Drg. No. 0000-101/102-POI-A-021 and ensuring completeness of the control system.

1.01.02 Any other application where it is felt that instrumentation cables are required due to system/operating condition requirements, are also to be provided by Contractor.

1.01.03 Other type of cables like fiber optic/co-axial cables for system bus, cables for connection of peripherals etc. (under Contractor's scope) are also to be furnished by the Contractor.

1.01.04 Contractor shall supply all cable erection and laying hardware from the main trunk routes like branch cable trays/sub-trays, supports, flexible conduits, cable glands, lugs, pull boxes etc. on as required basis for all the systems covered under this specification.

1.01.05 Wherever the quantity has been defined as on as required basis, the same are to be furnished by contractor on as required basis within his quoted lump sump price without any further cost implication to the Employer.

2.00.00 **Specification of Instrumentation cable**

2.01.00 **Common Requirements**

S. No.	Property	Requirement
1	Voltage grade	225 V (peak value)
2.	Codes and standard	All instrumentation cables shall comply with VDE 0815, VDE 0207, Part 4, Part 5, Part 6, VDE 0816, VDE 0472, SEN 4241475, ANSI MC 96.1, IS-8784, IS-10810 (latest editions) and their amendments read along with this specification.
3.	Continuous operation suitability	At 70 deg. C for all types of cables, while 205 Deg C for Type-C cables.
4.	Progressive automatic on-line sequential marking of length in meters	To be provided at every one meter on outer sheath.

	5.	Marking to read 'FRLS'	To be provided at every 5 meters on outer sheath except for Type-C cable.
	6.	Allowable Tolerance on overall diameter	+/- 2 mm (maximum) over the declared value in data sheet
	7.	Variation in diameter	Not more than 1.0 mm throughout the length of cable.
	8	Ovality at any cross-section	Not more than 1.0 mm
	9	Others	a) Durable marking at intervals not exceeding 625 mm shall include manufacturer's name, insulation material, conductor's size, number of pairs, voltage rating, type of cable, year of manufacturer to be provided. b) Cables shall be suitable for laying in conduits, ducts, trenches, racks and underground-buried installation c) Repaired cables shall not be acceptable.

2.02.00 **Specific Requirements**

Specification Requirements	Type-A cable	Type-B cable	Type F & G cable	Type-C cable
A. Conductors				
Cross section area	(Same as T/C)		0.5 sq. mm	0.5 sq. mm.
Conductor material	ANSI type KX	ANSI type SX	High conductivity Annealed bare copper	ANSI type KX
Colour code	Yellow-Red	Black-Red	As per VDE-815	Yellow-Red
Conductor Grade	As per ANSI MC 96.1		Electrolytic	As per ANSI MC 96.1
No & dia of strands		7x0.3 mm (nom)		
No. of Pairs	2	2	2,4,8,12,16,24,48	2
Max. conductor resistance per Km (in ohm) at 20 deg. C	As per ANSI MC 96.1		73.4 (loop)	As per ANSI MC 96.1

Reference Standard	As per ANSI MC 96.1		VDE 0815	As per ANSI MC 96.1
B. Insulation				
Material		PVC type YI 3 Teflon (i.e. extruded FEP)		
Thickness in mm (Min/Nom/Max)		0.25/0.3/0.35		0.4/0.50
Volume Resistivity (Min) in ohm-cm	1×10^{14} at 20 deg. C & 1×10^{11} at 70 deg. C.			---
Voltage Rating		225 V peak operating voltage		
Reference Standard		VDE 0207 Part 4		VDE 0207 Part 6 & ASTMD 2116.
Core diameter above insulation		Suitable for cage clamp connector		
C. **Pairing & Twisting**				
Max. lay of pairs (mm)			50	
Single layer of polyester numbered tape on each pair provided			Yes	
Unit formation of four pairs with printing of no. of Unit provided		N.A.	Yes	N.A.
Conductor /pair identification as per VDE0815		N.A.	To be provided (color coding attached).	N.A.
D. Shielding				
Type of shielding	←----------	Al-Mylar tape	----------→	
Individual pair shielding		No	To be provided for F-type cable	No
Minimum thickness of Individual pair shielding		No	28 micron	No

	Overall cable assembly shielding		To be provided	
	Minimum thickness of Overall cable assembly shielding		55 micron	
	Shielding coverage	100% with at least 20% overlap		
	Drain wire provided for individual shield	N.A.	Yes (for F-type) 7-strand 20 AWG (0.51 mm2) annealed Tin coated copper	N.A.
	Drain wire provided for overall shield	Yes. 7-strand 20 AWG (0.51 mm2) annealed Tin coated copper		
	E. FILLERS			
	Non-hygroscopic, flame retardant	To be provided		
	F. Outer Sheath			
	Material	←--- Extruded PVC compound YM1 with---→ FRLS properties		Teflon (i.e. extruded FRP)
	Minimum Thickness at any point	1.8 mm		0.4 mm
	Nominal Thickness at any point	>1.8 mm		0.5 mm
	Color		Blue	
	Resistant to water, fungus, termite & rodent attack		Required	
	Oxygen index as per ASTMD-2863	not less than 29%		N.A.
	Temperature index as per ASTMD-2863	not less than 250 deg.C		N.A.
	Acid gas generation by weight as per IEC-60754-1	Maximum 20%		N.A.

Smoke Density Rating as per ASTMD-2843	Maximum 60% (defined as the average area under the curve when the results of smoke density test plotted on a curve indicating light absorption vs. time as per ASTMD-2843)			N.A.
Reference standard	VDE207 Part 5			VDE207 Part 6 & ASTM D2116
G. Electrical Parameters				
Mutual Capacitance Between Conductors At 0.8 Khz (Max.)	200 nF/km		120 nF/km for F type 100 nF/km for G-type	200 nF/km
Insulation Resistance (Min.)	100 M Ohm/Km			
Cross Talk Figure (Min.) At 0.8 Khz	60 dB		60 dB	N.A.
Characteristic Impedance (Max) At 1 Khz	N.A.		320 OHM FOR F-TYPE 340 OHM FOR G-TYPE	N.A.
Attenuation Figure at 1 Khz (Max)	N.A.		1.2 db/km	N.A.
H. Complete Cable				
Complete Cable assembly	Shall pass Swedish Chimney test as per SEN-SS 4241475 class F3.			N.A.
Flammability	Shall pass flammability as per IEEE-383 read in conjunction to this specification			N.A.
I. Accessories				
Cable accessories of flame retardant quality.	Yes. (Accessories such as harnessing components, markers, bedding, cable jointer, binding tape etc.)			
J. Tests				
Routine & Acceptance tests	Refer sub-section IIIE			

	Type tests	Submission of type test results and certificate shall be acceptable provided the test has been conducted within last 5 years from the date of bid opening. In case the test is not conducted within last 5 years or spec requirements are not met, the same shall be conducted by contractor free of cost to Employer. Also, refer sub-section-IV:I9 TYPE TEST REQUIREMENTS FOR C&I.
	K Cable Drum	
	Type	Non-returnable wooden drum (wooden drum to be constructed from seasoned wood free from defects with wood preservative applied to the entire drum) or steel drum.
	Outermost layer covered with waterproof paper	Yes
	Painting	Entire surface to be painted
	Length	1000 m + 5% for up to & including 12 pairs 500 m + 5% for above12 pairs
3.00.00	**SPECIFICATION OF OPTICAL FIBER CABLES (OFC)**	
3.01.00	Optic Fiber cable shall be 4/8/12 core, galvanised corrugated steel taped armoured, fully water blocked with dielectric central member for outdoor/indoor application so as to prevent any physical damage. The cable shall have multiple single-mode or multi mode fibers on as required basis so as to avoid the usage of any repeaters. The core and cladding diameter shall be 9 +/- 1 micrometer and 125 +/- 1 micrometer respectively. The outer sheath shall have Flame Retardant, UV resistant properties and are to be identified with the manufacturer's name, year of manufacturer, progressive automatic sequential on-line marking of length in meters at every meter on outer sheath.	
3.02.00	The cable core shall have suitable characteristics and strengthening for prevention of damage during pulling viz. Steel central member, Loose buffer tube design, 4 fibers per buffer tube (minimum), Interstices and buffer tubes duly filled with Thixotropic jelly etc. The cable shall be suitable for a maximum tensile force of 2000 N during installation, and once installed, a tensile force of 1000 N minimum. The compressive strength of cable shall be 3000 N minimum& crush resistance 4000 N minimum. The operating temperature shall be -20 deg. C to 70 deg.C	
3.03.00	All testing of the fiber optic cable being supplied shall be as per the relevant IEC, EIA and other international standards.	
3.04.00	Bidder to ensure that minimum 100% cores are kept as spares in all types of optical fibre cables.	
3.05.00	Cables shall be suitable for laying in conduits, ducts, trenches, racks and under ground buried installation.	
3.06.00	Spliced / Repaired cables are not acceptable.	
3.07.00	Penetration of water resistance and impact resistance shall be as per IEC standard.	

4.00.00 SPECIFICATION OF POWER SUPPLY CABLES

For technical specification, testing requirements etc, refer relevant subsections of this specification.

5.00.00 INSTRUMENTATION CABLE INTERCONNECTION AND TERMINATION PHILOSOPHY

The cable interconnection philosophy to be adopted shall be such that extensive grouping of signals by large scale use of field mounted Group Junction Boxes (JBs) at strategic locations (where large concentration of signals are available, e.g. valves limit & torque switches, switchgear) is done and consequently cable with higher number of pairs are extensively used. The details of termination to be followed are mentioned in the given Table A.

TABLE A: CABLE TERMINATION TO BE FOLLOWED

Application	Type Of Termination		Type Of Cable
FROM (A)	TO (B)	END A	END B	
Valves/dampers drives (Integral Junction box)	Marshalling cubicle/ Marshalling cum termination Cubicle/local group JB	Plug in connector	Posts mount cage clamp type.	G
Transmitters, Process Actuated switches mounted in LIE/LIR	Integral Junction box of LIE/LIR	Plug in connector	Cage clamp (Rail mount) type.	F,G
RTD heads	Local junction box	Plug in connector	Cage clamp (Rail mount) type.	F
Thermocouple	CJC Box (if applicable)	Plug in connector	Cage clamp (Rail mount) type.	A,B,C*
Other Field Mounted Instrument	Local JB/Group JB	Plug in connector	Screwed, Cage clamp (Rail mount) type	F,G
RTD	Temperature transmitter	Plug in connector	Screwed, Cage clamp type	F
Thermocouple	Temperature transmitter	Plug in connector	Screwed, Cage clamp type	A,B,C*
Local Junction box, Temperature Transmitter, Int. Junction box of LIE/ LIR/Group JB/ MCC/SWGR	Group JB	Cage clamp (Rail mount) type.	Cage clamp (Rail mount) type.	F,G

Application	Type Of Termination		Type Of	Cable
FROM (A)	TO (B)	END A	END B	
Local Junction box, Temperature Transmitter, Int. Junction box of LIE/ LIR/Group JB/ MCC/SWGR	Marshalling Cubicle/ Marshalling cum Termination Cabinet	Cage clamp (Rail mount) type.	Posts mount cage clamp type.	F,G
Marshalling cubicle/ Termination Cabinet	Electronic system cabinet	Cage clamp Post mounted type.	Plug in connector/ Other System as per manufacturer's Standard	Internal wiring
Marshalling/ Termination System Cabinets	UCD mounted equipments	Post mount cage clamp type.	Plug in connector/ Cage clamp type (rail mounted).	F,G (with plug-in connector at one end)
DDCMIS/PLC cabinets	PC, Printers etc.	Plug in connector	Plug in connector	Mfr.'s Standard

Notes
1. Normally 10% spare cores shall be provided when the numbers of pairs of cables are more than four pairs except for pre-fabricated cables which shall be as per manufacturer's standard.
2. For analog signals, individual pair shielding & overall shielding & for Binary signals, only overall shielding of instrumentation cables shall be provided.
3. Also refer Drg. 0000-101/102-POI-A-021.
4. *For high temperature applications only.
5. Instrument Cabling for instruments/equipments covered under subsection-IV:I3 (MAIN EQP INST SYS) shall be as per manufacturer's standard .

6.00.00 **TERMINAL BLOCKS**

6.01.00 All terminal blocks shall be rail mounted/post mounted, cage clamp type with high quality non-flammable insulating material of melamine suitable for working temperature of 105 deg.C. The terminal blocks in field mounted junction boxes, temperature transmitters, instrument enclosures/racks, etc., shall be suitable for cage clamp connections. The terminal blocks in Control Equipment Room logic/termination/marshalling cubicles shall be suitable for post mounted cage clamp connection at the field input end. The terminal blocks for DDCMIS input/output connections from/to SWGR/MCC, Actuators with Integral Starter (for coupling

	relays and check back signals of 11 kV and 3.3 kV auxiliaries, LT drives/valves & dampers/solenoids, CT & VT, etc.) shall be provided with built in test and disconnect facilities complete with plug, slide clamp, test socket etc. The exact type of terminal blocks to be provided by the Bidder and the technical details of the same including width etc. shall be subject to Employer's approval.
6.02.00	All the terminal blocks shall be provided complete with all required accessories including assembly rail, locking pin and section, end brackets, partitions, small partitions, test plug bolts and test plug (as specified above for SWGR connections) transparent covers, support brackets, distance sleeves, warning label, marking, etc.
6.03.00	The marking on terminal strips shall correspond to the terminal numbering on wiring diagrams. At least 20% spare unused terminals shall be provided everywhere including local junction boxes, instrument racks/enclosures, termination/marshalling cabinets, etc. All terminal blocks shall be numbered for identification and grouped according to the function. Engraved labels shall be provided on the terminal blocks.
6.04.00	For terminating each process actuated switches, drive actuators, control valves, Thermocouple, RTD, etc. in Local Junction Boxes, etc, refer Drg no. 0000-999-POI-A-065.
6.05.00	The terminal blocks shall be arranged with at least 100 mm clearance between two sets of terminal blocks and between terminal blocks and junction box walls.
6.06.00	For ensuring proper connections, Bidder shall provide suitable accessories, along with insulation sleeves. The exact connecting accessory shall be finalized as per application during detail engineering stage subject to Employer's approval without any cost repercussions.
6.07.00	Internal wiring in factory pre-wired electronic equipment cabinets may be installed according to the Bidder's standard as to wire size and method of termination or internal equipment. Terminal blocks for connection of external circuits into factory prewired electronic equipment cabinets shall meet all the requirements as specified above.
7.00.00	**INTERNAL PANELS/ SYSTEM CABINETS WIRING**
7.01.00	Internal panel/cabinet wiring shall be of multi-stranded copper conductor with FRLS PVC insulation without shield and outer sheath meeting the requirements of VDE 0815.
7.02.00	Wiring to door mounted devices shall be done by 19 strand copper wire provided with adequate loop lengths of hinge wire so that multiple door opening shall not cause fatigue breaking of the conductor.
7.03.00	All internal wires shall be provided with tag and identification nos. etched on tightly fitted ferules at both ends in Employer's approved format. All wires directly connected to trip devices shall be distinguished by one additional red color ferrule.
7.04.00	All external connection shall be made with one wire per termination point. Wires shall not be tapped or spliced between terminal points.
7.05.00	All floor slots of desk/panels/cabinets used for cable entrance shall be provided with removable gasketed gland plates and sealing material. Split type grommets shall be used for prefabricated cables.
7.06.00	All the special tools as may be required for solder less connections shall be provided by Bidder.

7.07.00 Wire sizes to be utilized for internal wiring.

(i)	Current (4-20 mA), low voltage signals (48V); Ammeter/Voltmeter circuit, control switches etc. for electrical system.	0.5 Sq.mm.
(ii)	Power supply and internal illumination.	2.5Sq.mm. minimum (shall be as per load requirement.)

8.00.00 INSTRUMENTATION CABLE INSTALLATION AND ROUTING

8.01.00 All cables assigned to a particular duct/conduit shall be grouped and pulled in simultaneously using cable grips and suitable lubricants. Cables removed from one duct/conduit shall not be reused without approval of Employer.

8.02.00 Cables shall be segregated as per IEEE Std.-422. In vertically stacked trays, the higher voltage cable shall be in higher position and instrumentation cable shall be in bottom tier of the tray stack. The distance between instrumentation cables and those of other system shall be as follows:

From 11 kV/6.6 kV/3.3 kV tray system	-	914 mm
From 415V tray system	-	610 mm
From control cable tray system	-	305 mm

8.03.00 Cables shall terminate in the enclosure through cable glands. All cable glands shall be properly gasketed. Fire proof sealing (to prevent ingress of dust entry and propagation of fire) shall be provided for all floor slots used for cable entrance. Compression cable glands (double for armoured and single for other cables) shall be provided.

8.04.00 All cables shall be identified by tag. Nos. provided in Employer's approved format at both the ends as well as at an interval of 5 meters.

8.05.00 Line voltage drop due to high resistance splices, terminal contacts, insulation resistance at terminal block, very long transmission line etc. shall be reduced as far as practicable.

8.06.00 The cables emanating from redundant equipment/devices shall be routed through different paths. The above segregation of cables & wiring for redundant equipments/devices shall be in accordance with IEEE-Std-422.

9.00.00 CABLE LAYING AND ACCESSORIES

9.01.00 **CABLE LAYING**

1 Cables shall be laid strictly in line with cable schedule.

2 Identification tags for cables.

Indelible tags to be provided at all terminations, on both sides of wall or floor crossing, on each conduit/duct/pipe entry/exit, and at every 20 m in cable trench/tray.

	3 Cable tray numbering and marking. To be provided at every 10m and at each end of cable way & branch connection. 4 Joints for less than 250 Meters run of cable shall not be permitted. 5 Buried cable protection With concrete slabs; Route markers at every 20 Meters along the route & at every bend. 6 Road Crossings Cables to pass through buried high density PE pipes encased in PCC. At least 300 mm clearance shall be provided between - HT power & LT power cables, - LT power & LT control cables - LT control & instrumentation cables, Spacing between cables of same voltage grade shall be in accordance with the de-rating criteria adopted for cable sizing. 7 Segregation (physical isolation to prevent fire jumping) a All cable associated with the unit shall be segregated from cables of other Units. b Interplant cables of station auxiliaries and unit critical drives shall be segregated in such a way that not more than half of the drives are lost in case of single incident of fire. 8 Cable clamping All cables laid on trays shall be neatly dressed up & suitably clamped/tied to the tray. For cables in trefoil formation, trefoil clamps shall be provided. 9 Optical fiber cables inside conduit shall be laid on cable trays wherever available and feasible. In areas where the same are required to be buried, the same shall be buried in separate trench approx.1.6 meter depth, to be laid in 2" GI/rodent proof HDPE conduits covered with sand, brick and soil along the pipe line route; While crossing roads - to be laid in GI/rodent proof HDPE conduits with sand filling at bottom and sand, soil filling at top with cement concrete; While crossing canals/river- to be laid in GI/rodent proof HDPE conduits within hume pipe.
9.02.00	Bidder shall supply and install all cable accessories and fittings like Light Interface Units, Surge suppressors, Opto isolators, Interface Converters, Fibre Optic Card Cage, Fibre Optic Line Driver, Repeater / Modem (for Optical Fibre Cables), cable glands, grommets, lugs, termination kits etc. on as required basis.

9.03.00	Bidder shall furnish two completely new sets of cable termination kits like Crimping tools, etc., which are required for maintenance of the system as per the type of termination used.		
9.04.00	Cables, which terminate in cabinets of draw out sections shall have sufficient cable coiled in the bottom of the cabinet to permit full withdrawal of draw out sections without disconnecting the cables. When prefabricated cables with factory connectors on both ends are longer than required, the excess cable shall be coiled in the bottom of one or both termination cabinets.		
9.05.00	No splices shall be made in conductors for instrument and control circuits except where required at connections to devices equipped with factory installed pigtails. Such splices shall be made only in approved splicing boxes of fitting with removable cover. The splices shall be made with sufficient slack left in the wires to permit withdrawal of the splice from the splicing box for ease of future disconnection of the splices. All exposed conductor or connector surfaces shall be covered with a minimum of three half-lapped layers of all weather vinyl plastic electrical tape. Taping shall extend a minimum of two cable diameters over the cable jacket and a similar distance over the other insulation or connections requiring insulation.		
9.06.00	The Bidder shall be responsible for proper grounding of all equipment under C&I package. Further, proper termination of cable shields shall be verified and the grounding of the same shall be coordinated so as to achieve grounding of all instrumentation cable shields at same potential. This shall be completed prior to system tests. All the cables etc. required for grounding of all equipments supplied under this package are to be supplied by the Bidder.		
9.07.00	The Contractor shall take full care while laying / installing cables as recommended by cable manufacturers regarding pulling tensions and cable bends. Cables damaged in any way during installation shall be replaced at the expense of the Contractor.		
10.00.00	**FIELD MOUNTED LOCAL JUNCTION BOXES**		
	(i)	No. of ways	12/24/36/48/64/72/96/128 with 20% spares terminals.
	(ii)	Material and Thickness	4mm thick Fiberglass Reinforced Polyester (FRP).
	(iii)	Type	Door gasket shall be of synthetic rubber.
	(iv)	Mounting clamps and accessories	Suitable for mounting on walls, columns, structures etc. The brackets, bolts, nuts, screws, glands and lugs required for erection shall be of brass, included in Bidders scope of supply.
	(v)	Type of terminal blocks	Rail mounted cage-clamp type suitable for conductor size upto 2.5 mm2. A M6 earthing stud shall be provided.
	(vi)	Protection Class	IP: 55 minimum for indoor & IP-65 minimum for outdoor applications.
	(vii)	Grounding	To be provided.
	(viii)	Color	To be decided during detailed engineering & subject to Employer's approval.

11.00.00 **CONDUITS**

11.01.00 Conduits shall be generally used for interconnecting cables from field instruments to Local JB's. All rigid conduits, couplings and elbows shall be hot dipped galvanized rigid mild steel in accordance with IS: 9537 Part-I (1980) and Part-II (1981). The conduit interior and exterior surfaces shall have continuous zinc coating with an overcoat of transparent enamel lacker or zinc chromate. Flexible conduit shall be heat resistant lead coated steel, The temperature rating of flexible conduit shall be suitable for the following areas:

(i) Mills
(ii) Drum
(iii) Main steam, RH steam
(iv) Air Heaters
(v) Furnace, BFPDTs

For the remaining applications, water leak, fire and rust proof flexible GI conduits shall be provided.

11.02.00 The Bidder shall install conduits according to the general routing as approved by Employer and shall coordinate conduit locations with other works.

11.03.00 All grounding bushings within all enclosures shall be wired together and connected internally to the enclosure grounding lug or grounding bus with 8 AWG bare copper conductor. Conduit runs to individually mounted equipment shall be grounded to the Employer's cable tray grounding conductor with 12 AEG bare copper conductor. All grounding bushings, clamps and connectors shall be subject to approval of the Employer.

