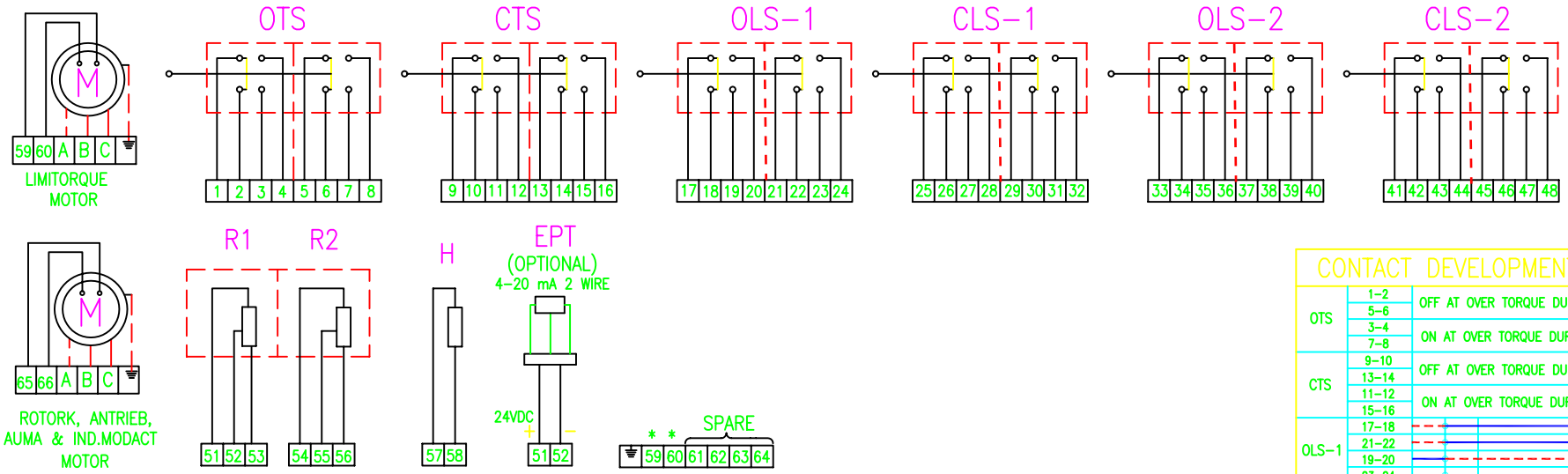


* – SPARE FOR ROTORK, AUMA, ANTRIEB & IND.MODACT

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

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

EPT – ELECTRONIC POSITION TRAMSMITTER (POTENTIOMETRIC TYPE, FOR INCHING DUTY)

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

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

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

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

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

OTS, CTS – TWO INDEPENDENT SWITCHS IN ANTRIEB & LIMITORQUE

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

R1–R2– POTENTIOMETER 2 x 100 OHMS

H – SPACE HEATER 1ø 240V AC SUPPLY

M – MOTOR 3ø 415V 50 Hz AC SUPPLY

SETTING PROCEDURE OF POSITION LIMIT AND TORQUE SWITCH

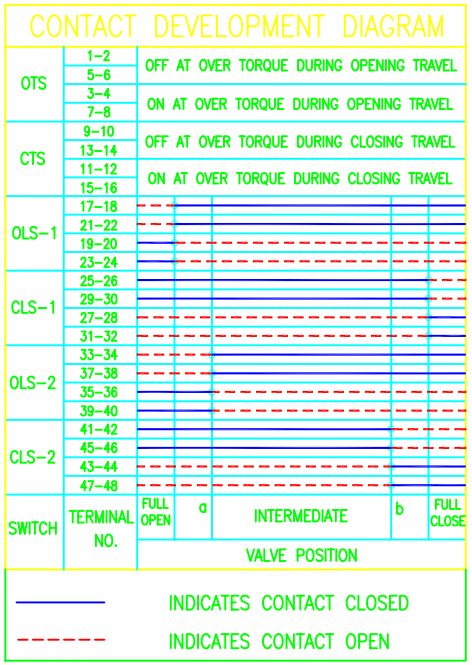
VALVES	OPEN		CLOSE	
	MAIN	BACK UP	MAIN	BACK UP
GATE VALVE OF 100 mm AND ABOVE IN 1500 CL AND ABOVE RATINGS	OLS	OTS	CLS	CTS
ALL OTHER GATE & GLOBE VALVES	OLS	OTS	CTS	@

@ – CLS NOT TO BE CONNECTED IN TRIP CIRCUIT

NOTE:

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

CONTACT DEVELOPMENT DIAGRAM



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

REV	DATE	CHED	APPD	DESCRIPTION
11	09.09 2000			CONTACT DEV. FIG.ADDED.

365-139

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

DRAWN	N.P.ESWAR
CHECKED	K.ARUNACHALAM
APPROVED	P.LOGANATHAN
DATE	09.09.2000

TITLE

INTERNAL WIRING DIAGRAM
FOR
ELECTRICAL VALVE ACTUATORS (AC)
(DRAWN FOR INTERMEDIATE POSITION OF VALVES)

DRAWING No. 4-V-MISC-90271 REV 11

RETRACED WITH REVISION 11

VOLUME : IIF/1

SECTION-III

TECHNICAL SPECIFICATION FOR ELECTRIC MOTOR ACTUATORS

1.00.00 SCOPE

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

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

2.00.00 STANDARDS

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

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

i) IS-9334

ii) IS-325

3.00.00 SERVICE CONDITIONS

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

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

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

4.00.00 RATING

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

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

5.00.00 **PERFORMANCE**

The actuator shall meet the following performance requirements:

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

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

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

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

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

6.00.00 **SPECIFIC REQUIREMENT**

6.01.00 **Construction**

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

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

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

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

6.02.00 **Motor**

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

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

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

6.02.04 Motor leads shall be terminated in the limit switch compartment.

6.02.05 Motor actuators for valves/dampers shall be non-integral type with separate starter units and operable from remote.

6.02.06 Earthing terminals shall be provided on either side of the motor.

6.03.00 **Limit Switches**

Each actuator shall be provided with following limit switches: -

6.03.01 2 torque limit switches, one for each direction of travel, self-locking, adjustable torque type.

6.03.02 4 end-of-travel limit switches, two for each direction of travel.

6.03.03 2 position limit switches, one for each direction of travel, each adjustable at any position from fully open to fully closed positions of the valve/damper.

6.03.04 Each limit switch shall have 2 NO + 2 NC potential free contacts. Contact rating shall be 5A at 240V A.C. or 0.5A at 220V D.C.

6.04.00 **Hand Wheel**

Each actuator shall be provided with a hand wheel for emergency manual operation. The hand wheel shall declutch automatically when the motor is energized.

6.05.00 Position Indicator/Transmitter

The actuator shall have:

6.05.01 One (1) built-in local position indicator for 0-100% travel.

6.05.02 One (1) position transmitter, potentiometer type, for remote indicator.

6.06.00 **Space Heater**

A space heater shall be included in the limit switch compartment suitable for 240V, 1 phase, 50 Hz supply.

6.07.00 **Wiring**

All electrical devices shall be wired up to and terminated in a terminal box. The internal wiring shall be of sufficient size for the power rating involved but in no case less than 1.5 Sq.mm copper. All wiring shall be identified at both ends with ferrules. All wires shall be fire resistance type.

6.08.00 **Terminal Box**

The terminal box shall be weather proof, with removable front cover and cable glands for cable connection. The terminal shall be suitable for connection of 2.5 Sq.mm copper conductor.

7.00.00 **ACCESSORIES**

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

7.01.00 One (1) triple pole MCCB for local isolation near the actuator

7.02.00 One (1) reversing starter with mechanically interlocked contactors, 3 thermal overload relays, 2 NO + 2 NC auxiliary contacts for each contactor.

7.03.00 One (1) remote-local selector switch.

7.04.00 CLOSE-STOP-OPEN oil tight push buttons with indication lights.

7.05.00 415/240 V or 415/110V control transformer with primary protected by fuse & secondary protected by Miniature Circuit Breaker (MCB).

8.00.00 **TEST**

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

9.00.00 **DRAWINGS, DATA & MANUALS**

9.01.01 To be Submitted with Bid

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

9.01.02 To be Submitted after Award of Contract

a) Actuator Data Sheet

b) Internal wiring diagram and suggested control schematic

c) Torque switch and limit switch contact development

d) Manufacturer's Catalogue

e) Instruction manual indicating clearly the installation methods, check ups and tests to be carried out before commissioning of the equipment.

f) Any other relevant drawings, documents or data necessary for satisfactory installation , operation and manufacturing.

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

SPECIFICATION FOR FIELD INSTRUMENTS

1.00.00 **FIELD INSTRUMENTS**

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

1.01.00 Pressure Transmitter

01.	Working Principle	:	Smart (HART Compatible)
02.	Type	:	2 - Wire
03.	Output Signal	:	4-20 mA DC.
04.	Signal Processing	:	Silicon solid state electronic circuitry
05.	Measuring Element	:	Capsule / Diaphragm
06.	Element material	:	AISI-316 (Stainless Steel) or better
07.	Static Pressure	:	150 % of maximum span continuously, without affecting the calibration.
08.	Turn-down ratio	:	60: 1.
09.	Span and Zero	:	Locally adjustable non-interacting. Facility for elevation and suppression by 100% of span
10.	Enclosure Class	:	IP-65
11.	Output Indicator	:	LCD
12.	Nameplate	:	Tag number, service engraved in SS tag plate
13.	Body	:	Forged Carbon Steel for air and flue gas application and SS for other application.
14.	Operating Voltage	:	16 - 48 Volts D.C.
15.	Load	:	600 Ohms (min.) at 24 Volts D.C.
16.	Ambient Temperature	:	0 - 50 ^{O}C
17.	Performance:		
	i) Accuracy	:	$\pm$ 0.1% of Span or better
	ii) Repeatability	:	$\pm$ 0.05% of Span or better
	iii) Response time	:	100 msec or better
18.	Sealing/Isolation	:	Extended diaphragm with 5 meters SS armoured capillary for viscous fluid applications.
19.	Accessories	:	a) Universal mounting bracket suitable for 2” pipe mounting. b) High tensile carbon steel U- bolts. c) Siphon for steam and hot water services. d) ½” NPT 2-valve stainless steel manifold, constructed from SS316 bar stock. e) Companion flange with nuts, bolts and gaskets.