11.04.00 All rigid conduit fittings shall conform to the requirements of IS: 2667, 1976. Galvanized steel fitting shall be used with steel conduit. All flexible conduit fittings shall be liquid tight, galvanized steel. The end fittings shall be compatible with the flexible conduit supplied.

11.05.00 All individually mounted equipment and devices shall be connected to the supply conduit, using not more than one meter of flexible conduit adjacent to the equipment or device. Flexible conduit shall be installed in all conduit runs, which are supported by both building steel and structures subject to vibration or thermal expansion. This shall include locations where conduit supported by building steel enters or becomes supported by the turbine generator foundation and where conduit supported by building steel or foundation becomes supported by steam generator framing.

11.06.00 Special areas, such as control rooms in which external noise is to be minimized, shall have flexible conduit in conduit runs where the runs cross from the main building framing to the control room framing.

11.07.00 Conduit supports shall be furnished and installed in accordance with these specifications. Support material shall comply with the following requirements.

i) Hanger rods shall be 12 mm diameter galvanized threaded steel rods.

ii) Single conduit supports shall be one-hole cast metal straps and clamp backs unless other types are acceptable to the Employer. Multiple conduit bank supports shall be constructed of special galvanized support channels with associated conduit clips.

11.08.00 Conduit sealing, explosion proof, dust proof and other types of special fittings shall be provided as required by these specifications and shall be consistent with the area and equipment with which they are installed. Fittings installed outdoors and in damp locations

	shall be sealed and gasketed. Hazardous area fittings and conduits sealing shall conform to NEC requirements for the area classification.
11.09.00	Contractor shall provide double locknuts on all conduit terminations not provided with threaded hubs and couplings. Water tight conduit unions and rain tight conduit hubs shall be utilized for all the application which shall be exposed to weather. Moisture pockets shall be eliminated from conduits.
11.10.00	Conduits shall be securely fastened to all boxes and cabinets.
12.00.00	**CABLE SUB-TRAY & SUPPORT**
12.01.00	The cable sub-trays and the supporting system, to be generally used between Local/Group JBs and the main cable trays and the same shall be furnished and installed by the Contractor. It is the assembly of sections and associated fittings forming a rigid structural system used to support the cable from the equipment or instrument enclosure upto the main cable trays (trunk route).
12.02.00	The covers on the cable sub-trays shall be used for protection of cables in areas where damage may occur from falling objects, welding spark, corrosive environment, etc. & shall be electrically continuous and solidly grounded. The cable trays shall not have sharp edges, burrs or projections injurious to the insulation or outer sheath of the cables.
12.03.00	The supporting arrangement of cable tray system shall be able to withstand the weight of the cable and cable tray system. The supporting interval shall not be more than the recommended span for the above loading for the type of cable tray selected. The tray shall not overhang by more than one meter from the support at the dead end. As far as practicable the cable sub-tray system shall be supported from one side only, in order to facilitate installation and maintenance of cables.
12.04.00	The Bidder shall furnish and install the estimated quantities and sizes of sub trays/troughs including all required fittings and adaptors on as required basis.

SUB-SECTION-IV: I8

CONTROL VALVES, ACTUATORS

CONTROL VALVES, ACTUATORS & ACCESSORIES

1.00.00	**CONTROL VALVES, ACTUATORS & ACCESSORIES**
1.01.00	**General Requirements**
1.01.01	The control valves and accessories equipment furnished by the Bidder shall be designed, constructed and tested in accordance with the latest applicable requirements of code for pressure piping ANSI B 31.1, the ASME Boiler & pressure vessel code, Indian Boiler Regulation (IBR), ISA, and other standards specified elsewhere as well as in accordance with all applicable requirements of the "Federal Occupational Safety and Health Standards, USA" or acceptable equal standards. All the Control Valves, their actuators and accessories to be furnished under this Sub-section will be fully suitable and compatible with the modulating loops covered under the Specification.
1.01.02	All the control valves and accessories offered by the Bidder shall be from reputed, experienced manufacturers of specified type and range of valves.
1.01.03	For control valve such as pressure and temperature control valve for Aux PRDS applications, Separator Drain Control Valves etc., also refer to the corresponding mechanical section in addition to requirements stipulated in this subsection.
1.02.00	**CONTROL VALVE SIZING & CONSTRUCTION**
1.02.01	The design of all valve bodies shall meet the specification requirements and shall conform to the requirements of ANSI (USA) for dimensions, material thickness and material specification for their respective pressure classes.
1.02.02	The valve sizing shall be suitable for obtaining maximum flow conditions with valve opening at approximately 80% of total valve stem travel and minimum flow conditions with valve stem travel not less than 10% of total valve stem travel. All the valves shall be capable of handling at least 120% of the required maximum flow. Further, the valve stem travel range from minimum flow condition to maximum flow condition shall not be less than 50% of the total valve stem travel. The sizing shall be in accordance with the latest edition of ISA handbook on control valves. While deciding the size of valves, Bidder shall ensure that valves trim exit outlet velocity as defined in ISA handbook does not exceed 8 m/sec for liquid services, 150 m/sec. for steam services and 50% of sonic velocity for flashing services. Bidder shall furnish the sizing calculations clearly indicating the outlet velocity achieved with the valve size selected by him as well as noise calculations, which will be subject to Employer's approval during detailed engineering.
1.02.03	Control valves for steam and water applications shall be designed to prevent cavitation, wire drawing, flashing on the downstream side of valve and down stream piping. Thus for cavitation/flashing service, only valve with anti cavitation trim shall be provided. Detailed calculations to establish whether cavitation will occur or not for any given application shall be furnished.
1.02.04	Control valves for application such as SH Spray Control, RH spray Control, Heavy Oil Heating, pressurizing and Control system shall have permissible leakage rate as per leakage Class V. All other control valves shall have leakage rate as per leakage Class-IV.
1.02.05	The control valve induced noise shall be limited to 85 dBA at 1 meter from the valve surface under actual operating conditions. The noise abatement shall be achieved by valve body and trim design and not by use of silencers.

2.00.00 **VALVE CONSTRUCTION**

2.01.00 All valves shall be of globe body design & straightaway pattern with single or double port, unless other wise specified or recommended by the manufacturer to be of angle body type. Rotary valve may alternatively be offered when pressure and pressure drops permit.

2.02.00 Valves with high lift cage guided plugs & quick-change trims shall be supplied.

2.03.00 Cast Iron valves are not acceptable.

2.04.00 Bonnet joints for all control valves shall be of the flanged and bolted type or other construction acceptable to the Employer. Bonnet joints of the internal threaded or union type will not be acceptable.

2.05.00 Plug shall be of one-piece construction cast, forged or machined from solid bar stock. Plug shall be screwed and pinned to valve stems or shall be integral with the valve stems.

2.06.00 All valves connected to vacuum on down stream side shall be provided with packing suitable for vacuum applications (e.g. double vee type chevron packing)

2.07.00 Valve characteristic shall match with the process characteristics.

2.08.00 Extension bonnets shall be provided when the maximum temperature of flowing fluid is greater than 280 deg. C.

2.09.00 Flanged valves shall be rated at no less then ANSI press class of 300 lbs.

3.00.00 **VALVE MATERIALS**

Sr. No.	Service	Body material	Trim Material
1	Non-corrosive, non-flashing and non-cavitation service except DM water	Carbon steel ASTM-A216 Gr. WCB for fluid temperature below 275 Deg. C Alloy steel ASTM-A217Gr. WC9 for fluid temperature above 275 Deg. C	316SS stellited with stellited faced guide posts and bushings.
2.	Severe flashing/cavitation services	Alloy steel ASTM-A217 Gr. WC9	440 C
3.	Low flashing/cavitation service	Alloy steel ASTM-A217 Gr. WC6	17-4 PH SS
4.	DM water service	316 SS	316 SS

NOTE Valve body rating shall meet the process pressure and temperature requirement as per ANSI B16.34.

However, Bidder may offer valves with body and trim materials better than specified materials and in such cases Bidder shall furnish the comparison of properties including cavitation resistance, hardness, tensile strength, strain energy, corrosion resistance and erosion resistance etc. of the offered material vis-a-vis the specified material for Employer's consideration and approval.

4.00.00 END PREPARATION

Valve body ends shall be either butt welded/socket welded, flanged (Rubber lined for condensate service) or screwed as finalized during detailed engineering and as per Employer's approval. The welded ends wherever required shall be butt welded type as per ANSI B 16.25 for control valves of sizes 65 mm and above. For valves size 50 mm and below welded ends shall be socket welded as per ANSI B 16.11. Flanged ends wherever required shall be of ANSI pressure-temperature class equal to or greater than that of the control valve body.

5.00.00 VALVE ACTUATORS

All control valves shall be furnished with pneumatic actuators except for pressure and temperature control valve for auxiliary PRDS application (electro-hydraulic / pneumatically operated) and separator drain control valve (electro-hydraulic type).The Bidder shall be responsible for proper selection and sizing of valve actuators in accordance with the pressure drop and maximum shut off pressure and leakage class requirements. The valve actuators shall be capable of operating at 60 deg.C continuously.

Valve actuators and stems shall be adequate to handle the unbalanced forces occurring under the specified flow conditions or the maximum differential pressure specified. An adequate allowance for stem force, at least 0.15 Kg/sq.cm. per linear millimeter of seating surface, shall be provided in the selection of the actuator to ensure tight seating unless otherwise specified.

The travel time of the pneumatic actuators shall not exceed 10 seconds.

6.00.00 CONTROL VALVE ACCESSORY DEVICES

6.01.00 All pneumatic actuated control valve accessories such as air locks, hand wheels/hand-jacks, limit switches, microprocessor based electronic Positioner, diffusers, external volume chambers, position transmitters (capacitance or resistance type only), reversible pilot for Positioner, tubing and air sets, solenoid valves and junction boxes etc. shall be provided as per the requirements.

7.00.00 SPECIFICATIONS FOR MICROPROCESSOR BASED ELECTRONIC POSITIONER

Electrical	Input Signal	4-20 mA
	Power Supply	Loop Powered from the output card of Control System.
	Hart Protocol	Compatibility For Remote Calibration & Diagnostics (Super-Imposed HART signal on Input Signal 4-20 mA)
	Valve Position Sensing	Position Sensing (Non Contact-Type), 4-20 mA O/P Signal For Control System to be provided
Environment	Operating Temp	(-)30 To 80 Deg. C
	Humidity	0-95 %
	Protection Class	IP-65 Minimum

	Remote Configuration and Diagnostics	a. The following functions shall be provided in the positioner: Remote Configuration, Calibration and Testing of the Actuator and advanced Diagnostic Features Like Stroke Counter or Travel Counter, Leakage In Actuators, On Line Partial Closure Test, Valve Signature Analysis, Step Response Test, Valve Friction/ Jamming Detection etc. (See Note* below) b. Factory Valve Signature Tests Reports (Pr Vs Valve Travel And Travel Vs I/P Signal) are to be provided.	
	Tests Certificates	Test certificates as per Manufacturer Standard/Relevant Standard are to be submitted	
	Configuration/	Remote Calibration, Auto & Manual Calibration Shall Be Possible	
	Operating	Operating Range	Full Range & Split Range Signal Range
	Modes	Valve Action	Direct & Reverse. Valve Action
		Flow Characterization	Possible To Fit Valve Characteristic Curve Linear & Equal Percentage
	Fail Safe/Fail Freeze	Fail Safe/Fail Freeze Feature is to Be Provided.	
	Pneumatic	Air Capacity	Sufficient To Handle The Valves Selected/Boosters To Be Supplied If required.
		Air Supply Pressure	To Suit The Air Supply Pressure/Quality Available.
		Process Connection	1/4 Inch NPT
	Performance	Characteristic Deviation	<=0.5 % Of Span
		Ambient Temp Effect	<=0.01 %/Deg C Or Better
	EMC & CE Compliance	Required To International Standard Like EN/IEC.	En50081-2 & En50082 Or Equivalent
	Accessories	In Built Operator Panel	Display With Push Buttons For Configuration And Display On The Positioner Itself (Password Protected/Hardware Lock)
		Hand Held Hart Calibrator	Universal Hart Calibrator To Be Provided, One Per Unit

	Press Gauge Block	For Supply & Output Pr., Filter Regulator Other Accessories Shall Be Provided As On Required Basis For Making System Complete.
	Electrical Cable Entry	1/2-Npt,Side Or Bottom Entry To Avoid Water Ingress
	Valves Mounting Assembly	For Sliding Stem/Rotary/Single Acting/ Double Acting On Required Basis

*** Note**:

Employer is providing a centralized HART management system including the HART multiplexing/interfacing system. The HART signals shall be picked up from marshalling terminals of DDCMIS (SG/TG DDCMIS as well as BOP DDCMIS), as applicable. The details of the above mentioned employer's HART management system are as below:

The following functionalities are provided through software of the HART management system:

1. For electronic transmitters, temperature transmitters and analysers:
   a. Constant scanning to monitor faults or changes to instrument configuration.
   b. Employer-defined and standard calibration and configuration procedures for all transmitters.
   c. Constant signal data collection facilities to maintain continuously updated records.
   d. Automatic tracking of configuration changes made in the field, such as may be introduced by hand-held communicator. All configuration function associated with hand-held communicators shall be available in the system.
   e. Event and log reports on screen as well as on printer.
   f. Any addition/deletion of transmitter will be reported on printer and logged in hard disk.

2. For electronic positioners:

a. Remote Configuration, Calibration and Testing of the Actuator

b. Advanced Diagnostic Features Like Stroke Counter or Travel Counter, Leakage In Actuators, On Line Partial Closure Test, Valve Signature Analysis, Step Response Test, Valve Friction/ Jamming Detection etc.

Above functionalities are achieved by the Employer's HART management system by providing industry standard softwares. If the bidder has any observations on the above, the same is to be brought out in the bid. Further, Bidder has to list out in his bid the softwares that are compatible with his electronic positioners.

8.00.00 **TEST AND EXAMINATION**

All valves shall be tested in accordance with the quality assurance programme agreed between the Employer and Contractor, which shall meet the requirements of IBR and other applicable codes mentioned elsewhere in the specifications. The tests shall include but not be limited to the following:

8.01.00 Non Destructive Test as per ANSI B-16.34.

8.02.00	Hydrostatic shell test in accordance with ANSI B 16.34 prior to seat leakage test.
8.03.00	Valve closure test and seat leakage test in accordance with ANSI-B 16.34 and as per the leakage class indicated above.
8.04.00	Functional Test: The fully assembled valves including actuators control devices and accessories shall be functionally tested to demonstrate times from open to close position.
8.05.00	CV Test: Please refer Cl No. 1.00.00, Sub-section-IV:I9 (Type test requirements), Control Valves.
	Bidder shall furnish all the control valves under this main plant package as finalized during detailed engineering stage without any price repercussions whatsoever depending on the process requirements. All the control valves provided by the Bidder for this project shall meet the specifications requirements specified herein. Specification for control valves in this Sub-section has to be read in conjunction with other relevant Sub-sections of this specification.

SUB-SECTION-IV: I9

TYPE TEST REQUIREMENTS

TYPE TEST REQUIREMENTS

1.00.00 TYPE TEST REQUIREMENTS

General Requirements

The Contractor shall furnish the type test reports of all type tests as per relevant standards and codes as well as other specific tests indicated in this specification. A list of such tests are given for various equipment in table titled 'TYPE TEST REQUIREMENT FOR C&I SYSTEMS' at the end of this chapter and under the item Special Requirement for Solid State Equipments/Systems. If the bidder proposes a different standard/code from that indicated at table 3.00.00, the same is acceptable provided the equivalence of the proposed standard is established by the bidder. For the balance equipment instrument, type tests may be conducted as per manufactures standard or if required by relevant standard.

(a) Out of the tests listed, the Bidder/ sub-vendor/ manufacturer is required to conduct certain type tests specifically for this contract (and witnessed by Employer or his authorized representative) even if the same had been conducted earlier, as clearly indicated subsequently against such tests.

(b) For the rest, submission of type test results and certificate shall be acceptable provided.

i. The same has been carried out by the Bidder/ sub-vendor on exactly the same model /rating of equipment. (For control valves, this shall be same size, type & design).

ii. There has been no change in the components from the offered equipment & tested equipment.

iii. The test has been carried out as per the latest standards along with amendments as on the date of Bid opening.

(c) In case the approved equipment is different from the one on which the type test had been conducted earlier or any of the above grounds, then the tests have to be repeated and the cost of such tests shall be borne by the Bidder/ sub-vendor within the quoted price and no extra cost will be payable by the Employer on this account.

As mentioned against certain items, the test certificates for some of the items shall be reviewed and approved by the main Bidder or his authorized representative and the balance have to be approved by the Employer.

The schedule of conduction of type tests/ submission of reports shall be submitted and finalized during pre-award discussion.

For the type tests to be conducted, Contractor shall submit detailed test procedure for approval by Employer. This shall clearly specify test setup, instruments to be used, procedure, acceptance norms (wherever applicable), recording of different parameters, interval of recording precautions to be taken etc. for the tests to be carried out.

The Bidder shall indicate in the relevant BPS schedule, the cost of the type test for each item only for which type tests are to be conducted specifically for this project. The cost shall only

be payable after the respective type tests are conducted in presence of authorized representative of Employer. If a test is waived off, then the cost shall not be payable.

2.00.00 SPECIAL REQUIREMENT FOR SOLID STATE EQUIPMENTS/ SYSTEMS

The minimum type test reports, over and above the requirements of above clause, which are to be submitted for each of the major C&I systems shall be as indicated below:

i) Surge Withstand Capability (SWC) for Solid State Equipments/ Systems

All solid state systems/ equipments shall be able to withstand the electrical noise and surges as encountered in actual service conditions and inherent in a power plant. All the solid state systems/ equipments shall be provided with all required protections that needs the surge withstand capability as defined in ANSI 37.90.1/ IEEE-472. Hence, all front end cards which receive external signals like Analog input & output modules, Binary input & output modules etc. including power supply, data highway, data links shall be provided with protections that meets the surge withstand capability as defined in ANSI 37.90.1/ IEEE-472. Complete details of the features incorporated in electronics systems to meet this requirement, the relevant tests carried out, the test certificates etc. shall be submitted along with the proposal. As an alternative to above, suitable class of EN 61000-4-12 which is equivalent to ANSI 37.90.1/ IEEE-472 may also be adopted for SWC test.

ii) Dry Heat test as per IEC-68-2-2 or equivalent.

iii) Damp Heat test as per IEC-68-2-3 or equivalent.

iv) Vibration test as per IEC-68-2-6 or equivalent.

v) Electrostatic discharge tests as per EN 61000-4-2 or equivalent.

vi) Radio frequency immunity test as per EN 61000-4-6 or equivalent.

vii) Electromagnetic Field immunity as per EN 61000-4-3 or equivalent.

Test listed at item no. v, vi, vii, above are applicable for electronic cards only as defined under item (i) above.

3.00.00 TYPE TEST REQUIREMENT FOR C&I SYSTEMS

Sl. No	Item	Test Requirement	Standard	Test To Be Specifically Conducted	NTPC's Approval Req. On Test Certificate
Col 1	Col 2	Col 3	Col 4	Col 5	Col 6
1	Elect. Metering instruments	As per standard (col 4)	IS-1248	No	Yes
2	Thermocouple	Degree of protection test	IS-2147	No	No

3	RTD	As per standard (col 4)	IEC-60751	No	No
4	Electronic transmitter	As per standard (col 4)	BS-6447 / IEC-60770	No	Yes
5	E/P converter	As per standard (col 4)	Mfr. standard	No	Yes
6	Instrumentation Cables Twisted & Shielded				
	-Conductor	Resistance test	VDE-0815	No	Yes
		Diameter test	IS-10810	No	Yes
		Tin Coating test (Persul-phate test)	IS-8130	No	Yes
	-Insulation	Loss of mass	VDE 0472	No	Yes
		Ageing in air ovens**	VDE 0472	No	Yes
		Tensile strength and elongation test before and after ageing**	VDE 0472	No	Yes
		Heat shock	VDE 0472	No	Yes
		Hot deformation	VDE 0472	No	Yes
		Shrinkage	VDE 0472	No	Yes
		Bleeding & blooming	IS-10810	No	Yes
	-Inner sheath***	Loss of mass	VDE 0472	No	Yes
		Heat shock	VDE 0472	No	Yes
		Cold bend/ cold impact test	VDE 0472	No	Yes
		Hot deformation	VDE 0472	No	Yes

		Shrinkage	VDE 0472	No	Yes
	-Outer sheath	Loss of mass	VDE 0472	No	Yes
		Ageing in air ovens**	VDE 0472	No	Yes
		Tensile strength and elongation test before and after ageing**	VDE 0472	No	Yes
		Heat shock	VDE 0472	No	Yes
		Hot deformation	VDE 0472	No	Yes
		Shrinkage	VDE 0472	No	Yes
		Bleeding & blooming	IS-10810	No	Yes
		Colour fastness to water	IS-5831	No	Yes
		Cold bend/ cold impact test	VDE-0472	No	Yes
		Oxygen index test	ASTMD-2863	No	Yes
		Smoke Density Test	ASTMD-2843	No	Yes
		Acid gas generation test	IEC-60754-1	No	Yes
	-fillers	Oxygen index test	ASTMD-2863	No	Yes
		Acid gas generation test	IEC-60754-1	No	Yes
	-AL-MYLAR shield	Continuity test		No	Yes
		Shield thickness		No	Yes
		Overlap test		No	Yes
	-Over all cable	Flammability Test	IEEE 383	No	Yes