f) ½" NPT cable gland

1.02.00 Differential Pressure Transmitter / Flow transmitter

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

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

1.03.00 Displacer Type Level Transmitters

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

	19.	Preferred Features	:	a) Test plug connection and cutout terminals physically separated from other electronics. b) Electronic Damping facility (adjustable).
1.04.00		Mass Flow meter		
1.04.01		Sensor		
	01.	Measuring Principle	:	Coriolis Mass flow.
	02.	Primary Element	:	Flow Tube of 316SS or better
	03.	Heating Arrangement	:	Integral.
	04.	Temperature Control	:	For heavy fuel oil application.
	05.	Process Connection	:	Flanged of rating as per process requirement.
	06.	Drain	:	Self-draining facility
	07.	Enclosure	:	Stainless steel
	08.	Accessories	:	Counter flanges, Mounting nuts, bolts, gaskets etc.
1.04.02		Transmitter		
	01.	Measured quantities	:	Mass Flow rate, Total Mass Flow, Density.
	02.	Input Signal Processing	:	Digital Processing.
	03.	Display	:	Digital Display (LCD).
	04.	Output	:	2 off. isolated 4-20mA DC output.
	05.	Load	:	< 750 ohms.
	06.	Power supply	:	240V AC, 50 Hz.
	07.	Turn Down	:	100:1
	08.	Accuracy	:	$\pm$ 0.2 % of measured value
	09.	Housing	:	IP 65
	10.	Nameplate	:	Tag number, service engraved in stainless steel tag plate
	11.	Accessories	:	a) Handheld configurator b) Mounting U-bolts, nuts, bolts, prefab cable etc. c) ½"NPT cable gland
1.05.00		Pressure Gauge and Differential Pressure Gauge		
	01.	Type	:	Bourdon/Bellows/Diaphragm
	02.	Sensing & Socket	:	AISI-316 SS
	03.	Movement Material	:	AISI-304 SS
	04.	Case Material	:	Stainless steel. IP-65.
	05.	Dial Size	:	Generally 150 mm
	06.	Scale	:	Black lettering on white in 270 ^{O} arc.

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

1.06.00 Temperature Gauge

	01.	Type	:	Bimetallic or gas filled.
	02.	Sensing Element Material	:	Bourdon - AISI-316 SS
	03.	Capillary Armoring	:	Stainless steel flexible
	04.	Movement Material	:	AISI 304 SS
	05.	Bulb / Stem Diameter	:	12 mm
	06.	Bulb / Stem Material	:	AISI 316
	07.	Capillary	:	Stainless Steel
	08.	Connection to well	:	½" NPT
	09.	Case Material	:	Stainless steel
	10.	Dial Size	:	150 mm in general
	11.	Scale	:	Black lettering on white in 270 ^{O} arc.
	12.	Mounting	:	Surface/Panel
	13.	Over range Protection	:	125 % of range or more

14.	Instrument connection	:	Bottom for local and back for panel mounting.
15.	Range	:	Normal temperature–50~70% of range.
16.	Zero adjuster	:	Micrometer screw adjustable from front.
17.	Window	:	Shatterproof glass.
18.	Accuracy	:	± 1 % or better
19.	Enclosure Class	:	IP-65
20.	Capillary	:	5 meters (local surface)/15.0 meters (local panel) - armoured stainless steel
21.	Compensation	:	Capillary and Case Compensation
22.	Accessories	:	a) Forged barstock thermowell screwed as per ASME PTC code. Process connection M 33X2 (M). Material of construction of Thermowell: - SS 316: In general - Inconel: For flue gas application - Tungsten carbide: For coal mill application.
23.	Nameplate	:	Tag number, service engraved in stainless steel tag plate

1.07.00 Thermocouples

01.	Type	:	a)	Type-J (Iron Constantan) / Type-K (Chromel Alumel) / Type-R (Pt.-Rhodium Pt.) / Type-S (90% Pt – 10% Rhodium). [As per application]
			b)	Duplex
			c)	Ungrounded
02.	Wire gauge	:	16 AWG for Type-K, 24 AWG for Type-R	
03.	Standard	:	ANSI-MC 96.1.	
04.	Protecting Tube :-			
	i) O.D.	:	8 mm	
	ii) Material	:	316-SS Seamless	
	iii) Filling	:	Magnesium Oxide (Purity above 99.4%)	
05.	Response time	:	a)	< 20 seconds for measurement.
			b)	< 10 seconds for control.
06.	Accuracy	:	± 1.1^0 C up to 300 ^{0} C & 0.4% of measured temperature range above 300 ^{0} C.	
07.	Head:			
	i) Type	:	IP-65 universal screwed type.	
	ii) Material	:	Die cast aluminum or better	
	iii) Terminal blocks	:	Nickel plated Brass - screw type/ silver plated	

iv) Instrument connection to well : ½" NPT

v) Cable connection : ½" NPT gland and grommet.

vi) Others : Terminal head cover with SS chain and suitable gasket. All thermowells in the high velocity steam service shall be checked for Strouhal's frequency limit to arrive at a safe size and design of thermowells.

08. Accessories :
a) Adjustable nipple-union-nipple [1/2" Sch 80 X ½" NPT (M)] with thermowell connection
b) Compression fittings/unions
c) Flanges etc. (for flanged connections only)
d) Forged barstock thermowell as per ASME PTC code. Process connection M 33X2 (M) in general or 1½" Flanged for Flue gas/Furnace/Air etc. application.

Material of construction of Thermowell:

SS 316: In general

Inconel: For flue gas application

Tungsten carbide: For coal mill application.

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

1.08.00 Resistance Temperature Detector

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

i)	Type	:	IP-65 universal screwed type.
ii)	Material	:	Die cast aluminum or better
iii)	Terminal blocks	:	Nickel plated Brass-screw type / silver plated
iv)	Cable connection	:	½" NPT gland and grommet.
v)	Others	:	Terminal head cover with SS chain and suitable gasket. All thermowells in the high velocity steam service shall be checked for Strouhal's frequency limit to arrive at a safe size and design of thermowells

10. Accessories : a) Adjustable nipple-union-nipple [1/2" Sch 80 X ½" NPT (M)] with thermowell connection

b) Compression fittings/unions

c) Flanges etc. (for flanged connections only)

d) Forged/barstock thermowell as per ASME PTC code. Process connection M33X2 (M).

Material of construction of Thermowell:

SS 316: In general

Inconel: For flue gas application

Tungsten carbide: For coal mill application.

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

1.09.00 Pressure Switch

01. Type : i) Piston for high pressure application

ii) Bellow / Diaphragm for low pressure application

02. Sensing element material : AISI SS-316. All other wetted part SS316.

03. Case Material : Die-cast aluminum alloy, neoprene gasket.

04. Setter Scale : Black graduation on white linear scale. Graduation 0-100% with red pointer for set points.

05. Over range : 150 % of maximum pressure

06. Adjustments : a) Internal Set Point

b) Differential adjustment

07. End Connection : 1/2" NPT (M) bottom connected

08. Switch configuration : Two SPDT

09. Switch Rating : 240V, 5A AC/220V, 0.5A DC

10.	Switch Type	:	Snap acting, shock & vibration proof
11.	Terminal Block	:	Suitable for full ring lugs.
12.	Cable connection	:	½" NPT conduit connection.
13.	Enclosure Class	:	IP-65.
14.	Performance	:	a) Repeat accuracy ± 1.0% b) Accuracy of Setting Indication of ± 1.5%
15.	Ambient temperature	:	0 – 50 Deg.C
16.	Nameplate	:	Tag number, service engraved in SS tag plate
17.	Accessories	:	a) Remote diaphragm seal with SS-316 capillary for viscous & corrosive application. b) Siphons for steam and hot water services. c) Retention ring and screws for surface mounting. d) 1/2" NPT 2 Valve SS-316 barstock manifold e) ½" NPT cable gland

1.10.00 Differential Pressure Switch

01.	Type	:	Bellows / Diaphragm / Piston actuated
02.	Sensing element material	:	AISI SS-316. For all other wetted part SS 316
03.	Case Material	:	Die-cast aluminum alloy with neoprene gasket.
04.	Setter Scale	:	Black graduation on white scale with 0-100% graduation and provided with red pointer for set point adjustment
05.	Over range	:	Static pressure on any one side, the other side being open to atmosphere.
06.	Adjustments	:	a) Internal set point adjustment b) Differential adjustment
07.	Process Connection	:	1/2" NPT (M) bottom / back connected.
08.	Switch configuration	:	Two SPDT
09.	Switch rating	:	240V, 5A AC/220V, 0.5A DC.
10.	Switch type	:	Snap acting type contacts, shock and vibration proof.
11.	Terminal Blocks	:	Suitable for full ring lugs for cable connection.
12.	Cable Connection	:	½" NPT conduit connection or compression gland.
13.	Performance	:	a) Repeat accuracy ± 1.0% b) Accuracy of set point Indication: ±1.5%

14.	Operating Ambient	:	0 - 50 ^{O}C (Maximum Continuous)
15.	Enclosure	:	IP-65
16.	Accessories	:	a) Snubbers for pulsating fluid application. b) Syphons for steam and hot water services. c) Retention ring and screws for surface mounting. d) 1/2" NPT 3-Valve SS-316 manifold constructed from barstock e) 1/2" NPT Cable gland
17.	Nameplate	:	Tag number, service engraved in stainless steel tag plate
18.	Remote Seal type for special application	:	a) Silicone oil / fluorolube filled remote diaphragm seal for dirty / viscous / corrosive fluid. b) SS armoured capillary at least 3 meters each. c) Adapter flanges with nuts, bolts and gaskets for instrument and process side.