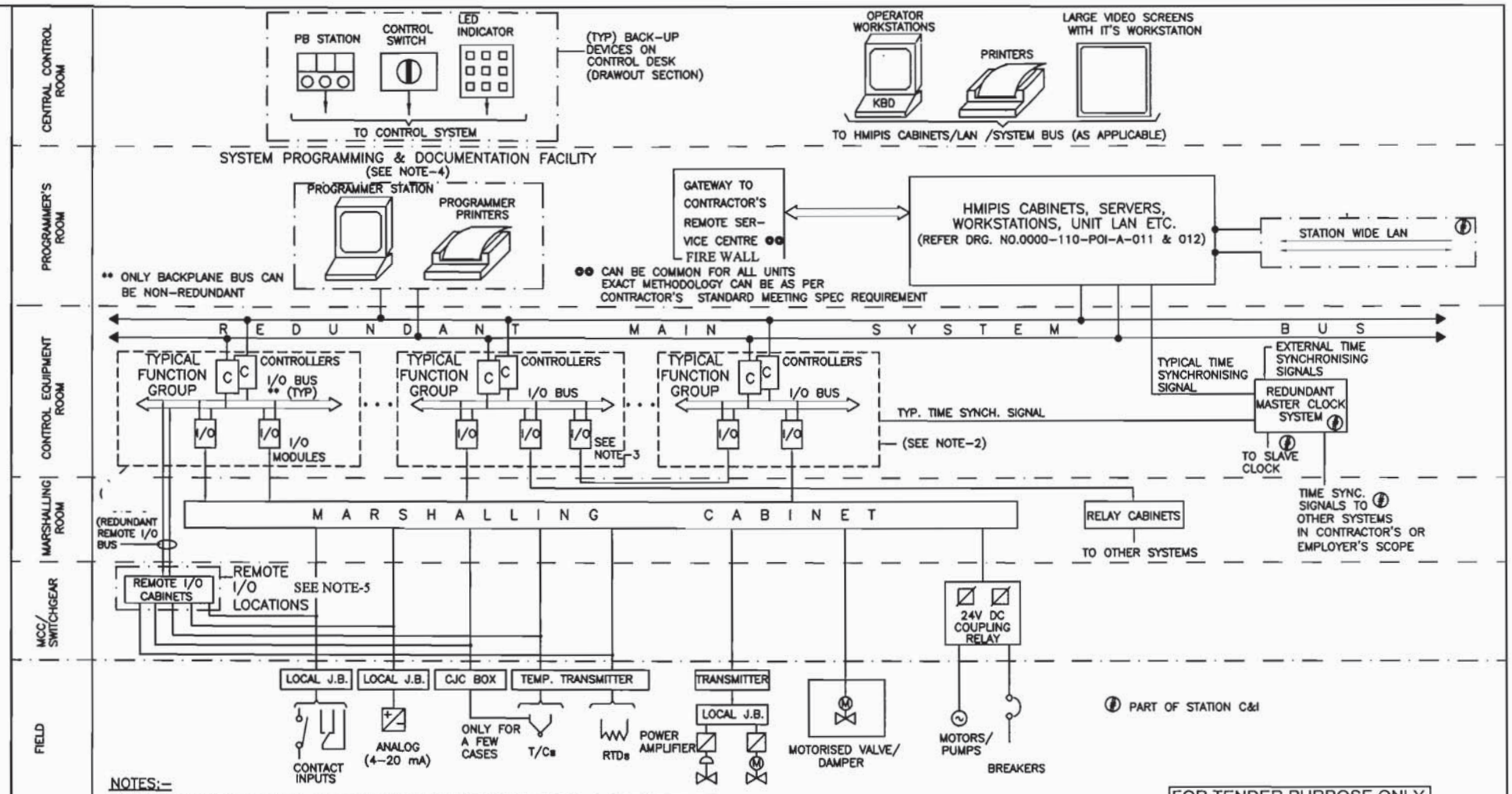
		Swedish Chimney Test	SEN 4241475	No	Yes
		Noise interference	IEEE Trans-actions	No	Yes
		Dimensional checks	IS 10810	No	Yes
		Cross talk	VDE-0472	No	Yes
		Mutual capacitance	VDE-0472	No	Yes
		HV test	VDE-0815	No	Yes
		Drain wire continuity		No	Yes
	* For Drain wire only				
	**These tests shall be carried out as per VDE0207 Part 6 & ASTMD-2116 for TEFLON insulated & outer sheathed cables				
	***Applicable for armoured cables only				
7	DC Power Supply System (Applicable for each model and rating)				
		Degree of protection test	IS-13947	Yes	Yes
		Short circuit current capability	Approved procedure	Yes	Yes
		Voltage Proof Test	UL 950,IEC950	Yes	Yes
		Burn In test	Approved procedure	Yes	Yes
		Efficiency	Approved procedure	Yes	Yes
		Audible Noise Test	Approved procedure	Yes	Yes
		Fuse Clearing Capability	Approved procedure	Yes	Yes
		Total harmonic content	Approved procedure/ CIGRES	Yes	Yes
		Radio Frequenc interference	IEC-CISPR22, IEC-61000-	Yes	Yes

			4-12(9b), IEC-61000-4-3, IEC-61000-4-5, IEC-61000-4-6		
		Over Load Test	Approved procedure	Yes	Yes
		Restart Test	Approved procedure	Yes	Yes
		Output voltage tolerance	Approved procedure	Yes	Yes
		Parallel operation	Approved procedure	Yes	Yes
		ESD immunity Test	IEC-61000-4-2-9(1)	Yes	Yes
		Electrical Fast transient/Burst Immunity Test	IEC-61000-4-4	Yes	Yes
		Surge Protection	IEC61312, IEC61024, VDE 100-534	Yes	Yes
		Insulation Test	Approved procedure	Yes	Yes
		Load Tests.	Approved procedure	Yes	Yes
		Preliminary light load test (without Battery supply)	Approved procedure	Yes	Yes
		Load sharing	Approved procedure	Yes	Yes
8	Battery	As per standard	IS-10918	No	Yes
9	Voltage Stabiliser	Over Load Test	Approved procedure	No	Yes
		Temp rise test without redundant fans	Approved procedure	No	Yes

		Input voltage variation test	Approved procedure	No	Yes
10	DDCMIS				
	BMS	Safety requirements	VDE0116 Sec 8.7	No	Yes
11	Conductivity Type Level Switch	Degree of protection test	IS-2147	No	No
12	Local Gauges	Degree of protection test	IS-2147	No	No
13	Process actuated Switches	Degree of protection test	IS-2147	No	No
14	Control Valves	CV test	ISA 75.02	No	Yes
15	PLCs	As per standard	IEC 1131	No	No
16	LIE / LIR	Degree of protection test	IS-2147	Yes	Yes
17	Flue gas O2 analyser, other Flue Gas analysers	Degree of protection test	IS-2147	No	Yes
18	Flow Nozzle Orifice plates	Calibration	ASME PTC BS 1042	Yes	Yes

Note:

Type Tests are to be conducted only for the items, which are being supplied as a part of this Package.



NOTES:-

1. FOR CONTRACT QUANTITIES, REFER SUBSECTION DDCMIS SECTION VI PART-A OF TECHNICAL SPEC.
2. CONTROL SYSTEM CABINETS REFER DRG. NO. 0000-110- POI-A-009 FOR FUNCTIONAL GROUPING.
3. HARDWIRED SIGNAL EXCHANGE (TYP.).
4. THE SKETCH IS ONLY INDICATIVE. FOR DETAILED PROGRAMMER STATION REQUIREMENT, REFER SUBSECTION DDCMIS.
5. THE REMOTE I/O CABINET SHALL BE APPLICABLE IF MENTIONED IN PART-A OF TECHNICAL SPECIFICATIONS

FOR TENDER PURPOSE ONLY

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NTPC Ltd
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

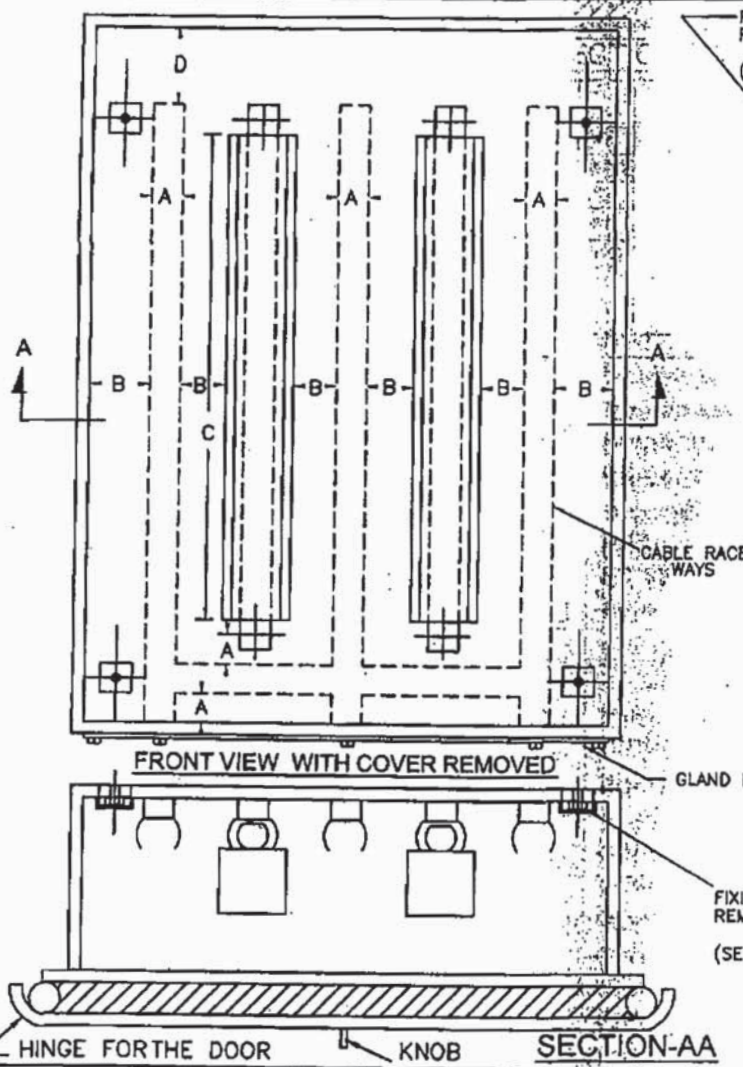
PROJECT: TYPICAL THERMAL POWER PROJECT
TG PACKAGE

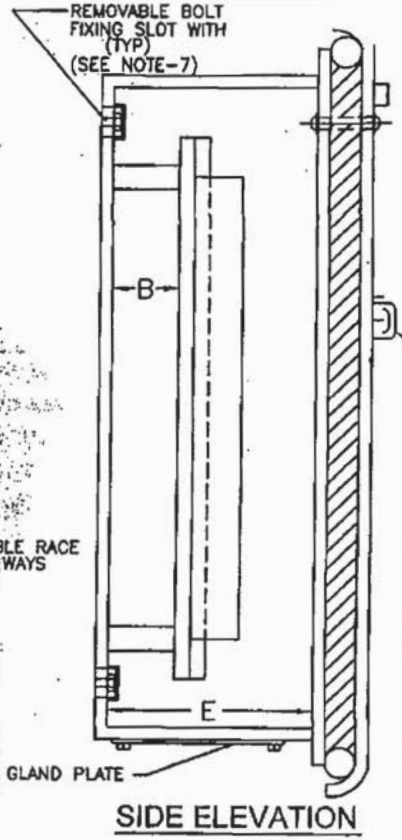
TITLE: DISTRIBUTED DIGITAL CONTROL, MONITORING AND INFORMATION SYSTEM (DDCMIS) CONFIGURATION DIAGRAM

REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE										23.05.05

CLEARED BY

SIZE	SCALE	DRG. NO.	REV. NO.
	N.T.S.	0000-110 -POI-A-001 Sh-1 Of 1	A





A – 75 mm
B – 25 mm
C – SEE NOTE-4
D – 100 mm
E – 150 mm

NOTES:-

1. JUNCTION BOXES SHALL HAVE GLAND PLATES AT THE BOTTOM OF THE BOX ONLY.
2. TUBULAR TYPE GASKETS WILL BE USED.
3. FRP JUNCTION BOXES, SHALL BE PROVIDED WITH POLYEUTHERENE COATING. ALSO REFER SUB SECTION INST CABLE, PART-B SECTION-VI FOR DETAILES.
4. DIMENSION OF 'F' SHALL BE BASED ON NO. OF TERMINAL BLOCKS.
5. THE EXACT TYPE & DIMENSION OF JUNCTION BOXES TO BE USED FOR A PARTICULAR APPLICATION SHALL BE AS DECIDED DURING DETAIL ENGG. STAGE AND SHALL BE SUBJECT TO EMPLOYER's APPROVAL WITHOUT ANY PRICE REPERCUSSION.
6. THE KNOB FOR ALL THE JUNCTION BOXES SHALL BE IDENTICAL.
7. ANY TYPE OF SEALED FIXING ARRANGEMENT AS PER MANUFACTURER's STANDARD CAN ALSO BE PROVIDED SUBJECT TO EMPLOYER's APPROVAL.

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नेशनल थर्मल पावर कारपोरेशन लिमिटेड
National Thermal Power Corporation Ltd.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

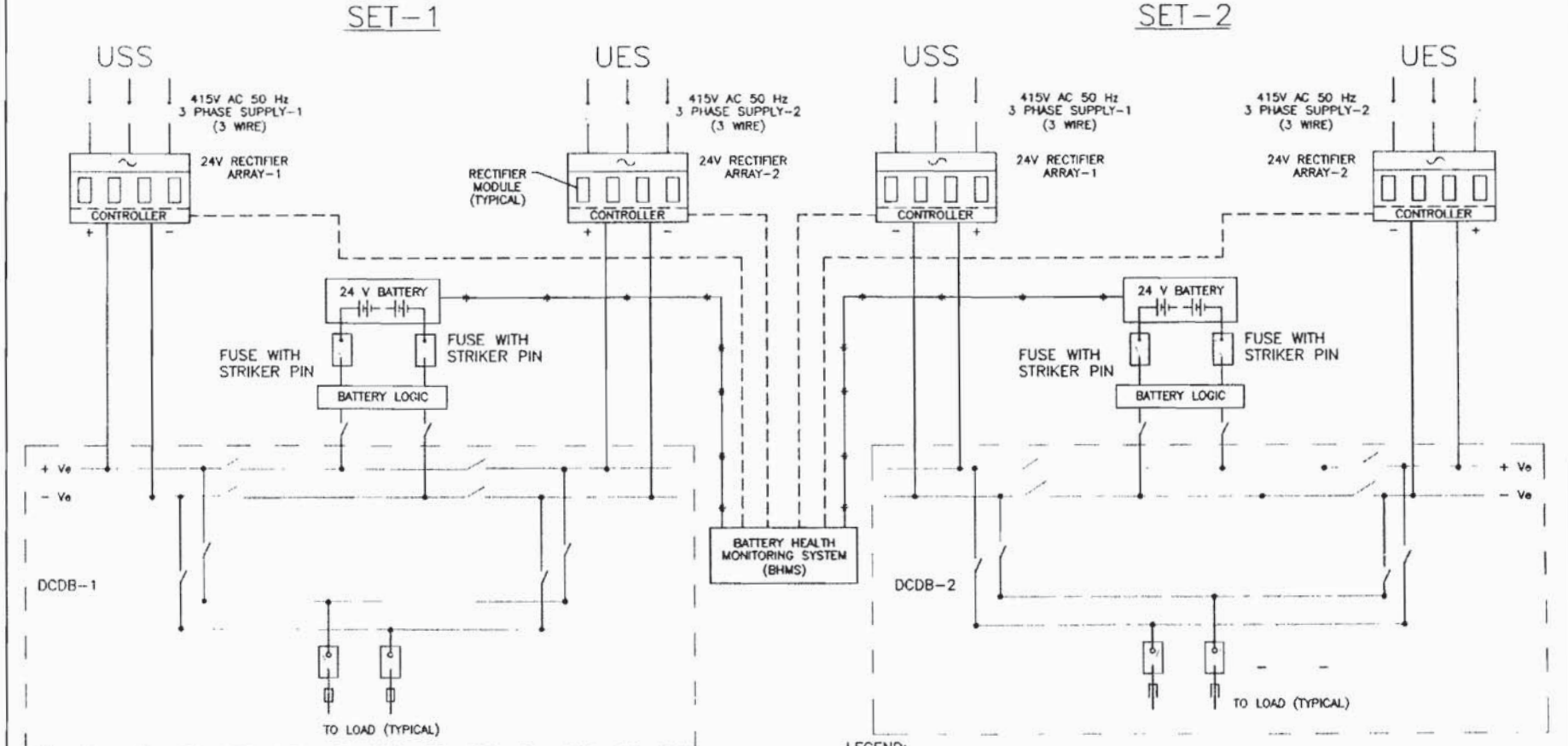
REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
D	GENERALLY REVISED		JM	KS							30.11.05
C	GENERALLY REVISED		JM	KS							04.08.06
B	GENERALLY REVISED	S.K.	A.R	PS							
A	FIRST ISSUE	S.K.	A.R	PS							04.05.05

CLEARED BY

PROJECT: TYPICAL THERMAL POWER PLANT

TITLE: LOCAL JUNCTION BOX CONNECTION DETAILS

SIZE	SCALE	DRG. NO.	REV. NO.
A3	N.T.S.	0000-999-POI-A-017	D



NOTES:- 1 SUITABLE INTERLOCK SYSTEM SHALL BE PROVIDEED IN FLOAT/BOOST CHARGING MODE.

LEGEND:
ISOLATOR
MCB
FUSE

FOR TENDER PURPOSE ONLY

TWO SET CONFIGURATION

NTPC. LIMITED
(A GOVT. OF INDIA ENTERPRISE)

PROJECT: TYPICAL THERMAL POWER PROJECT FOR STATION C&I PACKAGE

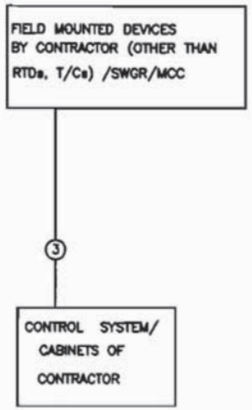
TITLE: SCHEME FOR 24 V DC POWER SUPPLY SYSTEM

REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE										14.11.08

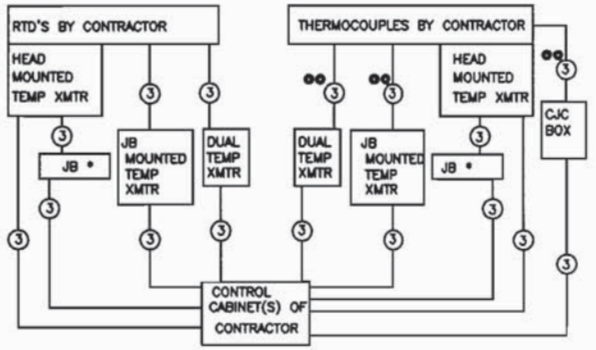
CLEARED BY

SIZE	SCALE	DRG NO	REV. NO
A3	N.T.S.	0000-405-POI-A-019 SH-1 OF 2	A

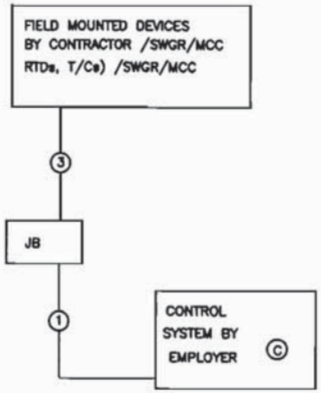
BOTH INSTRUMENTS/DEVICES AND CONTROLS IN CONTRACTOR SCOPE



CONTRACTOR'S RTD & THERMOCOUPLES AND TEMP TRANSMITTERS USED IN CONTRACTOR'S CONTROL SYSTEM



CONTRACTOR'S INSTRUMENTS/DEVICES USED IN EMPLOYER'S CONTROL SYSTEM



NOTES

© -- EMPLOYER'S SCOPE
* -- WHEREVER APPLICABLE
1- CABLES IN EMPLOYER'S SCOPE
3- CABLES IN CONTRACTOR'S SCOPE
●● - COMPENSATING CABLES
←(X)→ - SOFT LINKS

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	CM	ARCH.	APPD.	DATE
A	FIRST ISSUE									PS	
					CLEARED BY						

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N T P C LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

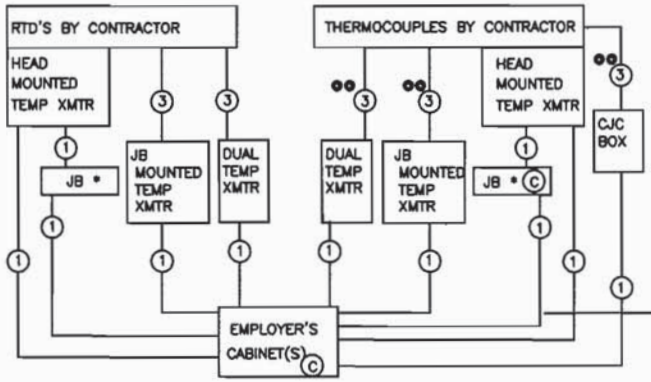
PROJECT: TYPICAL THERMAL POWER PROJECT
TG PACKAGE

TITLE: INSTRUMENTATION CABLING DIAGRAM

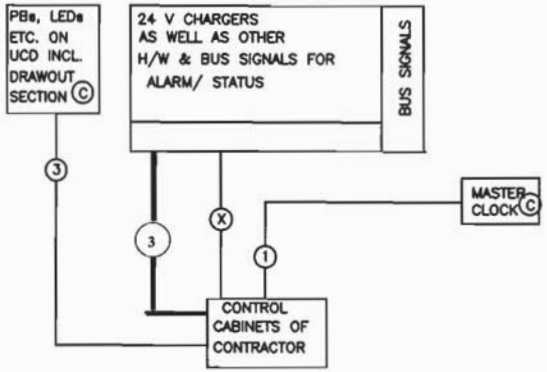
SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-110-P0I-A-021 SH 1 OF 4	A

CAD FILE NAME :

CONTRACTOR'S RTD & THERMOCOUPLES AND TEMP TRANSMITTERS USED IN EMPLOYER'S CONTROL SYSTEM



CONTROL DESK MOUNTED DEVICES AND OTHER MISC SIGNALS INCLUDING ALARM/ STATUS SIGNALS ETC.



NOTES

Ⓒ -- EMPLOYER'S SCOPE
* -- WHEREVER APPLICABLE
1- CABLES IN EMPLOYER'S SCOPE
3- CABLES IN CONTRACTOR'S SCOPE
●● - COMPENSATING CABLES
←(X)→ - SOFT LINKS

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD.	DATE
B	REVISED SCOPE OF TEMP TRANSMTRS	MS								PS	28-08-08
A	FIRST ISSUE	MS								PS	28-08-08
					CLEARED BY						

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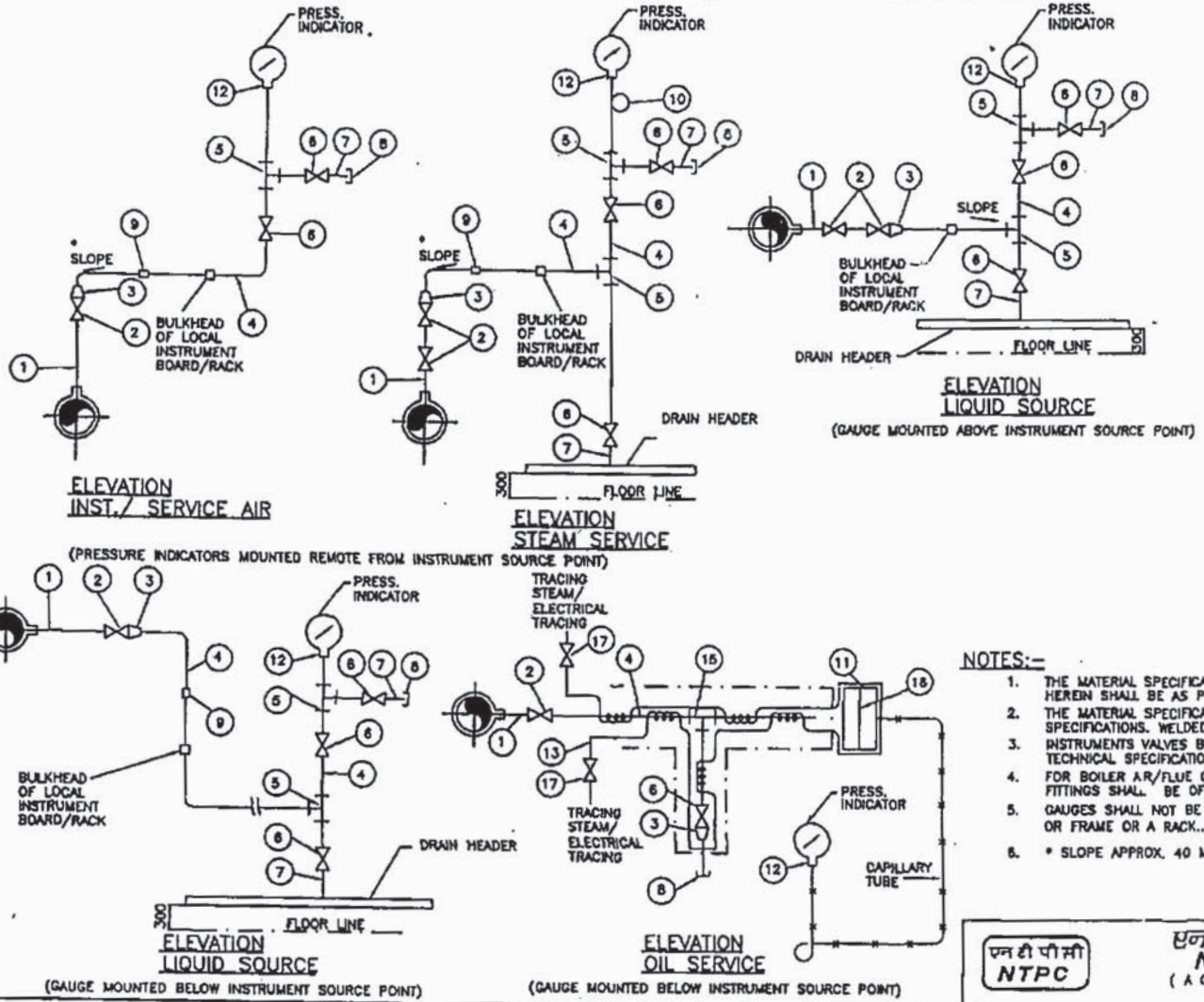
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

TITLE: TYPICAL THERMAL POWER PROJECT
TG PACKAGE
INSTRUMENTATION CABLING DIAGRAM

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-110-POI-A-021 SH 2 OF 4	B
		CAD FILE NAME :	



ELEVATION
INST./ SERVICE AIR

ELEVATION
STEAM SERVICE

ELEVATION
LIQUID SOURCE

(GAUGE MOUNTED ABOVE INSTRUMENT SOURCE POINT)

(PRESSURE INDICATORS MOUNTED REMOTE FROM INSTRUMENT SOURCE POINT)

ELEVATION
LIQUID SOURCE

(GAUGE MOUNTED BELOW INSTRUMENT SOURCE POINT)

ELEVATION
OIL SERVICE

(GAUGE MOUNTED BELOW INSTRUMENT SOURCE POINT)

LIST OF MATERIALS

ITEM NO.	DESCRIPTION
1.	1/2" , 3/4" , 1" NPS SCH 40/80/160/XXS/F91 (AS PER PROCESS REQUIREMENT) NIPPLE OF MATERIAL SAME AS THAT OF MAIN PIPE.
2.	1/2"/3/4"/1' SW GLOBE VALVE/GATE VALVE
3.	3/4" / 1" x 1/2" SW REDUCING INSERT
4.	1/2" / 3/4" PIPE
5.	1/2" / 3/4" SW EQUAL TEE
6.	1/2" / 3/4" SW GLOBE VALVE.
7.	1/2" / 3/4" NPS SW x 1/2" / 3/4" NPT(M) CARBON/ALLOY STEEL NIPPLE.
8.	1/2" / 3/4" NPT(F) CS CAP.
9.	1/2" / 3/4" PIPE UNION.
10.	6" SS SYPHON
11.	1/2" BLIND 300lbs RF ANSI FLANGE DRILLED AND TAPED FOR 1" NPT PIPE.
12.	SUITABLE ADAPTER.
13.	1/4" CHROME MOLY STEEL TUBE.
14.	
15.	1"/3/4" SW EQUAL TEE.
16.	DIAPHRAGM(WAFER ELEMENT)
17.	ISOLATION VALVE 316 SS,1/4"SW

NOTES:-

1. THE MATERIAL SPECIFICATION AND SCHEDULE NO. OF IMPULSE PIPE & NIPPLE AS LISTED HEREIN SHALL BE AS PER TECHNICAL SPECIFICATIONS.
2. THE MATERIAL SPECIFICATION AND RATING OF FITTINGS AS LISTED SHALL BE AS PER SPECIFICATIONS. WELDED/THREADED FITTINGS SHALL CONFIRM TO ANSI-B.16-11.
3. INSTRUMENTS VALVES BODY STEM MATERIAL AND PRESSURE CLASS SHALL BE AS PER TECHNICAL SPECIFICATIONS.
4. FOR BOILER AR/FLUE GAS SERVICES SOURCE CONNECTIONS IMPULSE PIPING AND ALL FITTINGS SHALL BE OF 3/4" NB SIZE.
5. GAUGES SHALL NOT BE MOUNTED ON THE PIPE. IT WILL BE MOUNTED ON A CHANNEL OR FRAME OR A RACK..
6. * SLOPE APPROX. 40 MM / METRE.

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NTPC LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

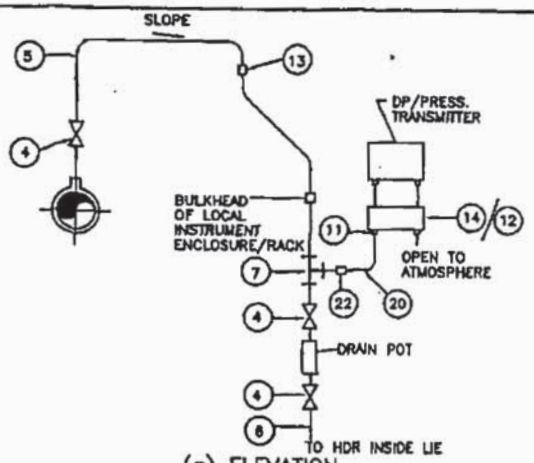
PROJECT: TYPICAL THERMAL POWER PROJECT (TG PACKAGE)

TITLE: INSTRUMENT INSTALLATION DIAGRAM (FOR PRESSURE GAUGE)

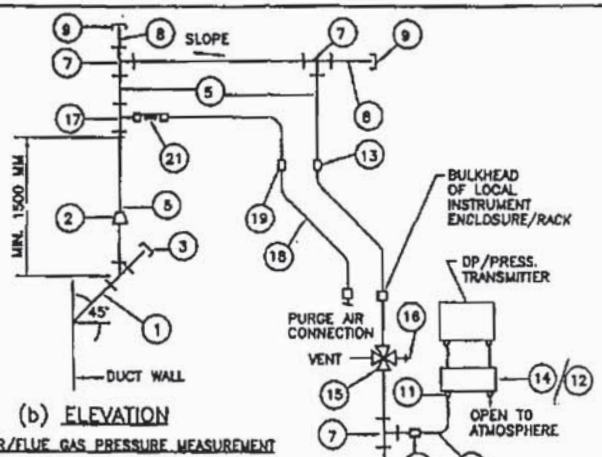
REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE										28.04.06

CLEARED BY

SIZE	SCALE	DRG. NO.	REV. NO.
A3	N.T.S.	0000-110-POI-A-022	A

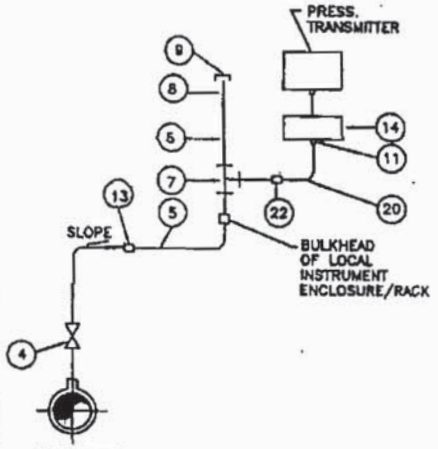


(a) ELEVATION
INST/SERVICE AIR PRESSURE MEASUREMENT

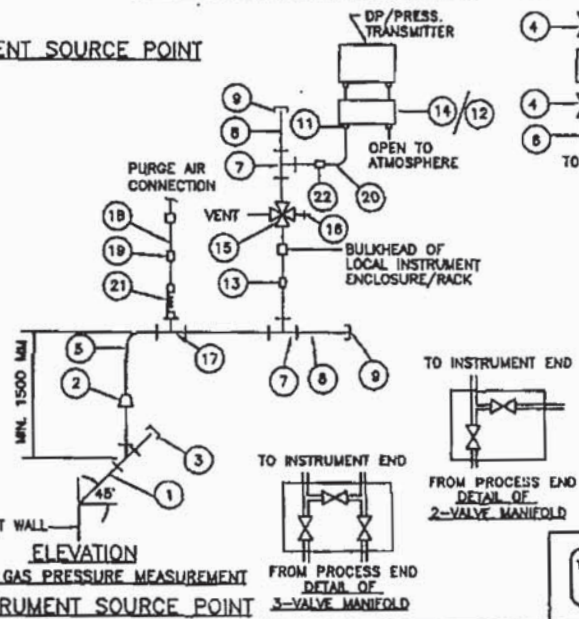


(b) ELEVATION
DIRTY AIR/FLUE GAS PRESSURE MEASUREMENT

TRANSMITTER MOUNTED BELOW INSTRUMENT SOURCE POINT



ELEVATION
INST/SERVICE AIR PRESSURE MEASUREMENT



ELEVATION
DIRTY AIR/FLUE GAS PRESSURE MEASUREMENT

TRANSMITTER MOUNTED ABOVE INSTRUMENT SOURCE POINT

LIST OF MATERIALS

ITEM NO.	DESCRIPTION
1.	42 X 405 MM M.S. BLACK PIPE
2.	M42x2 TO 3/4" REDUCING INSERT
3.	M42x2(F) M.S.CAP
4.	3/4" SW GLOBE VALVE/GATE VALVE
5.	3/4" NPS PIPE
6.	3/4" NPS SW 3/4" NPT(M) CS/AS NIPPLE
7.	3/4" SW EQUAL TEE
8.	3/4" NPS SCH 80 CARBON/ALLOY STEEL NIPPLE
9.	3/4" NPT(F) CS/AS CAP
10.	3/4" SW CS/AS EQUAL CROSS
11.	1/2" TUBE ADOPTER
12.	3 VALVE MANIFOLD
13.	3/4" PIPE UNION
14.	2 VALVE MANIFOLD
15.	3/4" SW 4 WAY VALVE
16.	QUICK DISCONECT FITTING
17.	3/4"SWx1/2"SW BRANCH TEE
18.	1/2" NB SEAMLESS GI PIPE
19.	1/2" NPT (F) GI FITTING
20.	SS TUBE
21.	FLEXIBLE HOSE WITH ONE END SOCKET WELDED (PIPE SIDE) & OTHER END WITH SUITABLE FITTINGS.
22.	3/4" x 1/2" S.S. TUBE UNION

NOTES:-

1. SEE NOTES UNDER DRG. NO.0000-110-POI-A-022.
2. IMPULSE LINE DRAIN CONNECTIONS SHALL BE DONE AS PER TECHNICAL SPECIFICATIONS
3. THE SLOPE IN THE HORIZONTAL OF THE IMPULSE PIPE SHALL BE APPROX. 50 mm/mtr.
4. THE EXACT ORIENTATION OF THE TRANSMITTERS WITH RESPECT TO VALVE MANIFOLDS ETC. WILL BE FINALISED DURING DETAILED ENGINEERING KEEPING IN VIEW THE MANUFACTURER'S RECOMMENDATIONS.
5. COMMON INSTRUMENT AIR HEADER (1"NB) USING REDUNDANT AIR FILTER REGULATORS WILL BE MADE IN EACH TRANSMITTER ENCLOSURE REQUIRING PURGE AIR. PURGE AIR FOR EACH INSTRUMENT LINE SHALL BE TAPPED FROM THIS HEADER USING INDIVIDUAL PURGE ROTAMETERS AS SHOWN IN DRG. NO. 0000-110-POI-A-034 TYPICALLY.

FOR TENDER PURPOSE ONLY

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NTPC LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT: TYPICAL THERMAL POWER PROJECT (TG PACKAGE)

TITLE: INSTRUMENT INSTALLATION DIAGRAM (PRESSURE MEASUREMENT USING PRESS / DP TRANSMITTERS (INST./SERVICE, DIRTY AIR/FLUE GAS)

REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
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VOLUME – II B

SECTION-D

STANDARD TECHNICAL REQUIREMENTS

1.0 GENERAL

This standard specification covers the design, material of construction, features, manufacture, inspection & testing at VENDOR'S and/or his sub-vendors' works, suitable painting and packing requirements of air receiver

2.0 CODES & STANDARDS

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As far as possible, the design, manufacture and performance of air receivers shall be in accordance with the latest applicable Indian/British/American/DIN standards.

The latest editions of the following shall be followed in particular:

IS: 2825 – Code for unfired pressure vessels

ASME – Section-VIII, Division-1

BS – 487-Fusion welded steel air receivers

IS: 7938 – Air receivers for compressed air installation

The materials of the various components shall conform to applicable IS/BS/ASTM/DIN standards.

3.0 DESIGN AND CONSTRUCTION

3.1 The air receivers shall be vertical self-supporting cylindrical vessels with supporting stands for resting on the civil foundation.

3.2 Other design parameters and design internal pressure of the receiver shall be as per the data specification sheet, if any, enclosed. The receiver shall be designed as per IS:7938.

3.3 Receivers shall be of welded construction with a minimum number of joints. Longitudinal seams in adjacent section of shell shall not be in the same line.

3.4 Receivers shall be provided with gasket inspection openings. Receivers below 500 mm diameter shall have at least two inspection holes. For receivers of larger diameter, manhole of minimum 450 mm diameter shall be provided. These openings shall be placed as far as possible from any welded seam and in no instance shall pierce any seam.

3.5 All welding shall be performed in accordance with relevant codes. Filler material that will deposit weld metal with a composition and structure as near as that of the material being welded shall be used. All welding electrodes shall be got approved by the Owner. The electrodes shall be

dried in ovens immediately before use to ensure freedom from porosity. All the circumferential and longitudinal butt welds of the air receiver shall be subjected to spot radiography. Tee joints and dished welding shall be subjected to 100% radiography.

3.6 All other welding on the air receiver, including filet weld and nozzle connection shall be DP tested as per IS: 2825 (Para 8.7.11).

3.7 Each finished receiver complete with all welded attachments shall be hydraulically tested at 150% of the design pressure. The test pressure shall be maintained for at least 30 minutes. All joints shall be gentle hammered during the test.

3.8 Receivers shall be provided with relief valve of the capacity and set pressure of the same at least 10% above working pressure. The spring in the relief valve in service for pressure up to and including 250 psi shall not be reset for any pressure more than 10% above or below the design set pressure. For higher pressures, the spring shall not be reset for any pressure more or below 5% design set pressure.

3.9 Each air receiver shall be complete with drain connection of 25 mm NB with a trap station consisting of a trap, strainer, isolation and bypass valves.

3.10 The receiver shall be provided with necessary number of nozzles. The orientation of the nozzles shall be subjected to the approval of the Owner.

3.11 Local instruments like pressure gauge, switch and temp. gauge of suitable range shall be supplied. Please refer specification for conveying air compressor for other instrumentation required.

3.12 The vendor will have all welding procedures & welders qualified in accordance with the relevant codes prior to commencing any welding at the works. These tests shall be witnessed by customer/client representative.

1.0.0 GENERAL

This specification covers the design**,** manufacture, assembly, inspection and testing at manufacturer's and/or his sub-constructor's works of hand operated chain pulley block.

2.0.0 CODES AND STANDARDS

The design, manufacture, inspection and testing and performance of hand operated chain pulley blocks shall confirm to latest editions of the following standards: -

a) IS: 3832 Specification for hand operated chain pulley block

b) IS 807: 1976 Codes of Practice for Design, Manufacture, Erection and Testing (Structural Portion) of cranes and hoists

c) IS: 3109(Part II) Calibrated load chain for pulley blocks and other lifting appliances

d) IS: 2429(Part II) Calibrated hand chain for pulley blocks and other lifting appliances

e) IS: 4460 Method for rating of machine cut spur and helical gears

f) Material Specification IS or approved

3.0.0 EQUPIMENT

3.1.0 CHAIN PULLEY BLOCK

The block shall be so designed that all components shall withstand without failure, an application to the block of a load equal to at least four times the working load limit.

3.1.1 Frame

Frame shall be robust in design and of welded construction. The frame shall be selected in such a way that head room requirement is minimum. Frame shall maintain alignment under all expected conditions of services.

3.1.2 Chain

The load chain shall be electrically welded, accurately calibrated, and pitched arid polished conforming to IS: 6216 Grade 80 as specified in data sheet 'A'.

The hand chain shall also be electrically welded, calibrated, pitched and polished and shall conform to IS: 2429 (Part II) grade 30. The length of chain and link dimension shall be as per IS: 3832.

3.1.3 Hook

The forged hook shall be properly heat-treated and so designed that in loaded condition, it is free to swivel without twisting the load chain. The hook shall conform to IS: 3815.

3.1.4 Reduction Gear

The reduction gear shall be spur or worm/worm wheel type. The spur gear and worm shall be of high-grade carbon steel and heat treated. The worm wheel shall be of bronze. A detachable steel cover shall be provided for total enclosure of the gear train and ample lubrication to be provided.

3.1.5 Brakes

Brakes shall be of screw friction disc type self-actuating or any other approved type as per manufacturer's standard practice. Brake capacity shall be ample and humid atmosphere shall not affect materials used. The brake shall prevent self lowering of load and arrest and sustain load in all working positions. The load brake shall also allow smooth lowering of the load without serious overheating which may impair sufficient working of block

3.1.6 Bearing

Bearing used shall be as per guidelines laid down in IS: 3832.

3.1.7 Wheel

The load chain wheel shall be made of heavy duty malleable casting and shall be designed to ensure, effective operation of the chain. Load chain, wheel shall be mounted on two ball bearings. Hand chain wheel shall be made from malleable casting/pressed sheet steel. The idler wheel shall be so shaped as

to avoid the twisting of the chain during operation. The P.C.D of idler wheels shall be such that the bending action of the link is avoided. The hand chain wheel shall be provided with flanges and designed to ensure effective operation with hand chain.

3.1.8 Other components

All other components of chain pulley block such as anchorage, guide, pawl, stripper etc. shall be designed and provided as per IS: 3832.

3.2.0 MONORAIL TROLLEY

Monorail trolley shall be provided if called for in the enclosed Data Sheet—A. Monorail trolley frame shall be of heavy section rolled steel, held together by bolts. Wheels shall be of high grade cast iron mounted on ball bearings. Axles and shafts shall be of carbon steel, accurately machined and suitably supported. The trolley shall be suitable for variations in I section beams. The trolley shall be geared travel type.

The hand chain required for trolley travel shall be as per clause 3.1.2 of this specification.

Hand chain wheel shall be as per clause 3.1.7 of this specification.

4.0.0 INSPECTION AND TESTING

The scope of inspection shall include but not limited to the following:

a) Material identification/co-relation for important items like hook, load chain, hand chain, wheels, nut and pawl etc.
b) Hardness for pawl and ratchet
c) Dye penetration test for hooks
d) Operational test including operational effort, velocity ratio etc,
e) Proof load test up to 1.5 times of working load limit.
f) Dimensional check of hook
g) Marking

DATASHEET

S. No.	Parameter	Description
1	Capacity (In Kg)	Suitable for lifting the heaviest load but not less than One (1) ton

2	Service condition	Class II outdoor
3	No. of CPB	1
4	Lift (m)	To suit bunker height and equipment on bunker roof top to be handled.
5	Type of suspension	Travelling Trolley
6	Head Room	Minimum permissible
7	Type of gear in CPB	Spur Gear
8	Type of bearing	Ball/Roller
9	Grade of Load Chain	Alloy Steel /Gr 80
10	Grade of Hand Chain	Steel / Gr. 30
11	Factor of Safety	As per Relevant IS

1.0 GENERAL

This standard specification covers the design, material construction features, manufacture, inspection & testing at VENDOR'S and / or his sub vendors works suitable painting and packing requirements of air compressor with drive.

2.0 CODES & STANDARDS

2.1 The design, manufacture, inspection & testing of air compressor as specified hereinafter shall comply with the requirements of the latest applicable Indian/British American Standards. The following standards/codes shall be following in particular.

a) IS:5456 Code of practice for testing pf positive displacement type air compressors and exhauster.

b) IS:5727 Glossary of terms relating to compressors and exhauster.

c) IS:6206 Guide for selection, installation and maintenance of air compressors.

2.2 The material of various components shall conform as specified in Data Sheet-A and where not specified, the material shall conform to the applicable IS / BS / ASTM / DIN Standards.

2.3 In case of any conflict between the above mentioned standards / codes and specification, the stipulations in the technical specification shall prevail. In case of any further conflict the same shall be referred to purchaser's engineer for clarification whose decision shall be final & binding.

3.0 DESIGN AND CONSTRUCTION

3.1 Air Compressors of reciprocating type shall be designed for continuous operation to satisfy the conveying air requirement for fail safe operation.

3.2 The design, manufacture and performance of air compressors shall comply with the requirements of latest applicable Indian / British American / DIN standards.

3.3 The compressors shall be water cooled, non lubricated type along with all accessories as specified in the data sheet - A. Intercoolers/ aftercoolers, if provided, shall also be of water cooled, shell – tube construction.

3.4 The compressors shall be designed to ensure trouble free operation with min. vibration and noise. Multiple cylinders, if employed, shall be arranged in such a way as to ensure min. unbalance.

3.5 The wall thickness of the compressor cylinder shall be selected to withstand highest internal pressure and at the same time shall allow a number of reborings.

3.6 The crank case shall be provided with oil level dip stick, breather and drain plug.

3.7 Any oil adhering to the piston rod shall be wiped-off by suitable wiper ring, suitable collars shall also be fixed on the piston rod between the packing and wiper rings so that any trickling oil flow can be stopped from moving towards the cylinder.