1.11.00 Level Switch

01.	Type	:	External cage float operated. Magnetically coupled.
02.	Float Material	:	AISI-316 stainless steel or better
03.	Other wetted parts	:	AISI-316 stainless steel or better
04.	External Cage	:	Carbon steel / Stainless steel as per process requirements, welded type / flanged construction. Cage pressure rating shall equal or exceed the rating of the main vessel.
05.	External cage mounting	:	Side-Side.
06.	External cage connection	:	25 NB socket welded.
07.	Switch housing	:	Epoxy coated die-cast aluminum alloy with neoprene gasket conforming to IP-65.
08.	Type of switch configuration	:	2 SPDT (two nos.)
09.	Contact rating	:	5A, 240V/AC, 0.25A, 220V DC
10.	Accessories	:	a) Counter flange, nuts & bolts, suitable gasket etc.

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

	06.	Document	:	Beta ratio calculation, assembly drawing and Flow vs. DP curve.
	07.	Meter run pipe	:	Same as pipe material
	08.	Accessories	:	Flanges, gaskets, nuts & bolts, root valves jack screw, meter run pipe, Drain & vent hole as per application etc..
1.14.00		Flow Nozzle		
	01.	Application	:	High fluid velocity flow measurement
	02.	Design Standard	:	ASME PTC 19.5
	03.	Number of Tapings	:	As required plus one additional pair of taps
	04.	Diameter Ratio	:	Between 0.4 and 0.7
	05.	Thickness	:	Suitable for the application
	06.	Document	:	Beta ratio calculation, assembly drawing and Flow vs. DP curve.
	07.	Meter run pipe	:	Same as pipe material
	08.	Accessories	:	Meter run pipe, nipples and root valves. (Inspection port assembly for nozzles used in plant performance purpose)
1.15.00		Gauge Glass		
	01.	Type	:	Reflex
	02.	Glass	:	Toughened borosilicate. Resistant to mechanical and thermal shocks.
	03.	Body material	:	Carbon steel / stainless steel- As per process requirements (Flanged Connection)
	04.	Pressure rating	:	Twice the maximum working pressure
	05.	Temperature rating	:	As required
	06.	Bolts and nuts	:	Rust proof alloy steel
	07.	Accessories	:	Suitable ball check valves of SS-304/316 body, gaskets, companion flange etc.
1.16.00		Power Cylinders (Pneumatic)		
	01.	Mounting Type	:	a) Fixed position mounting (End mounting).
			:	b) Trunnion mounting
	02.	Control Signal	:	4-20 mA DC to electro-pneumatic positioner. 24V DC operated solenoid valve operating on pneumatic line for open & closing purpose of on & off drive.
	03.	Supply Air	:	0-7 Kg / Cm^2.
	04.	Selection	:	Based upon thrust / torque, stroke length, angular movement, full-scale travel time, repeatability, space factor etc. Provision for air-to-open and air-to-close operation.

05.	Casing	:	IP-65.
06.	Accessories	:	a) Air lock relay b) Hand wheel. c) Air filter regulator with gauge. d) Volume Booster. e) Limit Switches. f) Positioner with Input and Output pressure gauges, local keypad & display. g) Solenoid Valve h) Integral non contact type position Transmitter (4-20 mA DC linear output). i) Junction box with cable gland
07.	Fail-safe operation	:	For regulating duty- stay put against power & air fail.
08.	Repeatability	:	Better than 0.5% of full travel.
09.	Hysterisis	:	Less than $\pm$1% of full travel
10.	Operating Temp. limit	:	50 Deg. C (min.)

1.17.00 Smoke Density Analyzer

01.	Type	:	In-situ infra red
02.	Principle of measurement	:	Transmission & absorption (Dual beam type)
03.	Light source	:	Modulated high intensity LED
04.	Display	:	Back Lit LCD
05.	Measurement range	:	0-999 mg/m^3, 0-999 mg/Nm^3, 0-100% opacity
06.	Measurement averaging	:	Selectable 10 sec to 60 minutes
07.	Accuracy	:	0.2% opacity
08.	Resolution	:	0.1% opacity
09.	Linearity	:	0.1% opacity
10.	Repeatability	:	0.1% opacity
11.	Flue gas temperature	:	350 ^{O}C (max 600 ^{O}C)
12.	Ambient temperature	:	0 - 60 ^{O}C
13.	Operating temperature	:	Transmitter & receiver- 0-90^{O}C, Electronic unit - 70 ^{O}C
14.	Mounting	:	Transceiver on opposite side of the duct
15.	Analog output	:	4-20mA DC (in 500 ohm resistance) to
16.	Alarm output	:	2 SPCO potential free rated at 230 VAC, 5A
17.	Power Supply	:	240V AC, 50 Hz, 1 Phase
18.	Automatic misalignment detection	:	Required

	22.	Accessories	:	a) Blower unit, tubes & fittings for calibration and purging, purge fail alarm in CCR b) Calibration gas cylinders for NO_x and CO filled in 10 Ltrs. of WC carbon cylinder with necessary SS regulator, SS gauges, SS tubings and SS fittings etc. as required. c) Mounting flanges, gasket etc.
	23.	Application	:	At economizer outlet
1.22.00		H2 + CO2 + Air Analyzer		
	01.	Type	:	Thermal Conductivity
	02.	Range Selection	:	3 ranges (H_2 in CO_2, H_2 in air and CO_2 in air)
	03.	Range	:	As required
	04.	Output	:	4-20mA DC (Isolated)
	05.	Operating ambient temp.	:	10 ^{O} C to 50 Deg. C
	06.	Power Supply	:	240V AC, 50Hz
	07.	Sample gas flow control	:	Required
	08.	Reference gas flow	:	Required
	09.	Reference gas pressure regulator	:	Required
	10.	Cell response	:	95% of change in 30 Sec.(Appox.)
	11.	Accuracy	:	2% of full scale
	12.	Repeatability	:	1% of full scale
	13.	Local Indicator	:	Indicating meter of 1% accuracy
	14.	Alarm facility	:	Dual (High & Low) independently adjustable.
	15.	Contact rating	:	0.5A at 220 V AC
	16.	Enclosure	:	Flame Proof
	17.	Accessories	:	Calibration gas, mounting accessories and others as required to be provided
	18.	Application	:	Generator Gas Purity.
1.23.00		Radar Type Level Measurement		
	01.	Type	:	Radar based on Time Domain Reflectometry
	02.	Antenna	:	Co axial / single rod type guided wave or Horn type as required for the application
	03.	Communication	:	Two wire 4-20mA DC, HART or Field Bus protocol.
	04.	Environmental temperature	:	0 – 50 ºC
	05.	Enclosure	:	Explosion proof /IP 65 as per application
	06.	Cable Entry	:	½" NPT

07.	Calibration	:	a)	Self calibration with internal reference
			b)	Zero & Span calibration
08.	Programming	:	Handheld programmer & Local keypad	
09.	Process Connection	:	Flanged /screwed	
10.	Electronic Housing	:	Epoxy painted Die-Cast aluminium alloy	
11.	Antenna / Flange assembly	:	316 SS or Hestalloy (as required)	
12.	Output Indicator	:	Digital Integral Display	
13.	Accuracy	:	5 mm or 0.1% of probe length	
14.	Accessories	:	a)	Programming tool kit
			b)	Gasket

1.24.00 Temperature Switch

01.	Type	:	Bimetallic or gas filled.
02.	Sensing Element Material	:	Bellow / Bourdon AISI SS-316
03.	Bulb Material	:	AISI SS-316
04.	Capillary	:	Stainless steel armored
05.	Movement Material	:	AISI SS-304
06.	Case material	:	Epoxy coated steel plate or die-cast aluminum alloy with neoprene gasket and clear glass where applicable cover conforming to IP-65. (Explosion proof for NEC Class-1, Division 1 area).
07.	Scale	:	Black lettering on white background
08.	Over range Protection	:	120 %
09.	Instrument connection	:	Bottom
10.	Switch configuration	:	Two SPDT
11.	Switch rating	:	240V, 5A AC/220V, 0.5A DC
12.	Switch type	:	Snap acting, shock and vibration-proof.
13.	Adjustability	:	Internal Set point adjustable over span range
14.	Cable connection	:	3/4" ET conduit connection or compression gland.
15.	Compensation	:	a) Capillary compensation with invar wire throughout the capillary length.
			b) Case compensation
16.	Performance :		
	i) Scale Accuracy	:	±1.0 % of full scale
	i) Repeatability	:	< 0.5 % of full range
	ii) Response time	:	Less than 40 seconds with thermowell
17.	Capillary length	:	5 meters (minimum) for local mounting/15 meters for local panel mounting.

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

15.	Stability	:	Less than 0.25% of Span / Zero for six months.
16.	Cable connection	:	¾" ET
17.	Mounting	:	Field (pipe/wall mounting)
18.	Accessories	:	Air filter regulator, mounting accessories, cable gland etc.