3.8 Suction and discharge valves shall be suitable for quick opening and closing in conformity with the rotating speed of the crank shaft. Valves shall have large effective areas permitting low air velocity along with cushioning arrangement to minimise shock. Valve discs shall be of stainless steel (containing 15% or more chromium) heat treated, tempered and ground. The valve seats, guides & springs shall be of hardened stainless steel.

3.9 Crankshaft, crank pin piston pin bearings shall be of antifriction or journal type depending on manufacturer's standard practice.

3.10 Splash or forced feed type of lubrication shall be provided for all bearings and sliding components.

3.11 The air receiver shall be sized that even in the event of total stoppage of air flow from the compressor, operation of conveying is not stopped for 2 cycle time duration.

3.12 Drive motor shall be connected to the air compressor directly or through V-belt or any other suitable type of power transmission system as specified in the data sheets. Shafts should be coupled through heavy-duty flexible coupling in case of direct drive.

3.13 The power rating of the drive shall be selected such that a min. margin of 15% is available over the total input power required at compressor drive shaft at the rated condition. Total input power shall include air compression power plus any power consumed in auxiliaries etc., (if any), when the driver is not directly coupled to compressor, due account shall be made for losses in power transmission in addition to the above 15% extra margin.

4.0 MATERIAL OF CONSTRUCTION

The material of construction for various parts of package air compressors shall be as follows:-

a) Compressor cylinder :CI ,IS- 210, grade FG-260
b) Piston :Aluminum
c) Piston rod :EN-8 as per BS -970
d) Connecting rod :Forged steel as per IS-1875 Cl IV
e) Piston ring :Teflon with 25-30% carbon.
f) Crank case :CI , IS-210 Grade FG-260
g) Suction and delivery valves :S.S as per EN-56 of BS-970
h) Air receiver :MS as per IS (2062)
i) For other parts :As per latest IS/BS/ASTM/AIS/ equivalent standards depending upon the parts

5.0 INSTRUMENTATION AND ACCESSORIES

The conveying air compressor and drive shall be supplied completed with the following instrumentation and accessories as minimum.

a) Discharge air pressure gauge
b) Pressure switch to control actuation of compressor drive motor.
c) Starter for drive motor.
d) Pressure relief valve
e) Drain valve
f) Delivery valve

6.0 INSPECTION & TESTING

6.1 The manufacturer shall conduct all tests to ensure that the equipment finished shall conform to the requirements of this specification and in compliance with requirements of applicable codes & standard.

6.2 All materials used for conveying air compressor and drive shall be of tested quality. Materials shall be tested as per the relevant standards and test certificates shall be made available to the purchaser.

6.3 Test at Shop:

a) All pressure parts shall be subjected to hydraulic testing at a pressure twice the maximum design pressure or 150% of design pressure whichever is more for a period not less than one (1) hour.

b) Assembled receiver shall he hydraulically tested at a pressure twice the maximum working pressure or 150% of the design pressure and the test pressure shall be maintained for at least 30 minutes. All joints shall be gently hammered during the test.

c) Pneumatic test at design pressure shall also be carried out.

7.0 PAINTING

7.1 All parts of air compressors with drive shall be painted as specified in Data Sheet-A or as per the specification furnished elsewhere.

7.2 Before transportation of the equipment necessary cleaning, flushing etc, shall be done shop coats of rust inhibiting paints, lacquers etc., shall be applied to various parts as necessary.

1.0 GENERAL

This specification covers the PURCHASER'S general requirement of design, materials, constructional features, manufacture, inspection and testing at VENDOR''S works and/or his sub vendor's works of Denseveyor, and accessories specified hereinafter.

2.0 CODES AND STANDARDS

2.1 The design, material, construction, manufacture, inspection and performance of the Transporter and accessories, shall comply with all statutory regulations and safety codes currently applicable in the locality where the equipment will be installed. The equipment shall also conform to the latest applicable Indian/British/USA/DIN Standards.

2.2 The material of construction and other works of the Transporter and accessories shall in general conform to the following standards/codes but will be subjected to any modification and requirement as specified in Section C of Technical Speciation.

i) Transporter Vessel – Mild Steel to IS 2062 (Gr. A min); Construction as per IS-2825 / BS5500/ASME SEC-VIII, Div-1
ii) Material Handling Valve – As indicated in Sec-C of the specification
iii) Flange – MS as per ANSI B 16.5

2.3 Where the above standards are in conflict with the stipulations of this specification, this specification supersedes them. In case of any further conflict in this matter, the decision of the Engineer will be final and binding.

3.0 DESIGN REQUIREMENTS

3.1 The dense phase pneumatic conveying system shall be designed for low velocity for conveying of materials as indicated in Section C.

3.2 The system shall consist of dome shaped vessels made of Carbon Steel complete with pneumatically operated dome/metering valves capable of closing through a solid head of material to make a pressure tight seal.

3.3 The bottom of vessel shall have transition bend and a control air supply system to the side of the conveying vessel.

3.4 Airtight seal system shall be provided between the transporter and the feeding point.

3.5 Transporter shall be equipped with **air strainer** to prevent pipe scale /dirt from causing pressure regulator malfunctioning.

3.6 Automatic drain filter and oil fog lubricator set shall be fitted into the air line to dome valve/metering valve for use with pneumatic controls.

3.7 Any air line stop valve fitted in the air supply line of transporter shall be of ball type to avoid any restriction to air flow, when open.

4.0 CONSTRUCTIONAL FEATURES

4.1 The transporter vessel shall be fabricated from mild steel plate to the design of vendor. The vessel shall be of welded structure and shall be provided with necessary supporting structure. The vessel shall be airtight/leak proof in fully assembled condition. Conveying vessel shall be designed and tested as per IS 2825 class-III vessel. Temperature of mill reject coming into the conveying vessel shall be considered as 200 °C. Conveying vessel shall be designed for a pressure 10% above the maximum pressure encountered in the vessel. The conveying vessel shall be constructed with tested quality mild steel plates. They shall withstand the abrasive & hot condition of the mill rejects and operating air pressure. The conveying vessel shall be supported independently on steel columns. The vessel shall have suitably located and adequately numbered air connections for supply of compressed air for conveying mill rejects through pipes to overhead bin.

4.2 Dome/Metering valve shall be of manufacturer's standard construction and will be easily openable and closeable type. All joints will be flanged with asbestos free or silicon rubber gaskets suitable for 200 °C.

4.3 All bends will be of long radius cast bends (R = 5D). Conveying pipes will be of mild steel heavy duty type.

5.0 TESTING AND INSPECTION

5.1 The purchaser shall have free access to those parts of manufacturer's works which are concerned with the fabrication of the steel work and shall be afforded with all reasonable facilities at all stages of preparation, fabrication and trial assemblies for satisfying himself that the fabrication is being undertaken in accordance with the provisions of this specification

5.2 Should any structure or part of a structure be found not to comply with any of the provision of this specification, it shall be liable to rejection. No structure or part of the structure, once rejected shall be resubmitted for inspection/test except in cases where the purchaser or his authorized representative considers the defect as rectifiable defects which may appear during fabrication shall be made with the consent of and according to the procedure laid down by the purchaser, the purchaser may, at his discretion, check the test results obtained at the manufacturer's works by independent tests at the Government test house or elsewhere, and should not be found to be unsatisfactory shall be rejected. The costs of such tests shall be borne by the contractor.

5.3 Scope of inspection shall include but not limited to the following:

i) Material used in the fabrication shall be with manufacturer's test certificate with proper correlation for physical properties and chemical analysis. In the absence of correlation actual tests shall be done.

ii) Welders shall be qualified as per ASME Standard. Only qualified welders shall be employed for the fabrication purpose.

iii) Electrodes shall be of makes approved by BHEL.

iv) All fillet welds, root run and trial run of butt welds shall be subjected to visual dye penetrating test with no linear indication. Acceptable norm for dye-penetrating test shall be as per Appendix-8 of ASME SEC. VII Div. 1.

v) Special tests like NDT as per relevant code will be carried out for fabrication items.

vi) Chemical analysis and hardness tests of linear plates shall be carried out.

vii) Dimension shall be maintained as per approved drawings.

DATA SHEET

S. No.	Parameter	Description
1	Quantity of material to be conveyed per hour by each denseveyor	As mentioned in Section-C
2	Capacity of denseveyor envisaged	Adequately sized to meet above requirement
3	Air supply pressure available	Bidder to Decide
4	Any Cooling envisaged for dome valve & quantity of cooling water	Bidder to Decide
5	Distance over which material is to be conveyed	Refer Layout Drawings

1.0 GENERAL

1.1 This specification covers the PURCHASER'S general requirement of design, manufacture, fabrication, assembly, inspection, testing and delivery to site or mill reject bunker and accessories specified.

2.0 CODES AND STANDARDS

2.1 The design, material, construction, manufacture, inspection, testing and performance of the mill reject bunker shall comply with all statutory regulations and all safety codes currently applicable in the locality where the equipment will be installed.

2.2 The material of construction and other works of the mill reject bunker shall in general conform to the following standards /codes but will be subject to any modification and requirements as specified in data sheet A of Section-D.

a)	Structural steel	:	IS-2062 Gr A (min)
b)	Rolled Steel Beams, Channels and Angle Sections	:	IS-808
c)	Scheme of Symbols for Welding	:	IS-813
d)	Covered Electrodes for Metal Arc Welding of Structural Steel	:	IS-814
e)	Code of practice for use of Metal Arc Welding for general Construction in Mild Steel	:	IS-816
f)	Code of practice for inspection of Welds	:	IS-822
g)	Code of practice for use of structural steel in general building construction	:	IS-800
h)	Dimension for steel plate, sheet and Strip for structural and general Engineering purposes	:	IS-1730
i)	Recommendation for metal arc welding	:	IS-9575

2.3 Where the above standards are in conflict with the stipulations of this specification, the specification supercedes them. In case of any further conflict in this matter, the decision of the ENGINEER shall be final binding.

3.0 DESIGN REQUIREMENT

3.1 The coal mill reject bunker shall be fabricated of mild steel plate with adequate stiffeners welded on. The bunker shall be supported on the concrete foundation provided by the purchaser. Foundation bolts, gratings etc. shall be provided by the bidder.

3.2 The reject bunker shall be complete with twin sector discharge gate, stainless steel liners, flanged connections, platforms, gratings/chequered plates, access staircase, hand railings etc. The equipment shall be designed and equipped for outdoor operation, complete with all accessories.

4.0 CONSTRUCTIONAL FEATURES

4.1 The bunker shall be of welded structure and shall be provided with necessary supporting structure. Flanged opening shall be provided at the bottom of the bunker for attaching the twin sector gate. The inclined part of the bunker shall be designed with a valley angle of not less than 60 deg. To the horizontal. The design of the bunker shall be such that the problem of formation of arch is eliminated. The inside surface shall be provided with liner MOC as specified elsewhere in the specification. Explosion diaphragm/Pressure relief valve shall be provided to release air from the bunker in case pressure inside the bunker exceeds 1 .0 kg/cm^2(g)

4.2 Vendor shall furnish all steel work required for support and access for operation and maintenance. This shall include platforms, grating/chequered plates, stairways, hand railings, base plates, foundation bolts etc. Purchaser will provide only the foundation with pockets. The bunker shall have shed over it and shall be provided with monorail & hoist for equipment handling.

4.3 The storage bunker shall be so arranged that any 10 ton capacity truck can be conveniently loaded under it by an operator standing on the platform. The bunker-supporting column shall be so spaced to have a clear road access of 5.0 m width & clear headroom of 5.5 m.

4.4 Access and platform shall be provided with 32 mm thick MS grating & 32 mm MS GI pipe hand railing.

4.5 The storage bunker shall be provided with filter bags as specified elsewhere in the specification. Filter bags shall be suitably treated to minimize the chances of filter catching fire. It shall be possible to plug opening for damaged bag filters, if any, to facilitate un-interrupted operation. Suitable explosion vents shall be provided for the bag filter unit. Sequential cleaning cycle shall be initiated with pressure drop signal across the bag filter once sufficient cleaning air pressure is available. Solenoid/pneumatic valves shall be provided for this purpose. Bag cleaning mechanism shall be automatic and

shall comprise of solenoid valves. Air nozzles shall be provided just above the filter to facilitate individual cleaning of each bag.

4.6 The terminal boxes for terminating reject conveying pipes shall be of steel construction with necessary deflector or impingement plate to take care of impact and wear due to high velocity reject particles discharging into the bunker.

5.0 INSPECTION AND TESTING

5.1 The purchaser shall have a free access at all reasonable times to these parts of manufacturer's works which are concerned with the fabrication of the steel work and shall be afforded all reasonable facilities at all stages of preparation, fabrication and trial assemblies for satisfying himself that the fabrication is being undertaken in accordance with the provisions of this specification.

5.2 Should any structure or part of a structure be found not to comply with any of the provisions of this specification, it shall be liable to rejection. No structure or part of structure, once rejected shall be resubmitted for inspection/ test except in cases where the purchaser or his authorized representative considers the defect as rectifiable. Defects which may appear during fabrication shall be made good with the consent of and according to the procedure laid down by the purchaser. The purchaser may, at his discretion, check the test results obtained at the manufacture's works by independent tests at the government test house or elsewhere and should the material so tested be found to be unsatisfactory shall be rejected. The cost of such tests shall be borne by the contractor.

5.3 Examination of material of construction, verification, correlation and identification with material test certificate.

5.4 Ensuring that the relevant weld procedure and welder qualifications tests are in accordance with fabrication code.

5.5 Inspection during fabrication at appropriate stage including fit up. Witness of dye penetrant testing at root and final run for all groove welds and final run for fillet welds as per ASTM E 165. All surfaces examined shall be free of:

a) Relevant linear indications (Linear indications are those indications in which length is more than three times the width and only indication with major dimension greater than 1.6 mm shall be considered relevant).

b) Four or more rounded defects in a line separated by 1.6 mm or less (edge to edge). Rounded indications are those where length less than three times the width.

5.6 Any other tests as specified in the fabrication code.

5.7 Dimensional check match marking as per approved drawings.

6.0 SCOPE OF INSPECTION FOR RACK AND PINION GATE

6.1 Examination of materials of construction, verification, correlation/testing and identification of material with test certificate for important items like body, drives, warm shaft, rack & pinion, wheel etc.

6.2 Dye Penetration check on drive shaft & warm shaft as per IS-3658 and there shall be no surface defects.

6.3 Dimensional check

6.4 For chain proof load shall be carried out.

6.5 Hardness of rubber component

6.6 Check for overall dimension, completeness, no load working after assembly.

6.7 Clearing, marking and painting.

Mill Discharge Spout and Pyrite Hopper

- Each coal mill has a discharge spout with a pneumatic cylinder operated knife gate valve for discharging rejects into a pyrite hopper of adequate capacity. This hopper shall serve to store the mill rejects between each operating cycle of dense phase system. Minimum effective storage capacity shall be 2-3 times the effective (batch capacity) of the conveying vessel.

- Each pyrite hopper shall be provided with a manually operated plate/ dome type valve of approved design at the bottom, adequately sized manhole/inspection door, impingement deflector plate, sizing gird and emergency chute with manually operated Knife gate valve and reject quenching arrangement (water spray) shall be provided. Any platform/ structural support (as per IS 2062 Gr A/B) required to maintain the above equipment before pneumatically operated plat / dome valve. Necessary explosion vent (rupture disc with MOC SS 304/316) of proven design shall be provided in each pyrite hopper.

- Each emergency chute shall be provided with a manually operated gate valve to transfer mill rejects from pyrite hopper to ground or to Owner's trolley. The gates shall be of robust construction and suitable for trouble free operation. The lever/gear wheel arrangement for manual operation shall be designed such that minimum effort is required to operate the gate. Necessary access and platform shall be provided. Limit switches shall be provided to indicate the valve position on control panel.

- Each pyrite hopper shall be provided with two level switches – one to start the operating sequence and the other to indicate the hopper above grid chocked condition.

- Open/ Close Limit switches shall be provided in all manual and pneumatic KGVs and these limit switches shall be interlocked with MRS control system. Solenoid box cum local control panel shall be provided. Same shall house system start stop, vessel pressure indication, probe over ride, purge button so that system can be locally optd. It shall be possible to operate individual vessel from local pneumatic panel for few cycles in emergency.

- Following control modes shall be provided

- Remote mode: System shall be controlled through MRS control System.

- Local Mode:

a) Energized mode: Manual override shall be selected from MRS control System. System logic shall be executed in MRS control system itself.
b) De-energized mode: MRS control system shall be delinked and system (individual stack up assembly) shall be operated manually.

- The sizing grid shall be provided inside the pyrite hopper to prevent oversized mill rejects, tramp iron etc. from entering the conveying vessel. The arrangement for collecting bigger pieces of coal rejects from the grid includes, among others, Knife Gate Valve, chute work etc. Bigger pieces of coal rejects shall roll down from the grid and through KGVs, chute work etc. Bigger pieces of coal rejects shall roll down from the grid and can be removed through the over sized seized reject removal gate (to be provided preferably at the bottom of inspection door) be discharged to Owners trolley. The arrangement shall be finalized during detail engineering. The grid shall be made of minimum 10 mm dia. M.S. bars IS with clear opening of 40 mm x 40 mm.

ANNEXURE-V

DRAWINGS/ DOCUMENTS TO BE SUBMITTED WITH THE BID

Bidder shall submit the following drawings / documents along with their bid

a) Utility requirement in the format given under Vol-III
b) Copy of Electrical Scope between BHEL & Vendor duly stamped
c) Electrical Equipment Specification for Mill Reject Handling System duly stamped
d) Electrical load list
e) **Deviation schedule** with reference to specific clauses of the specification along with reason for such deviation in the format given under Vol-III
f) Un priced copy of price format indicating quoted/ not quoted against each row/column
g) Copy of pre-bid clarifications, if any, duly signed & stamped
h) Signed/Stamped copy of Compliance cum Confirmation Certificate (Vol-III)

OFFER WILL BE CONSIDERED AS INCOMPLETE IN ABSECE OF ANY OF ABOVE DOCUMENTS.

DOCUMENT OTHER THAN ABOVE, IF ANY, SUBMITTED WITH THE OFFER WILL NOT FORM PART OF CONTRACT AND ACCORDINGLY WILLNOT BE CONSIDERED FOR BID EVALUATION.

VOLUME-III

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) The EQUIPMENT'S functional guarantees shall stand valid till at least eighteen (18) months from PERFORMANCE GUARANTEE test of equipment as per technical specification or commercial terms and conditions, whichever is later.

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.

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.

PRE-BID CLARIFICATION SCHEDULE FOR 2x660MW MAUDA STPP STAGE-II

S. No.	Section/Clause /Page No.	Statement of the referred clause	Clarification Required

The bidder hereby certifies that above mentioned are the only clarifications required on the technical specification for the subject package.

SIGNATURE:_____

NAME:_____

DESIGNATION:_____

COMPANY: _____

DATE:_____

COMPANY SEAL

INSTRUMENT AIR REQUIREMENT* FOR 2x660MW MAUDA STPP STAGE-II

S. No.	Description	Requirement (m^3/ min & Pressure)	Intermittent/ Continuous
01			
02			
03			
04			
05			
06			

SERVICE WATER REQUIREMENT* FOR 2x660MW MAUDA STPP STAGE-II

S. No.	Description	Requirement (m^3/ min & Pressure)	Intermittent/ Continuous
01			
02			
03			
04			
05			
06			

EQUIPMENT WATER REQUIREMENT* FOR 2x660MW MAUDA STPP STAGE-II

S. No.	Description	Requirement (m^3/ min & Pressure)	Intermittent/ Continuous
01			
02			
03			
04			
05			
06			

* Bidder shall furnish the instrument air, service water and equipment water requirement along with supporting calculation and reference document.