1.27.00 Air Filter Regulator

01.	Filter Element	:	Sintered Bronze
02.	Filter Size	:	5 microns
03.	Input Air	:	10.0 Kg/Sq. cm (maximum)
04.	Output	:	Adjustable from 0-2.0 Kg / Sq. cm or 0-7.0 Kg / Sq. cm (continuous) as applicable for I/P converter, control drives and control valve
05.	Effect of Supply	:	Maximum 0.02 Kg/Sq. cm for a change pressure variation in supply pressure of 4 Kg/Sq. cm
06.	Bowl Material	:	Metallic cover around high temperature area / clear transparent polycarbonate with metallic cover for ordinary applications.
07.	Accessories	:	2" dial size output pressure gauge
08.	Desirable Feature	:	No perceptible drop of pressure on opening the drain port.

1.28.00 Solenoid Valve

01.	Operating Principle	:	Electromagnetic (noiseless)
02.	Coil voltage rating	:	240 V AC / 220 V DC/24 V DC/110 V (as required)
03.	Ways	:	Generally 3-ways other depending on requirement
04.	Port size	:	1/4" NPT all ports
05.	Body	:	SS bar stock
06.	Trim	:	SS-316
07.	Duty	:	Suitable for continuous energization
08.	Sealing	:	Airtight and leak proof
09.	Ambient Temperature	:	0 - 50 ^{O} C
10.	Fluid Temperature	:	0-150 ^{O} C (approx.)
11.	Coil Enclosure	:	Stainless Steel
12.	Insulation	:	Class-H
13.	Coil Casing	:	IP-65 (Explosion proof for NEC Class-1, Division-1 area)
14.	Mounting	:	On pipe or on panel
15.	Cable Connection	:	3/4" ET
16.	Accessories	:	Mounting brackets, nuts and bolts

17.	Preferred feature	:	a) Solenoid valve directly integral to actuator body shall have NAMOOR interface for uniformity b) Local indication for power

1.29.00 Sight Glass

01.	Type	:	Flap-type
02.	End connection	:	Screwed / Flanged
03.	Material:		
a)	Body	:	CS/SS as per process medium
b)	Indicator	:	Stainless steel
04.	Sight Glass	:	Toughened Borosilicate
05.	Gasket	:	Neoprene
06.	Bolts & Nuts	:	High tensile steel
07.	Hydraulic Test Pressure	:	1.5 times maximum working pressure
08.	Accessories	:	As required

1.30.00 Flow Indicating Switch

01.	Type	:	On line metal tube Rotameter
02.	End connection	:	Flanged
03.	Material:		
a)	Body	:	CS/SS as per process medium
b)	Float	:	Stainless steel
c)	End fittings/flange	:	Stainless steel
d)	Other wetted part	:	Stainless steel
b)	Casing	:	Di cast Alluminium
04.	Accuracy	:	+/- 2.0% of FSR
05.	Rangeability	:	10:1
06.	Electrical connection	:	¾" ET
07.	Switch type	:	Snap acting hermitically sealed 2 nos. SPDT
08.	Contact rating	:	5A, 240V AC
09.	Protection class	:	IP-65
10.	Accessories	:	As required

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

~~2.01.00 Closed Circuit Television System~~

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

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

	-	Type	Snap action micro switch
	-	Rating	5A, 240V AC, 0.2A, 220V DC
	-	Mounting	Flush
viii)	Terminal points		All components piped & wired to terminal points
ix)	Accessories	i)	Flow regulator
		ii)	Flow gauges
		iii)	Sample rate set valves
		iv)	Other accessories as required to make the system complete

5.20.00 Technical Specification of Residual Chlorine Analyser

SENSOR

Method	:	Amperometric
Electrodes	:	Gold Cathode/Silver Anode
Cell Material	:	PVC
Electrolyte	:	Potassium Bromide

TRANSMITTER

Type	:	Microprocessor Based with self diagnostic features
Transmitter Output	:	4 – 20 mA
Enclosure Protection	:	IP65
Enclosure Material	:	Polyester coated Al.
Electrical Connection	:	½" NPT (F)
Mounting	:	FIELD
Display Type	:	LCD
Display Details	:	4 digit backlit LCD matrix
Diagnostics	:	Required
Meter Range	:	0-1 mg/l
Resolution	:	0.01 ppm
Area Classification	:	SAFE
Electromagnetic Compatibility	:	BUILT – IN
Temp. Compensator	:	AUTO – BUILT – IN
Temp. Compensating element	:	PT100

5.21.00 Technical Specification of Turbidity Analyser

SENSOR

Reference type	:	On Line
Operating principle	:	Alternating Light Source
Cleaning	:	Self Cleaning
Electrode holder – type	:	Flow Through
Body Material	:	CPVC
Process Connection	:	½" NPT (F)

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

3.00.00 CONTROL PANEL/DESK MOUNTED INSTRUMENTS AND ELECTRICAL SYSTEM ACCESSORIES

3.01.00 Coupling Relay

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

3.02.00 Bar graph Indicator

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

	Indicator and Tray	:	Prefab Cable
13.	Accessories	:	i) Mounting Tray ii) Engraved phenolic nameplate affixed to front flange to identify each indicator by tag number and each point by measured variables.
14.	Alarm Facility	:	1 HI and 1 LO for each channel independently adjustable over span. Voltage free outputs
15.	Reference Junction Compensation	:	Built-in cold junction compensation for thermocouple inputs
16.	Feature	:	i) Alarm level indication by flashing cursor ii) Green Digital display of parameter value in front panel with a 3.1/2 digit display.