SIGNATURE:_____

NAME:_____

DESIGNATION:_____

COMPANY: _____

DATE:_____

COMPANY SEAL

2x660 MW MAUDA STPP STAGE-II - MILL REJECT SYSTEM										
SUGGESTIVE PRICE FORMAT										
		1	2	3	4	5	6=Sum (2 to 5)	7	8	9=6+7+8
S.No.	Details of Works or Equipment/System	Price percentage of total ex-works supply price at column 2 of 1.1.1	Ex-works price	ED	CST	FREIGHT	FOR SITE	E&C Charges	Serivce Tax on E&C	Total
1.1.0	**Lumpsum prices**									
1.1.1	Total lumpsum firm price inclusive of all taxes duties and other levies as applicable for design, engineering, manufacturing, inspection and testing, painting, supply/delivery duly packed at project site including freight , unloading, storage and handling at site, design & construction of structural and minor civil works at site etc.,erection and commissioning, trial run at site,PG Test and handing over to the customer of Complete Mill Reject System in line with drawings/ documents/ test procedures approved by BHEL/Customer, inclusive of all prevailing taxes, duties and other levies for Mill Reject System complete with all accessories including Mandatory spares, erection and commissioning spares, maintenance tools and tackles as required for the total scope defined as per technical specification PE-TS-385-160-A001 taking into account all clarifications, confirmations and agreements till date.	100%								
	Notes:									
a)	***Bidder to note that total price indicated above at 1.1.1 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 including electrical and control & instrumentation.***									
b)	***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.***									
c)	***Bidder to note that prices indicated in column 7 and 8 (i.e. E&C and service tax) shall be minimum 20 % of total price indicated in column 9.***									
1.2.0	**Break - up of Prices given at 1.1.1 above. (To be used during contract execution for payment)**									
1.2.1	Lumpsum firm price for supply of denseveyors with dome /butterfly/ vertical swing type valve and accessories inclusive of all taxes, duties and other levies as applicable .	16%								
1.2.2	Lumpsum firm price for supply of Pyrite hopper with level probes, temperature switch, rupture disc inclusive of all taxes, duties and other levies as applicable .	12%								
1.2.3	Lumpsum firm price for supply of pneumatic panel/ Air control module/ Solenoid box with accessories inclusive of all taxes, duties and other levies as applicable	4%								
1.2.4	Lumpsum firm price for supply of storage bunkers, pressure relief valves, bag filters with pressure switch , terminal boxes , level probes, chain pulley blocks with accessories inclusive of all taxes duties and other levies as applicable.	25%								
1.2.5	Lumpsum firm price for air compressors with drive etc inclusive of all taxes, duties and other levies as applicable	12%								
1.2.6	Lumpsum firm price for Air receivers with accessories inclusive of all taxes, duties and other levies as applicable	2%								
1.2.7	Lumpsum firm price of pipes for Mill reject conveying, Compressed air & cooling water services etc inclusive of all taxes, duties and other levies as applicable	6%								
1.2.8	Lumpsum firm price for Air & Water line valves inclusive of all taxes, duties and other levies as applicable	1%								
1.2.9	Lumpsum firm price for pneumatically operated knife gate valves for different application inclusive of all taxes, duties and other levies as applicable .	4%								
1.2.10	Lumpsum firm price for Alloy C.I bends/ fittings/laterals inclusive of all taxes, duties and other levies as applicable .	6%								
1.2.11	Lumpsum firm price for Field instruments & cable glands & lugs, cable trays inclusive of all taxes, duties and other levies as applicable .	1%								
1.2.12	Lumpsum firm price for controls & sugnal cables/ cable glands & lugs, cable trays inclusive of all taxes, duties and other levies as applicable .	6%								
1.2.13	Lumpsum firm price of fixed sump pump along with all its control, inclusive of all taxes, duties and other levies as applicable.	0.50%								
1.2.14	Lumpsum firm price for Mandatory spares (Annexure III) as required inclusive of all taxes, duties and other levies as applicable .	4%								
1.2.15	Lumpsum firm price for Start-up & commissioning spares (Annexure II) as required inclusive of all taxes, duties and other levies as applicable .	0.25%								
1.2.16	Lumpsum price for special Maintenance tools and tackels as per Annexure I inclusive of all taxes, duties and other levies as applicable.	0.25%								
	Total of 1.2.1 to 1.2.16 (Should match with 1.1.1). However , the break up prices indicated under this head are for internal use only & NOT for any comparision purpose & or making adjustment for scope variation.	**100%**								
1.3.0	**Unit Prices (To be used for adjustment against any scope variation and information)**									
1.3.1	Unit price per meter with erection/ laying of conveying air Pipes inclusive of taxes, duties & other levies etc. (bidder to indicate the pipe size also)									
1.3.2	Unit price per meter with erection/ laying of Mill Reject conveying Pipes inclusive of taxes, duties & other levies etc. (bidder to indicate the pipe size also)									

ANNEXURE-I

2x660 MW MAUDA STPP STAGE-II - MILL REJECT SYSTEM

List of Special Maintenance Tools & Tackles

Sl.No.	Description	Qty.	Unit	Unit Ex-works price	Total ex-works price	ED	CST	FREIGHT	FOR SITE

Annexure II

2x660 MW MAUDA STPP STAGE-II - MILL REJECT SYSTEM

Start-up & commissioning spares

Sl.no	Description	Qty.	Unit	Unit Ex-works price	Total ex-works price	ED	CST	FREIGHT	FOR SITE

Annexure III

2x660 MW MAUDA STPP STAGE-II - MILL REJECT SYSTEM

List of Mandatory Spares

Sl.no	Description	Qty.	Unit	Unit Ex-works price	Total ex-works price	ED	CST	FREIGHT	FOR SITE
1	**Mill Reject Handling System**								
	A. Pneumatic Conveying System								
	1. Conveying System Spares								
	a) Pneumatic main valves	4 sets of each type							
	b) Pneumatic/Solenoid Two/ Three position control valve	4 sets of each type							
	c) Plate/Dome valve (including seals) with Actuators (pneumatic/hydraulic)	6 nos.							
	d) Plate/Dome valve seals	6 sets							
	B. Compressors (Reciprocating type, if applicable)								
	1. Compressor with motor	1 no of each							
2	**MEASURING INSTRUMENTS**								
	1. Electronic Transmitters								
	1.1 Transmitters of all types, ranges and model no. (for the measurement of Pressure,differential pressure flow, level,etc.)	10% or 1 no. of each type and model whichever is more							
	1.2 Level Transmitters (Ultrasonic/ radar type)	50% of each type and length, including sensors							
	2. Temperature elements								
	2.1 RTD's* of each type and length(with head assembly, terminal block & nipple)	10% or 2 nos. of each type and length, whichever is more							
	2.2 Thermocouples of each type like Ktype, R-type, metal etc. * (with head assembly, terminal block & nipple)	10% or 2 nos. of each type and length which ever is more							
	2.3 Cold Junction compensation boxes of each model (if applicable)	10% or 2 nos. which ever is more- Not Applicable							
	2.4 Themostatic units for each model of CJC box (if applicable)	10% or 2 nos. which ever is more- Not Applicable							
	2.5 Thermowell for application like mill outlet temperature and SH/RH/Eco/ flue gas temp. in furnace	10% or 2 nos. of each type and length whichever is more							
	2.6 Temperature transmitters	10% of each type and length							
	3. Local Indicators like temperature gauges, pressure gauges, differential pressure gauges, flow gauges, flow meters etc.,	5% or 1 no. of each make, model and type whichever is more (to be divided to various ranges in proportion to main of all make, model, type population)							
	4. Process Actuated Switch Devices Includes all types of Pressure, differential pressure, flow, temperature, differential temperature, level switch Devices	5% or 1 no. of each type and model whichever is more							
	5. PD Type Flow Transmitters	1 no. of each type and model							
	6. Flue gas Analyzer instruments for oxygen (i) Electronic card Assemblies of each type (ii) Sets of gaskets/"O" rings (iii) Temperature Sensor & heater assembly (iv) Complete Probe with shield assembly (v) Consumables like filter elements etc	 1 no. Each complete instrument 10% 2 sets 20% 2 nos 100%							
3	**PROCESS CONNECTION PIPING (FOR IMPULSE PIPING/TUBING, SAMPLING PIPING / TUBING AND AIR SUPPLY PIPING AS APPLICABLE)**								
	1. Valves of all types and models	10% or 1 no. of each type, class, size and model whichever is more.							
	2. 2 way, 3way, 5way valve manifolds	10% or 1 no. of each type, class, size and model whichever is more.							
	3. Fittings	10% or 1 packet of each type, class, size and model whichever is more.							
	4. Purge meters	5% of each model or 1 no. whichever is more.							
	5. Filter regulators	20% of each model or 2 nos. whichever is more.							
4	**INSTRUMENTATION CABLE, INTERNAL WIRING & ELECTRICAL FIELD**								
	1. Pre fabricated cable of each type.	10% of installed quantity							
	2. Pre fabricated cable connector of each type	10% or 1 no. of each type and model, whichever is more.							
	3. Other cables	5% of each type, pair and size of actual installed quantity							
5	**CONTROL VALVES, ACTUATORS & ACCESSORIES**								
	1. Pneumatic and electro-hydraulic actuator assembly	10% or 1 no. of each type, model and rating, whichever is more							
	2. Valve trim (including cage, plug, stem, seat rings, guide bushings etc.)	1 set for each type of control valve, whichever is more							
	3. Diaphragms, O' rings, seals etc. of all types, make etc.	200%							
	4. Pressure Gauges of all types, make, rating etc.	10% or 2 nos. of each type whichever is more.							
	5. Solenoid valves (if applicable)	10% or 2 nos. of each type whichever is more.							
	6.Positioner units	10% or 2 nos. of each type whichever is more.							

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 applcable 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, in case it is found applicable during detail engineering.**

ANNEXURE-IV: DEVIATION SHEET (COST OF WITHDRAWAL)

PROJECT:- 2x660 MW MAUDA STPP STAGE-II

PACKAGE:- MILL REJECT HANDLING 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
TECHNICAL DEVIATIONS									
COMMERCIAL DEVIATIONS									
PARTICULARS OF BIDDERS/ AUTHORISED REPRESENTATIVE									
NAME				DESIGNATIONS		SIGN & DATE			

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
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 descrepancy in the nature of impact (positive/ negative), positive will be considered for evaluation and negative for ordering.

ANNEXURE -IV

2 x 660 MW MAUDA STPP STAGE-II - Mill Reject Handling System
Mode: Pneumatic Conveying

Sl.No.	Description / Item	Working	Standby	Power Consumption (KW) (at motor input terminal)	Duty Factor	Total Power Consumption (KW)
1	2	3	4	5	6	7 = 3 x 5 x 6
1	Conveying Air Compressor	1	1		1.00	
					Total KW	

Notes

1 **If the actual power consumption exceeds the guaranteed power consumption, liquidated damages shall be payable by the Contractor at the rate of 3299 USD per KW excess power consumption, over the base guaranteed figure indicated by him in his bid. Such liquidated damages may be recovered by the Owner by deduction from the contract price or by enforcing the contract performance guarantee or in any other manner deemed fit by the Owner. For this purpose, the drives of standby equipment shall not be considered.**

2 **Power consumption (KW) of air compressors shall be measured at motor input terminals when operating at the rated capacity and pressure and performed on test rig at the vendor's works and actual motor shall be used for this purpose.**

3 **For bid evaluation purpose on account of guaranteed auxiliary power consumption over base auxilliary power figure mentioned below, the same shall be loaded at the rate of 3299 USD per KW for the differential power consumption.**

4 **Base aux power figure is 151.5 KW at duty factor 1.00.**

ANNEXURE-VI

DRAWINGS/ DOCUMENTS TO BE SUBMITTED AFTER AWARD OF CONTRACT

The successful bidder shall submit the following drawings / documents during detail engineering for customer's approval /information:

Sl. No.	BHEL DRG.NO	DRAWING TITLE	REMARKS	SUBMISSION SCHEDULE - WEEK NUMBER FROM DATE OF LOI
1	PE-V0-385-160-A001	P & I Diagram- Mill Reject Handling System	APPROVAL	10
2	PE-V0-385-160-A002	P & I Diagram of Compressor	APPROVAL	10
3	PE-V0-385-160-A003	Design Philosophy of MRS and System Sizing Calculation (Compressor, Air receiver, blow tank, pyrite hopper, bag filter, bunker)	APPROVAL	10
4	PE-V0-385-160-A004	Equipment Layout Drawing of Unit Assembly & Piping Layout Details of Mill Reject System /Trench & Insert details of MRS/ Pipe Support Drawing/ piping layout between compressor house to mill bay area	APPROVAL	4
5	PE-V0-385-160-A005	Layout - Compressor House	APPROVAL	10
6	PE-V0-385-160-A006	Earthing & Cable Tray Layout for MRS	APPROVAL	10
7	PE-V0-385-160-A007	Load Data for Bunker	APPROVAL	10
8	PE-V0-385-160-A008	G-A- of Self manufactured Items	INFORMATION	10
9	PE-V0-385-160-A009	GA and foundation details of Air Receiver	INFORMATION	6
10	PE-V0-385-160-A010	GA of Bunker	APPROVAL	6
11	PE-V0-385-160-A011	GA and Data sheet of Rupture Disc	INFORMATION	6
12	PE-V0-385-160-A012	GA and Data sheet of Metallic Expansion Bellow	INFORMATION	8
13	PE-V0-385-160-A013	GA and Data sheet of Chain Pulley Block	INFORMATION	8
14	PE-V0-385-160-A014	GA, Data sheet & Performance Curve of Conveying Air Compressor Motor	APPROVAL	8
15	PE-V0-385-160-A015	GA, Data sheet & foundation detail of Compressor and wiring diagram of compressor panel	APPROVAL	10
16	PE-V0-385-160-A016	GA and Data sheet of Bag Filter	INFORMATION	10
17	PE-V0-385-160-A017	GA and Data Sheet of Sump Pump (fixed/portable type) & Motor Data sheet for Drain sump Pump & wiring diagram for sump pump	INFORMATION	8
18	PE-V0-385-160-A018	GA and Data sheet of Manual/Pneumatic Operated Knife Gate & Pneumatic cylinder	APPROVAL	10
19	PE-V0-385-160-A019	GA of Gate Valve/ NRV/ Check Valve/Globe Valve/Ball Valve/Butterfly Valve	INFORMATION	8
20	PE-V0-385-160-A020	Data sheet of Instruments - MRS	APPROVAL	12
21	PE-V0-385-160-A021	Cable Schedule - Signal and Control	INFORMATION	12
22	PE-V0-385-160-A022	Control Write Up & Interlocks, Pneumatic Circuit of Transporter Vessel, Block Logic for MRS & I/O List & HMI-Screens for MRS	APPROVAL	12
23	PE-V0-385-160-A023	Cable interconnection diagram	APPROVAL	10
24	PE-V0-385-160-A024	GA of Local Control Panels	APPROVAL	14
25	PE-V0-385-160-A025	QAP of Self manufactured Items	APPROVAL	10
26	PE-V0-385-160-A026	QAP for Local Control Panels	APPROVAL	8
27	PE-V0-385-160-A027	QAP for Bag Filter	APPROVAL	10
28	PE-V0-385-160-A028	QAP for Conveying Air Compressor	APPROVAL	8

29	PE-V0-385-160-A029	QAP for Conveying air compressor Motors	APPROVAL	10
30	PE-V0-385-160-A030	QAP for Knife Gate Valve (HW/CW/Pneumatic) & pneumatic cylinder	APPROVAL	10
31	PE-V0-385-160-A031	QAP for Chain Pulley Block	APPROVAL	8
32	PE-V0-385-160-A032	QAP for Ball Valve/Butterfly valve	APPROVAL	8
33	PE-V0-385-160-A033	QAP for Sump Pump with Motor	APPROVAL	12
34	PE-V0-385-160-A034	QAP for Metallic Expansion Bellows	APPROVAL	10
35	PE-V0-385-160-A035	QAP for MS ERW Pipes	APPROVAL	8
36	PE-V0-385-160-A036	QAP for Bunker & Misc MS Structurals / Plates	APPROVAL	6
37	PE-V0-385-160-A037	QAP for Rupture Disc	APPROVAL	6
38	PE-V0-385-160-A038	QAP for GM Gate/Globe/Check Valve/Ball valve	APPROVAL	8
39	PE-V0-385-160-A039	QAP of INSTRUMENTS (PG/PS/PT/TS/TG/SV)	APPROVAL	12
40	PE-V0-385-160-A040	Type test certificate/procedure for MRS compressor motor	APPROVAL	12
41	PE-V0-385-160-A041	Piping and Valve Schedule	INFORMATION	10
42	PE-V0-385-160-A042	Painting Schedule	INFORMATION	10
43	PE-V0-385-160-A043	Instrument Schedule	INFORMATION	10
44	PE-V0-385-160-A044	Sub Vendor List with Inspection Category	APPROVAL	10
45	PE-V0-385-160-A045	Welding Procedure Specification	APPROVAL	4
46	PE-V0-385-160-A046	O&M Manual	INFORMATION	8
47	PE-V0-385-160-A047	PG test Proceedure	APPROVAL	24

Notes:

1. The above drawing list is tentative and shall be finalized with the successful bidder after placement of order. While some of the drawings indicated above may not be applicable, some additional drawings may also be required based on scope of work.
2. Drawings shall be prepared in Auto-Cad latest edition. Required no. of hard and soft copies (editable) of the drawings shall be furnished as per requirement specified elsewhere in the specification.
3. Only manual calculation with authentic supporting literature (e.g. extracts of hand Book/ standard/codes) shall be acceptable. All design calculations and drawings shall be in SI system only.
4. Bidder to note that all values/dimensions/elevations etc. without supporting back up data adopted/assumed by the successful bidder (during contract stage) in the design calculation/drawings shall be taken by the customer/owner to be correct unless they are stipulated in the specification. Any problem arising later in this regard shall be made good by the successful bidder at his cost and no extension of time shall be granted for the same.
5. All the drawings and documents including general arrangement drawing, data sheet, calculation etc. to be furnished to the customer during detailed engineering stage shall include / indicate the following details for clarity w.r.t. Inspection, construction, erection and maintenance etc.:-

    a) All drawings and documents shall indicate the list of all reference drawings including general arrangement.

    b) All drawings shall include / show plan, elevation, side view, cross - section, skin section, blow - up view; all major self-manufactured and bought out items shall be labelled and included in BOQ / BOM in tabular form.

    c) Painting schedule shall also be made as a part of general arrangement drawing of each equipment / items indicating at least 3 trade name.

    d) All the drawings required to be furnished to customer during detailed engineering stage shall include technical parameters, details of paints and lubrication, hardness and BOQ / BOM in tabular form indicating all major components including bought out

items and their quantity, material of construction indicating its applicable code / standard, weight, make etc.

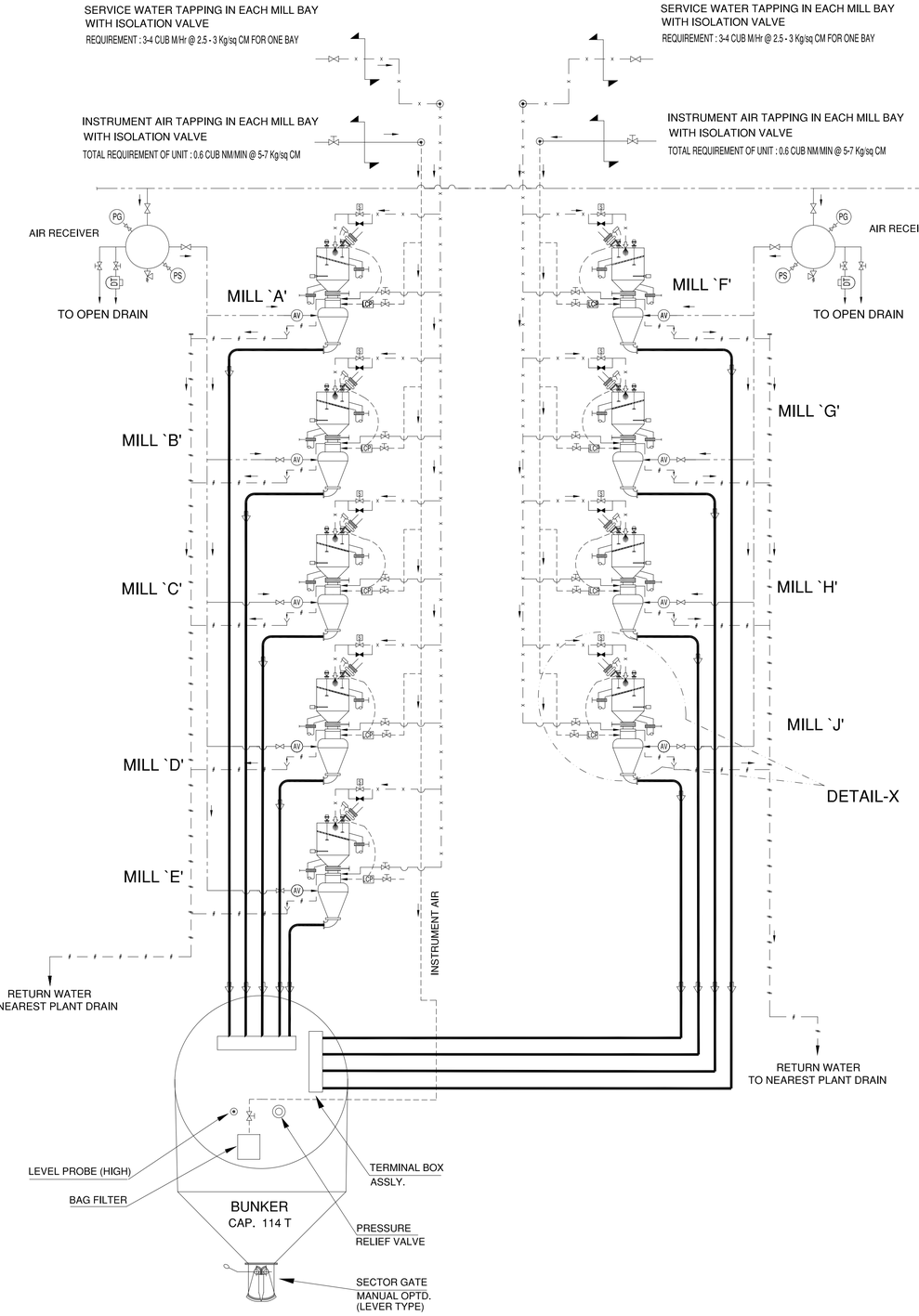
e) Drawings/ documents to be submitted for purchasers review/ approval shall be under Revision A, B, C… etc. while drawings /documents to be submitted thereafter for customer's approval after purchaser's approval shall be under R-0, 1, 2, 3 ….etc.

6. Drawings and documents not covered above but required to check safety of machines/system, shall be submitted during detailed engineering stage without any commercial implication.
7. All drawings shall include "B.O.M" and indicate quantity, material of construction, make along with IS/BS No., Technical parameters, dimensions, hardness, machining symbol and tolerance, requirement of radiography and hydraulic tests, painting details, elevation, side view, plan, skin section and blow-up view for clarity.
8. All drawings shall be prepared as per BHEL's title block and bear BHEL's drawing No.
9. 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.
10. Bidder to follow the following the drawing submission schedule:
    - 1st submission of drawings from date of LOI as per the submission schedule.
    - Every revised submission incorporating comments – within 10 days.
    - BHEL/Customer shall furnish their approval/comments within 21 days of submission
    - Bidder to submit revised drawings complete in all respects incorporating all comments. Any incomplete drawing submitted shall be treated as non-submission with delays attributable to bidder's account. For any clarification/ discussion required to complete the drawings, the bidder shall himself depute his personal to BHEL for across the table discussions/ finalizations/ submissions of drawings.

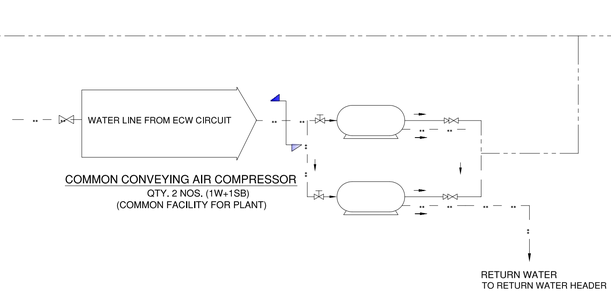
LIST OF BASIC DRAWINGS

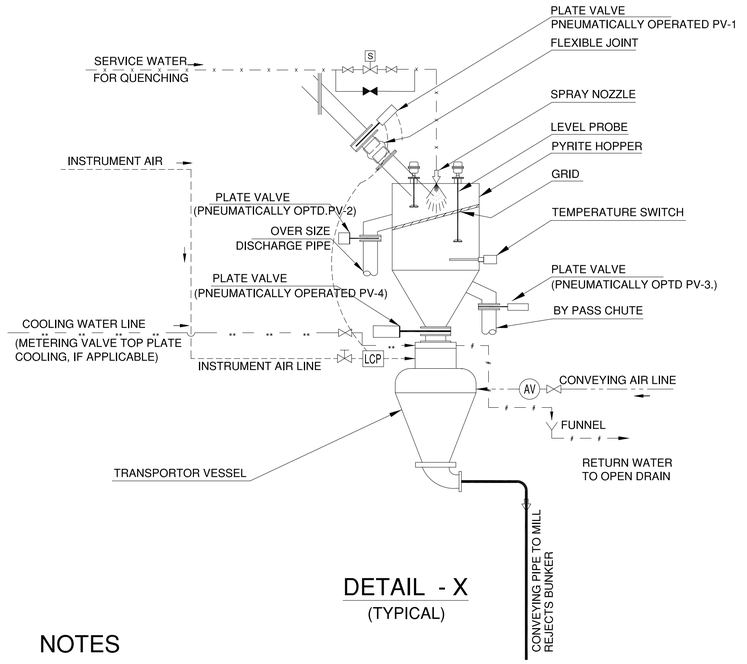
BHEL DRG NO	DRG TITLE
PE-V0-391-160-A001	P & I Diagram- Mill Reject Handling System
PE-V0-391-160-A003	Design Philosophy of MRS and System Sizing Calculation (Compressor, Air receiver, blow tank, pyrite hopper, bag filter, bunker)
PE-V0-391-160-A004	Equipment Layout Drawing of Unit Assembly & Piping Layout Details of Mill Reject System /Trench & Insert details of MRS/ Pipe Support Drawing/ piping layout between compressor house to mill bay area
PE-V0-391-160-A005	Layout - Compressor House
PE-V0-391-160-A007	Load Data for Bunker
PE-V0-391-160-A008	G-A- of Self manufactured Items
PE-V0-391-160-A009	GA and foundation details of Air Receiver
PE-V0-391-160-A010	GA of Bunker
PE-V0-391-160-A014	GA, Data sheet & Performance Curve of Conveying Air Compressor Motor
PE-V0-391-160-A015	GA, Data sheet & foundation detail of Compressor and wiring diagram of compressor panel
PE-V0-391-160-A022	Control Write Up & Interlocks, Pneumatic Circuit of Transporter Vessel, Block Logic for MRS & I/O List & HMI-Screens for MRS
PE-V0-385-160-A023	Cable interconnection diagram
PE-V0-391-160-A044	Sub Vendor List with Inspection Category

Note: Drawings listed above have been identified as basic drawings. During contract engineering stage, approval of these drawings from BHEL/Customer shall be treated as clearance to milestone payment for completion of design & engineering.



UNIT#1 (TYP)





DETAIL - X
(TYPICAL)

NOTES

1. THE DRG INDICATES BROAD SCOPE & WORKING PRINCIPAL OF THE SYSTEM. FLOW DIAGRAM SHALL BE READ IN CONJUNCTION WITH TECHNICAL SPECIFICATION.
2. THE DRG INDICATES SCOPE OF WORK FOR SINGLE UNIT. TYPICAL ARRANGEMENT SHALL BE PROVIDED FOR SECOND UNIT ALSO.

LEGEND:-

- MILL REJECTS CONVEYING PIPE
- CONVEYING AIR
- INSTRUMENT AIR
- COOLING WATER
- SERVICE WATER
- RETURN WATER

- GATE VALVE
- BALL VALVE
- NORMALLY CLOSED BALL VALVE
- NON RETURN VALVE
- DT — DRAIN TRAP
- AV — AIR VALVE
- LCP — LOCAL CONTROL PANEL
- SAFETY VALVE
- PG — PRESSURE GAUGE
- PS — PRESSURE SWITCH
- S — SOLENOID OPTD. VALVE

S.No.	DATE	DESCRIPTION	BY	CHD	APD

REVISIONS

JOB NO. 385
STATUS CONTRACT
DISTRIBUTION
TO
NO.
REV | DATE | ALTD | CHKD | APPD
ZONE

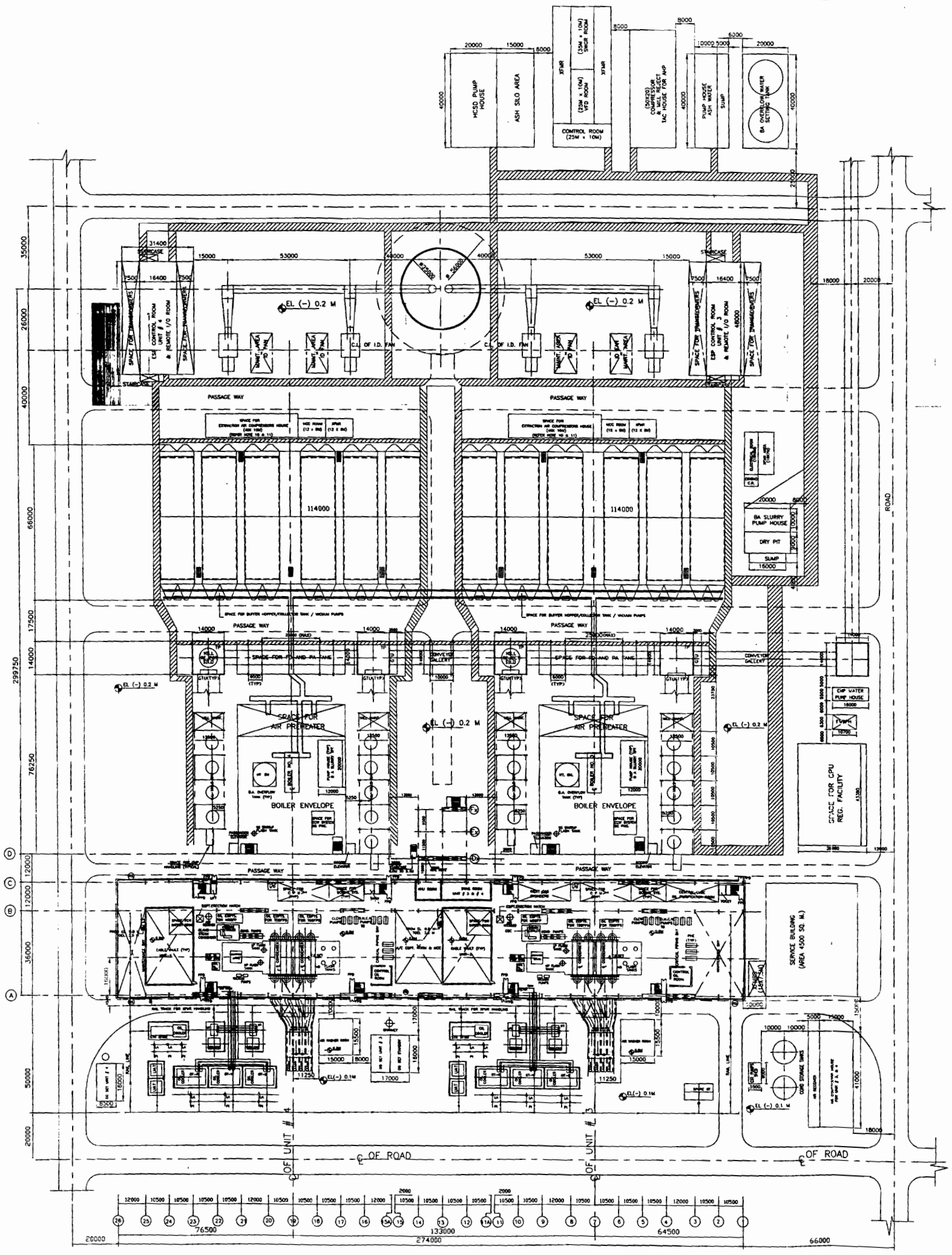
2X660 MW MAUDA STPP STAGE-II

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR : PROJECTS ENGG MGMT
NOIDA

TITLE
SINGLE LINE FLOW DIAGRAM
MILL REJECT HANDLING SYSTEM

	NAME	SIGN	DATE
DRAWN	RB		20/06/13
CHECKED	RN/VK		20/06/13
APPRD	GB		20/06/13

CARD CODE | DRG.NO. PE-DG-385-160-A001 | REV 0
SHEET NO 1 | NO OF SHEETS 1



N

LEGEND

	PIPE HATCH
	VERTICAL BRACING
FPD	FIRE PROOF DOOR
	GRATING
	CHEQUERED PLATE
R	REMOVABLE
	HAND RAILING
	PIPE & CABLE TRESTLE
	FIRE BARRIER WALL

NOTES:-

1. THE EQUIPMENT SHALL BE GENERALLY IN ACCORDANCE WITH THE LAYOUT AND DIMENSIONAL REQUIREMENTS INDICATED IN THESE DRAWINGS. HOWEVER BUILDING SIZES INDICATED ARE MINIMUM REQUIREMENT AND ACTUAL SIZE SHALL BE AS PER FUNCTIONAL REQUIREMENT BUT NOT LESS THAN THOSE INDICATED IN THESE DRAWINGS.
2. NO PIPES, CABLES, STRUCTURES ARE TO BE PLACED BELOW 8.0M (BOP, BOC OR BOS) IN FRONT OF BOILER BETWEEN THE 12.0M CORRIDOR SEPERATING MAIN PLANT AND FIRST ROW OF BOILER COLUMNS (i.e. CD BAY)
3. ALL DOORS ON C– ROW PROVIDED AT 8.5M & 17.0M, INTERCONNECTING WITH BOILER ARE OF DOUBLE DOOR TYPE TO AVOID INGRESS OF DUST TO MAIN PLANT BUILDING.
4. LOCATION OF DOORS/REMOVABLE COVERS SHOWN IN THE DRAWINGS ARE INDICATIVE AND SHALL BE FINALISED DURING DETAILED ENGINEERING.
5. ALL DIMENSIONS ARE IN MM'S AND LEVELS ARE IN METRES.
6. FIRE BARRIER WALL IS PROVIDED ON A–ROW BETWEEN AXIS NO. 8–13, & 20–25
7. ALL ELEVATIONS INDICATED IN THE DRG ARE w.r.t. T.G. BUILDING GROUND FLOOR ELEVATION AS(±)0.00M.
   i) FINISHED FLOOR OF PAVING SLAB IN BOILER/ESP/ID FAN AREA SHALL BE (–)0.2M
   ii) FINISHED FLOOR ELEVATION IN MILL BAY AT GROUND LEVEL SHALL BE 0.00M.
   iii) FINISHED FLOOR LEVEL IN X–FMR YARD SHALL BE (–) 0.10M.
   iv) FINISHED FLOOR LEVEL INSIDE CHIMNEY SHALL BE 0.00M.
   v) FINISHED FLOOR LEVEL IN THE VARIOUS BUILDINGS IN MAIN PLANT AREA SHALL BE 0.00M.
8. ALL CABLE SPREADER ROOMS TO BE PROVIDED WITH DRAINAGE ARRANGEMENT.
9. BOTTOM OF STEEL OF PIPE / CABLE RACK IN MILL BAY AREA SHALL BE MINIMUM EL 17.0M.
10. FOR FLY ASH HANDLING EITHER VACUUM PUMPS OR EXTRACTION AIR COMPRESSORS SHALL BE PROVIDED.
11. IN CASE OF VACUUM PUMPS FOR DRY ASH SYSTEM, THESE SHALL BE LOCATED BELOW ESP NEAR IT'S 1ST FIELD AND THE SWGR. ROOM FOR THE SAME SHALL BE CONSTRUCTED AT THE END OF ESP AS SHOWN IN THE DRAWING. IN CASE OF EXTRACTION AIR COMPRESSORS, THESE ALONG WITH SWGR. ROOM SHALL BE LOCATED AT THE END OF ESP AS SHOWN IN THE DRAWING.
12. VERTICAL BRACING BETWEEN AXIS NO. 13–14 AT D–ROW SHALL BE DESIGNED SO AS TO PROVIDE CLEAR OPENING OF 6000X4000MM FOR MOVEMENT OF EQUIPMENTS.
13. BRICK WALL REQUIREMENTS :
   i) ALL STAIRCASES AT 'A' ROW & 'C' ROW SHALL BE PROVIDED WITH 230 mm THICK BRICK ENCLOSURE.
   ii) ALL CABLE SPREADER ROOM WALLS.
   iii) WALLS OF UPS & BATTERY CHARGER & C&I BATTERY ROOMS, CONTROL EQUIPMENT ROOMS.
   iv) HT/LT SWITCH GEAR ROOMS, BOILER M.C.C ROOM.
   v) AIR HANDLING UNITS(AHU).
   vi) OIL EQUIPMENT ROOM .
14. RCC WALL : 250 mm THK RCC WALL FROM EL 0.0M TO 0.6M FOR LUBE OIL ROOM.
15. D–ROW IS THE FIRST ROW OF BOILER AND MILL BAY COLUMNS.
16. LOCATION AND SIZES OF TRANSFORMERS SHOWN IN TRANSFORMER YARD IS INDICATIVE ONLY.
17. LOCATIONS OF VERTICAL BRACINGS SHOWN HERE ARE INDICATIVE ONLY AND THE SAME SHALL BE FINALIZED DURING DETAIL ENGINEERING.

FOR TENDER PURPOSE

एनटीपीसी लिमिटेड
NTPC Limited
(A Government of India Enterprise)
ENGINEERING DIVISION

PROJECT : MOUDA SUPER THERMAL POWER PROJECT
STAGE–II (2 x 660 MW)

TITLE : EQUIPMENT LAYOUT PLAN AT EL 0.00M.

REV NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	APPD.
A	RELEASED FOR TENDER PURPOSE			M E C C&I	

CLEARED BY

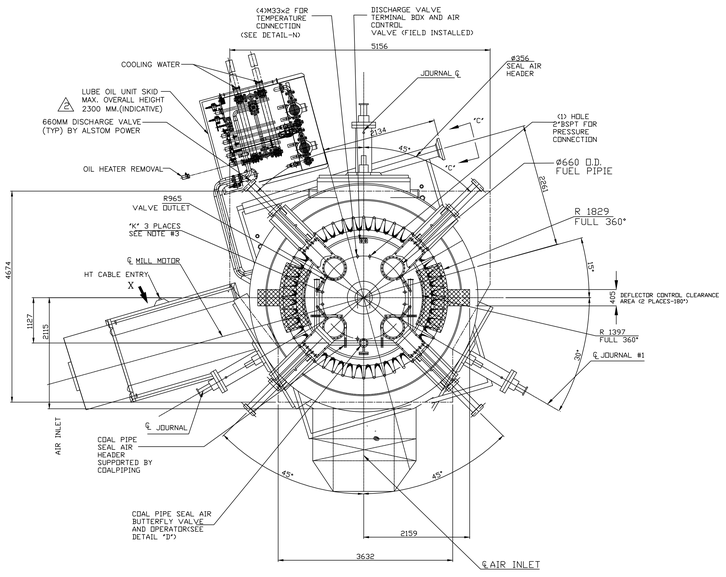
SIZE	SCALE	DRG NO	REV. NO.
A–1		9575–999–POM–A–001	A

AUTOCAD DRG. NO MOUDA–II–LAY001–2X660 MW–TR 01/10/2009

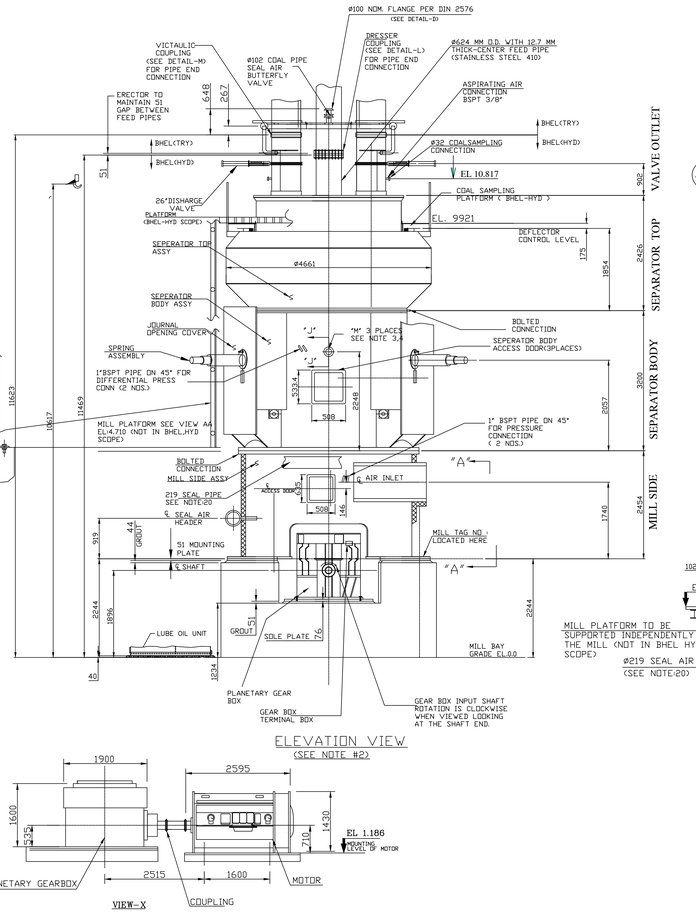
FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

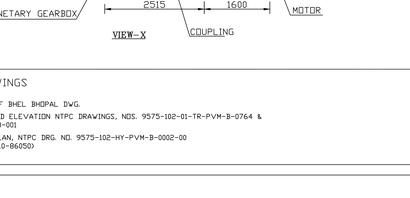
DRG. NO. 0-00-620-86051



PLAN VIEW
(SEE NOTE #2)

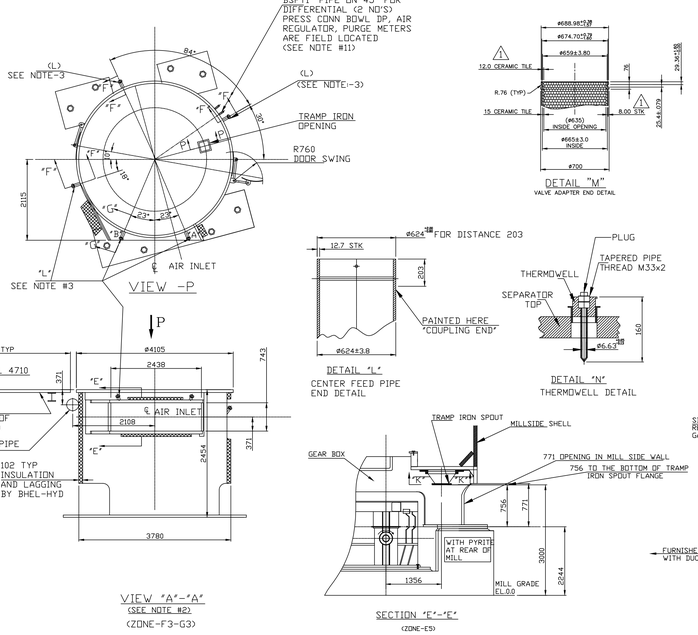


ELEVATION VIEW
(SEE NOTE #2)



VIEW-X

KEY PLAN



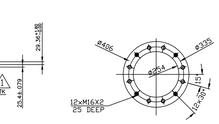
VIEW "A"-"A"
(SEE NOTE #2)
(ZONE-F3-G3)

DETAIL 'L'
CENTER FEED PIPE END DETAIL

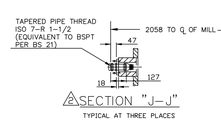
DETAIL 'N'
THERMOWELL DETAIL

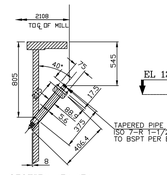
SECTION 'E'-'E'
(ZONE-E5)

DETAIL "M"
VALVE ADAPTER END DETAIL

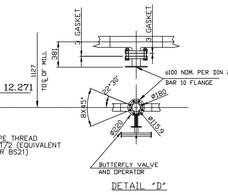


VIEW "K"-"K"
TRAMP IRON SPOUT FLANGE
(ZONE-G7)

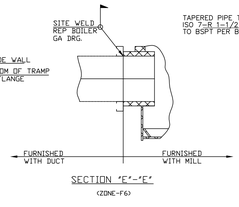




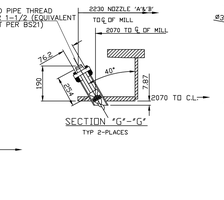
SECTION 'F'-'F'
TYP 3-PLACES



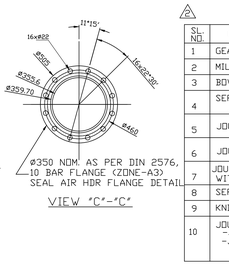
DETAIL 'D'



SECTION 'F'-'F'
(ZONE-F6)



SECTION 'G'-'G'
TYP 2-PLACES



VIEW "C"-"C"

NOTES:-

01. ALL DIMENSIONS ARE IN MM.
02. FOR RELATIVE LOCATIONS AND TRUE ORIENTATION OF MILL, MILL PARTS AND EXTERNAL EQUIPMENT SEE KEY PLAN
03. FOR FIRE EXTINGUISHING SYSTEM.
 (2) NOZZLES "K" PIPE THREAD ISO 7-R 1-1/2 OR BSPT 1-1/2 - SEPARATOR TOP
 (5) NOZZLES "J" PIPE THREAD ISO 7-R 1-1/2 OR BSPT 1-1/2 -MILL SIDE
 (3) NOZZLES "M" PIPE THREAD ISO 7-R 1-1/2 OR BSPT 1-1/2 -SEP. BODY
04. ALL CONNECTIONS TO BE AS PER ISO, NOMINAL SIZE IN MM
05. CRANE HOOK TRAVEL FROM GROUND FLOOR TO 19617 SEE ELEVATION VIEW. THE CRANE HOOK MUST TRAVEL 2337 FROM THE ℄ OF THE MILL ALONG THE ℄ OF THE JOURNAL TO 3962 FROM THE ℄ OF THE MILL ALONG THE ℄ OF THE JOURNAL. SEE KEY PLAN.
06. REFER DRG No. 9575-102-HY-PVM-B-0002 FOR FOUNDATION ARRANGEMENT OF MILL AND MOTOR
07. CABLES & PNEUMATIC AIR CONNECTION ARE TO BE ROUTED SO AS TO HAVE FREE MAINTENANCE AREA AROUND MILL
08. 6MM GAP SHOULD BE MAINTAINED BETWEEN VALVE BODY OUTLET STUB & FUEL PIPE ENDS AT PIPE COUPLING JOINTS
09. COOLING WATER AND FIRE QUENCHING WATER INLET LINES SHOULD BE PROVIDED WITH VALVE(BHEL-T/PC SCOPE) TERMINAL POINT FOR COOLING WATER INLET/ OUTLET LINES IS LUBE OIL COOLER INLET/ OUTLET FLANGES. COUNTER FLANGE WITH FASTENERS PROVIDED BY BHEL(HYD). FIRE FIGHTING WATER COMPLETE SCOPE IS WITH BHEL TRICHY/ PC-CHENNAI, UPTO THE NOZZLES(REFER NO.3)
10. TWO SETS OF TAPPING POINTS ARE PROVIDED FOR MILL DIFFERENTIAL AIR LINE CONNECTION. ONE SET IS USED
11. BOWL DP PRESSURE TAPPINGS, DP TRANSMITTER, PRESSURE REGULATOR & PURGE METER IS IN ALSTOM MILLING SYSTEM SCOPE. LOW PRESSURE AND HIGH PRESSURE LINES,VALVES AND TEES ETC. ARE BY BOP.DP PRESSURE TAPPINGS IS IN BHEL, HYD. SCOPE.
12. STEAM PIPING WITH VALVES FOR MILL FIRE FIGHTING SYSTEMS IN BHEL-T/PIPING CENTRE SCOPE.
13. PNEUMATIC AIR PIPING WITH ISOLATING VALVES FOR PULVERISED CDAL SAMPLING AT TWO PLACES AND MDV OPERATION ARE IN BHEL-T SCOPE.
14. SEAL AIR PIPING WITH VALVE UPTO SEAL AIR HEADER AROUND MILL IS IN BHEL-T SCOPE.
15. PLATFORMS, LADDERS, STAIRCASE, HANDRAILS & EMBEDED PLATES ARE IN BHEL TRICHY. SCOPE.
16. REJECT HANDLING SYSTEM IS IN BHEL-PEM SCOPE
17. REFER BOILER DRGS No. 9575-102-01-TR-PVM-B-0764 FOR LOCATION AND ORIENTATION OF MILLS.
18. ALL ELEV. INDICATED IN THE DRG ARE WITH RESPECT TO TG BUILDING (STATION BUILDING) GROUND FLOOR LEVEL OF EL.0.000M (FINISHED FLOOR LEVEL) WHICH CORRESPONDS TO RL 271.5M. FINISHED FLOOR LEVEL OF BOILER AREA (-)0.200M & OF MILL AREA EL.0.00M VRT TO MILL.
19. FOR PF SAMPLING IN PC PIPES BY ROTARY PROBE APPROACH PLATFORM, PNEUMATIC AIR SUPPLY WITH ISOLATION VALVES AND 230 V AC POWER SUPPLY SHALL BE IN THE SCOPE OF BHEL-T, AT ALL FOUR CORNERS OF BOILER.
20. CLEARANCE FOR SEAL AIR PIPE MUST BE MAINTAINED IN PLATFORM DESIGN.
21. PROVISION FOR FUTURE INSTALLATION OF ROTARY CLASSIFIER TO BE MADE CONSIDERING THE FOLLOWING
 a) ADDITIONAL HEIGHT DIFFERENCE (SEE) MM
 b) ELECTRICAL CONNECTION TO ROTARY CLASSIFIER DRIVE
 c) SEPARATOR TOP WILL BE REPLACED BY ROTARY CLASSIFIER DURING RETROFITTING
22. MANUFACTURING OF MILLS BY BHEL (UNDER LICENSING AGREEMENT WITH ALSTOM USA).

SL. NO.	COMPONENTS	WEIGHT MT	QTY NO
1	GEARBOX ASSEMBLY	17.5	1
2	MILLSIDE ASSEMBLY	17.674	1
3	BOWL AND BOWL HUB ASSEMBLY	18.33	1
4	SEPARATOR BODY ASSY. W/OUT JOURNALS	22.662	1
5	JOURNAL SHAFT ASSEMBLY	20.53	3
6	JOURNAL HEAD ASSEMBLY	5.58	3
7	JOURNAL OPENING COVER ASSEMBLY WITH SPRING ASSEMBLY	3.91	3
8	SEPARATOR TOP ASSEMBLY	16.665	1
9	KNIFE GATE VALVE ASSLY	4.4	1(SET)
10	JOURNAL MAINENANCE -JOURNAL TILT OUT -JOURNAL BEARING & END PLAY CHECKING	6.03 6.45	1

REFERENCE DRAWINGS

1. MOTOR GA DRG. : REF' BHEL BHOPAL DWG.
2. BOILER GA PLAN AND ELEVATION NTPC DRAWINGS, NOS. 9575-102-01-TR-PVM-B-0764 & 9575-102-01-TR-PVM-B-001
3. MILL FOUNDATION PLAN, NTPC DRG. NO. 9575-102-HY-PVM-B-0002-00 (BHEL DWG NO: 0-00-610-86050)

REV.	DATE	ALTERED	CHECKED	APPROVED
ZONE				

REV.	DATE	ALTERED	CHECKED	APPROVED
ZONE				

REV.	DATE	ALTERED	CHECKED	APPROVED
ZONE				

REV.	DATE	ALTERED	CHECKED	APPROVED
02	20.12.12	PG	RR	MVRM
ZONE	BHEL REVISED AS PER CUSTOMER COMMENTS DTD 10-12-12 REF: CC957531003I0 WEIGHT TABLE OF MILL COMPONENTS REVISED AS PER DETAIL ENGG VALUES			
01	20.11.12	PG	RR	MVRM
ZONE	BHEL REVISED AS PER CUSTOMER COMMENTS DTD 21-08-12 REF: CC957531004I0			

THE FOLLOWING CONDITIONS APPLY EXCEPT OTHERWISE STATED.

1. REF. TO HY0230261 FOR UNSPECIFIED TOLERANCES.
2. CHAMFER M/CD. SHARP EDGES 1.2 TO 1.0 AT 45°.
3. INTERNAL M/CD. CORNER RADII 1 TO 0.7
4. THE SURFACE ROUGHNESS WHERE-EVER NOT SHOWN SHALL BE TAKEN FROM THE SURFACE ROUGHNESS SHOWN OUT SIDE THE BACK SLASH GIVEN DR THE TOP MOST RIGHT CORNER OF THE DRG.

CUSTOMER: NTPC LIMITED

PROJECT : MAUDA STG-II 2x660 MW

BHARAT HEAVY ELECTRICALS LIMITED HYDERABAD

	NAME	SIGN.	DATE	NO.OF VAR.
DRN.	PG		31.07.12	
CHD.	RR		31.07.12	
APPD.	MVRM		31.07.12	

DEPT. 446 | CODE | PULV. ENGG. | SCALE | WEIGHT (KG) N.A. | REF. TO ASSY DRG. N.A. | ITEM NO. | NO.OF ITEMS

TITLE: GENERAL ARRANGEMENT OF HP 1103 MILL (WITH PLANTERY GEARBOX)

DRAWING NO. 9575-102-HY-PVM-B-0001 | REV. 02

SHEET NO. 01 | NO OF SHEETS 01

0-00-620-86051

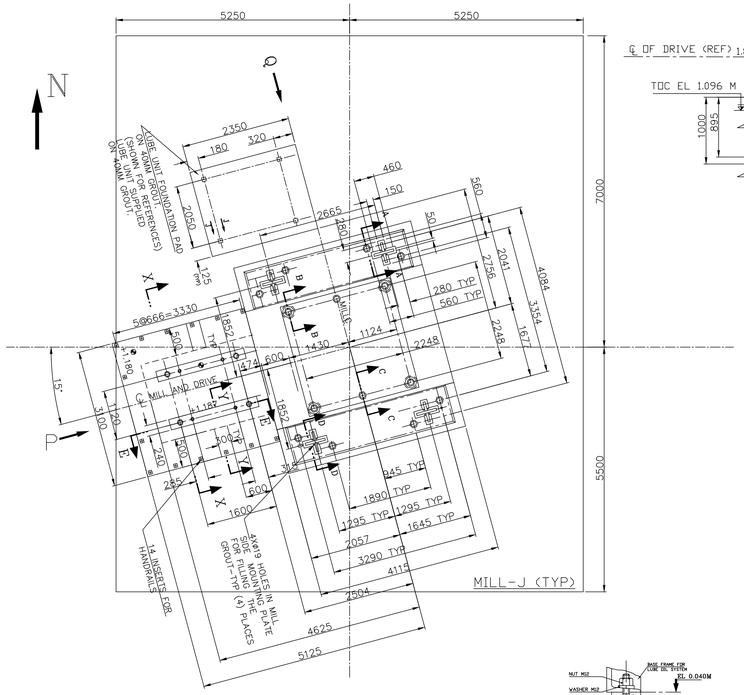
COMP. FILE NAME | REF. DRG. NO. | INVENTORY NO

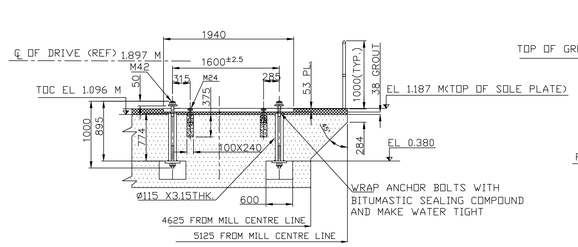
FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

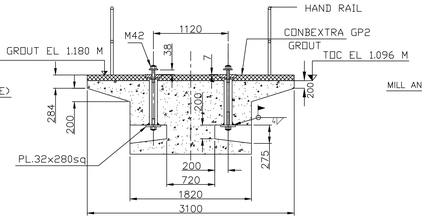
DRG. NO. 0-00-610-86050

SH.01 OF 03

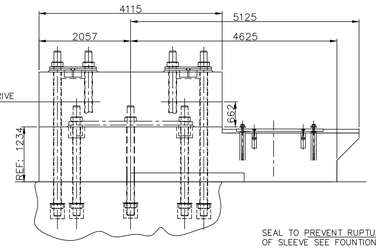




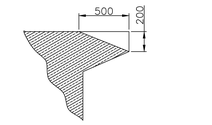
SECTION-E-E



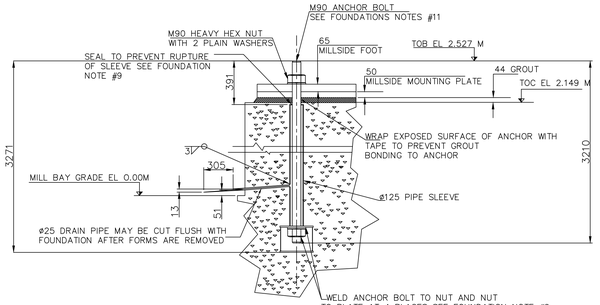
SECTION-X-X



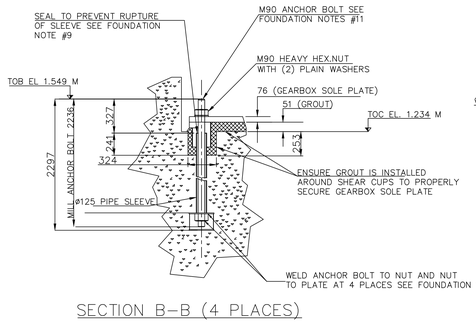
VIEW-Q



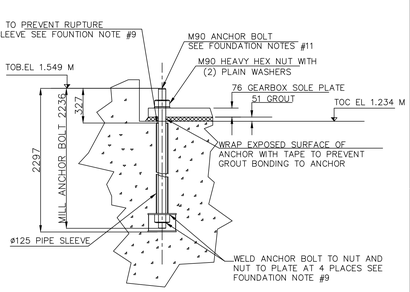
SECTION-Y-Y
(DETAIL FOR CABLE ENTRY)



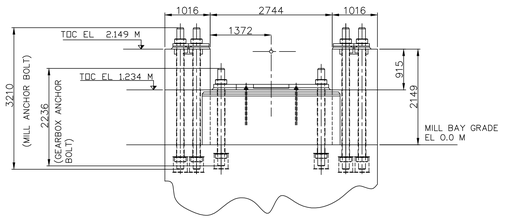
SECTION A-A (8 PLACES)



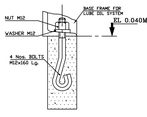
SECTION B-B (4 PLACES)



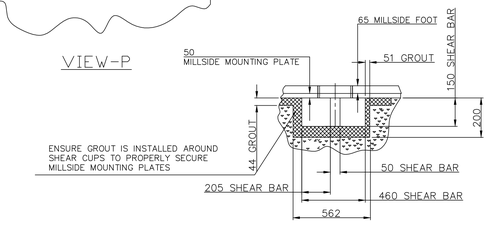
SECTION C-C (2 PLACES)



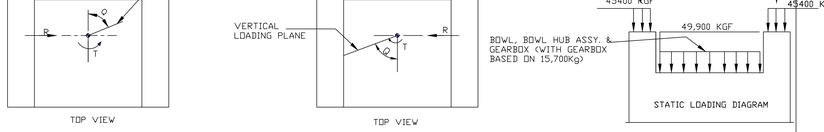
VIEW-P

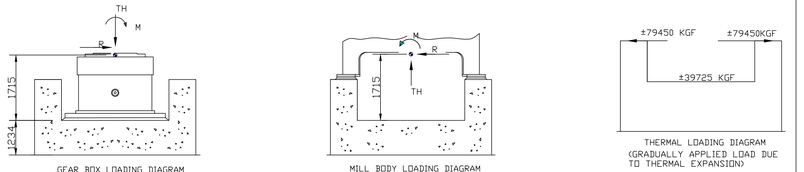


SECTION-JJ
(FOR LUBE OIL UNIT FRAME FIXING (TYPICAL AT 4 PLACES)



SECTION D-D (4 PLACES)

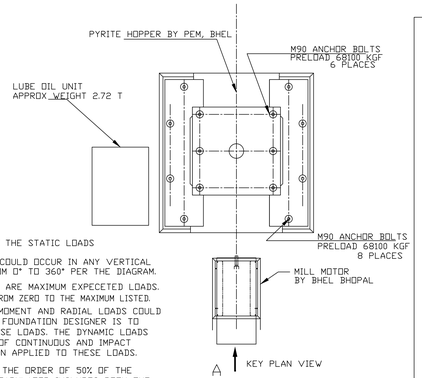




MAXIMUM DYNAMIC FOUNDATION LOADING (ACTUAL)	
MOMENT (M)	126738 KGM
THRUST (TH)	190680 KGF
RADIAL (R)	38590 KGF
TORQUE (T)	97380 KGM
ANGLE (Q)	0° THRU 360° RANDOM DIRECTION SEE NOTE #2
TORQUE (Tm)	PEAK TORQUE

LEGEND:

℄ - LOAD CENTER
KGM - KILOGRAM-METRE
KGF - KILOGRAM-FORCE



NOTES:

1. ALL DYNAMIC LOADS ARE IN ADDITION TO THE STATIC LOADS
2. THE MOMENT (M) AND RADIAL FORCE (R) COULD OCCUR IN ANY VERTICAL PLANE - I.E THE ANGLE 'Q' RANGES FROM 0° TO 360° PER THE DIAGRAM.
3. THE LOADS TABULATED IN THIS DRAWING ARE MAXIMUM EXPECETED LOADS. THE LOADS WILL VARY DURING OPERATION FROM ZERO TO THE MAXIMUM LISTED. THE DIRECTION AND MAGNITUDE OF THE MOMENT AND RADIAL LOADS COULD OCCUR IN ANY DIRECTION (NOTE 2). THE FOUNDATION DESIGNER IS TO DESIGN THE FOUNDATION TO HANDLE THESE LOADS. THE DYNAMIC LOADS TABULATED CONSIST OF A COMBINATION OF CONTINUOUS AND IMPACT LOADS, BUT NO IMPACT FACTOR HAS BEEN APPLIED TO THESE LOADS.
4. THE CONTINUOUS DYNAMIC MOMENT IS ON THE ORDER OF 50% OF THE VALUE TABULATED. THE MOMENT VALUE TABULATED INCLUDES BOTH THE NORMAL GRINDING MOMENT AND THE IMPACT MOMENT DUE TO GRINDING TRAMP MATERIAL (NON-COAL MATERIAL, ROCK, IRON, ETC)

ELEVATION VIEW

MOTOR DATA:-

SUPPLIER	: B H E L - BHOPAL
RATING	: 696 KW
SPEED	: 985 RPM
FULL LOAD AMP STATOR	: 168 AMP
VOLTAGE 3 PHASE 50 Hz	: 3300 VOLTS
APPROX. WEIGHT OF MOTOR	: 7550 Kgs
APPROX. WEIGHT OF ROTOR	: 1700 Kgs
GD^2 OF ROTOR	: 288 Kgm^2
MAXIMUM FOUNDATION LOAD	: 112 kN- UPWARDS 186 kN- DOWNWARDS
DIRECTION OF ROTATION	: CLOCKWISE (BI-DIRECTIONAL)

MILL DATA

1. MOTOR SPEED : 985 RPM
2. SPEED OF PULVERIZER : 33 RPM
3. TOTAL WT. OF MILL (EXCLUDING MOTOR) : 140 TONNES.
4. TYPE OF LOAD : MODERATE SHOCK LOAD.

FOUNDATION NOTES:-

1. THIS DRAWING REPRESENTS A SUGGESTED FOUNDATION ARRANGEMENT ONLY. BHEL HYD. IS NOT RESPONSIBLE FOR FOUNDATION DESIGN, PIER TO FOOTING CONNECTION, WORKMANSHOP OR MATERIAL USED. THE FOUNDATION SHOULD BE OF WELL-REINFORCED CONCRETE, DESIGNED IN ACCORDANCE WITH APPLICABLE CODES AND SPECIFICATIONS.
2. ANCHOR BOLTS, NUTS, WASHERS AND SHIMS ARE SUPPLIED BY ALSTOM/BHEL FOR PULVERIZER & GEARBOX.
3. LUBE SKID (TANK) LOCATED NEAR THE MILL WILL REST ON GROUT ABOVE 0.2M FROM THE FINISHED FLOOR .
4. SEE HP 1103 BOWL MILL ARRANGEMENT DRAWING 0-00-620-86051 (NTPC DRG NO. 9575-102-HY-PVM-B-0001) FOR LOCATION AND ORIENTATION OF MILL FOUNDATION AND LUBE OIL SKID W.R.T. BOILER.
5. TOTAL CIVIL FOUNDATION IS NOT IN THE SCOPE OF BHEL HYD.
6. MOTOR MOUNTING PLATE, FOUNDATION BOLTS, SHIMS, PACKERS, SLEEVE ETC. ARE IN BHEL BHOPAL'S (MOTOR SUPPLIER) SCOPE.
7. THE MASS OF CONCRETE MAKING UP THE FOUNDATION SHOULD BE NOT LESS THAN 3 TIMES THE MASS OF THE PULVERIZER.
8. PULVERISER AND PULVERIZER MOTOR FOUNDATIONS MUST BE ONE HOMEGENEOUS BODY.
9. ALL ANCHOR BOLTS ARE TO BE SET IN PIPE SLEEVES PER SECTIONS "A-A", "B-B" AND "C-C". SLEEVES MUST BE FREE OF WATER, DIRT, GROUT AND OTHER DEBRIS AND SEALED WATER AND DUST TIGHT AT THE TOP WITH SUITABLE MATERIAL. SEAL MUST ALLOW ANCHOR BOLT TO ELONGATE WHEN TENSIONED. ANCHOR BOLTS ARE TO BE WELDED AS SHOWN TO PREVENT ROTATION. THE BOTTOM NUT CAN (TOP PLATE, SHELL AND BOTTOM PLATE) IS TO BE DESIGNED TO PREVENT TURNING OF THE CAN & ANCHOR BOLT IN THE FOUNDATION DUE TO THE TORQUE LOAD GENERATED BY THE TENSIONING OF THE ANCHOR BOLT.
10. FOR REQUIRED CLEARANCES AROUND PIERS, REFER BOWL MILL ARRANGEMENT DRAWING (NTPC DRG NO. 9575-102-HY-PVM-B-0001)
11. ANCHOR BOLTS SIZING AND PRELOADING IS BASED ON ANCHOR BOLT MATERIAL OF ASTM A-36
12. ANCHOR BOLTS SHALL BE WITHIN ±3 MM OF THIER DESIGN LOCATION AT THE TOP OF THE BOLT AND VERTICAL WITHIN 1 mm PER 1 METER
13. THE CONCRETE SURFACES TO BE GROUTED ARE TO BE ROUGHENED TO EXPOSE SOUND AGGREGATE. THE SURFACE PROFILE SHOULD HAVE A ROUGHNESS OF 6 TO 13 (PEAK TO VALLEY MEASUREMENT). THIS CAN BE DONE BY USING A NAIL RAKE PRIOR TO THE CONCRETE HAS CURED BY CHIPPING.
14. MILL MOTOR IS IN BHEL BHOPAL SCOPE OF SUPPLY AND SHALL BE SAME AS OF BARH-II 2x660 MW.
15. ALLOWABLE VERTICAL RIGID BODY FOUNDATION DEFLECTION (SETTLING, START-UP, STEADY-STATE AND SHUT DOWN): 3MM MAXIMUM.
16. ALLOWABLE FOUNDATION BENDING AND TWISTING (SETTLING, START-UP,STEADY-STATE AND SHUT DOWN): 0.13MM PER 3048MM.
17. MAXIMUN ALLOWABLE PIER DEFLECTION:
    - UNISON MOVEMENT ±0.38MM @ TOP OF PIER.
    - OPPOSITE MOVEMENT ±0.38MM @ TOP OF PIER.
18. EL (+/-) 0.0M CORRESPONDS TO RL 271.5M.

THE FOLLOWING CONDITIONS APPLY EXCEPT OTHERWISE STATED.

1. REF. TO HY0230261 FOR UNSPECIFIED TOLERANCES.
2. CHAMFER M/CD. SHARP EDGES 1.2 TO 1.0 AT 45°
3. INTERNAL M/CD. CORNER RADII 1 TO 0.7
4. THE SURFACE ROUGHNESS WHERE-EVER NOT SHOWN SHALL BE TAKEN FROM THE SURFACE ROUGHNESS SHOWN OUT SIDE THE BACK SLASH GIVEN OR THE TOP MOST RIGHT CORNER OF THE DRG.

CONTRACT

REV.	DATE	ALTERED		RR
		CHD./APPD.		
ZONE				

REV.	DATE	ALTERED		RR
		CHD./APPD.		
ZONE				

REV.	DATE	ALTERED		RR
02	27.09.12	CHD./APPD.	MVRM	
ZONE	REVISED AS PER CUSTOMER COMMENTS VIDE REF CC/9573102/1469 DT. 27-09-2012.			

REV.	DATE	ALTERED		RR
01	06.09.12	CHD./APPD	MVRM	
ZONE	REVISED AS PER CUSTOMER COMMENTS VIDE REF CC/9573102/705 DT. 09-08-12.			

OWNER: NTPC LIMITED (A Government of India Enterprise)

PROJECT: MOUDA SUPER THERMAL POWER PROJECT
STAGE-II (2x660 MW)
STEAM GENERATOR PACKAGE

BHARAT HEAVY ELECTRICALS LIMITED
HYDERABAD

	NAME	SIGN.	DATE	NO.OF VAR.
DRN.	PG		31.07.12	
CHD.	RR		31.07.12	
APPD.	MVRM		31.07.12	

DEPT.	UNTOL DIMS. GR.	SCALE	WEIGHT (KG)	REF. TO ASSY DRG.	ITEM NO.	NO.OF ITEMS
PULV ENGG. CODE 446	C/M/F	NTS				

TITLE: FOUNDATION PLAN OF HP-1103 MILL (WITH PLANETARY GEAR BOX)

CARD CODE

DRAWING NO. 9575-102-HY-PVM-B-0002 REV. 02

SHEET NO. 01 NO OF SHEETS 01

0-00-610-86050

COMPUTER FILE NAME | REF. DRG. NO. | SIGN. AND DATE | INVENTORY NO