3.03.00 Valve Position Indicator

01.	Input	:	4-20 mA DC/1-5 Volts DC
02.	Indication	:	Pointer and Scale. Moving Coil Meter
03.	Readable Distance	:	3 meters (minimum)
04.	Pointer Deflection	:	90 Deg Sector or linear
05.	Mounting	:	Flush Panel (Horizontal/vertical)
06.	Accuracy	:	$\pm$1% or better
07.	Protection Class	:	IP-42
08.	Operating Ambient Temp.	:	0-50 ^{O}C
09.	Scale	:	0-100%
10.	Bezel Size	:	DIN Standard

3.04.00 Digital Indicator

01.	Type	:	Four and half digit LED seven-segment display with sign.
02.	Face Dimension	:	72 x 144 mm / 48 x 96 mm (as applicable)
03.	Display Character	:	13.8 mm, Green (LED)
04.	Accuracy	:	0.1% of reading, $\pm$2 digit
05.	Input	:	4-20mA DC/1-5 V DC/RTD/Thermocouple
06.	Mounting	:	Flush Panel
07.	Power Supply	:	240V $\pm$10%, 50 $\pm$2.5 Hz
08.	Output Contact	:	2 nos SPDT, contact rating 5A at 240V AC/ 0.25A at 220V DC
09.	Power/Signal Connection	:	Screwed

Large Display (150x300 mm) indicators shall be provided for MW, MVAR and frequency indications.

3.05.00 Push Button

01.	Type	:	Shrouded square format
02.	Face Dimension	:	32 x 32 mm (maximum)
03.	Contact Configuration	:	2 NO + 2 NC
04.	Contact Addition	:	Add-on block up to 4 each with 2 pairs of contacts
05.	Contact Material	:	Hard Silver Alloy
06.	Contact Rating	:	500V / 10 A
07.	Utilization Category	:	AC11 / DC11
08.	Insulation Voltage	:	2 KV for 1 minute between terminals and earth
09.	Mechanical Life	:	1 million operation
10.	Construction	:	Aluminum shrouding with plastic lens
11.	Colors	:	Red, Green, Yellow, Black, etc.
12.	Connection	;	Screw terminals
13.	Enclosure Class	:	IP-52
14.	Legend	:	Engraving

3.06.00 Illuminated Push Button

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

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

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

3.10.00 Indicating Meters (D.C)

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

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

3.11.00 Auxiliary Relay

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

3.12.00 Electrical Transducer

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

3.13.00 Synchroscope

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

4.00.00 **CONTROL VALVES, ACTUATORS & ACCESSORIES**

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

a) Bidder shall exercise caution in selecting severe service control valves like BFP recirculation valves, HP & LP bypass valves, superheater & reheater attemperator valves, PRDS valves for Boiler & Turbine, Soot blower steam pressure control valve, control valves whose down stream are connected to vacuum such as HP/LP heater emergency level control, condenser make up water control valve, separator level control and CEP minimum flow control valve. For such critical applications, Bidder shall offer valves which are proven for similar application. Above valves shall have leakage class equal or better than class-V with metal-to-metal seating.

b) Wherever, steam conditioning calls for Pressure reducing & desuperheating, combined PRDS type valves shall be offered.

c) Bidder shall provide redundant control valves for Main condensate flow control, Superheat attemperation control and Reheat attemperation control as a minimum for high availability. For other application, if the availability criteria for the plant cannot be met even with the best established product, redundant control valves shall be provided.

d) Control valves shall be located near floor or platform for ease of access and with adequate clearances for maintenance and lay-down and shall be placed as station with upstream motorized isolating valve, down-stream isolating valve, inching duty motorized bypass valve and manual drain valves. Each redundant control valve shall have its upstream motorized and down-stream manual isolating valves. Where quick shut off requirement is foreseen such as in case of SH & RH attemperation valves, upstream isolation valve shall be pneumatic type.

4.01.00 General

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

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

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

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

4.01.05 Valve Body / End Connections

4.01.06 Valve end to end dimension and connection shall be according to ANSI standard, straight through pattern. However, Bidder may offer angle body valve for high pressure drop applications. For high pressure drop applications, construction of the valve shall be such that the gland is not exposed to inlet pressure.

4.01.07 Control valves of 40 mm. size and above with line pressure up to 50 Kg / Sq. cm may have flanged or welded end connections.

4.01.08 Control valves, used in high pressure services shall have butt welded end connections for size 65mm and above and socket weld end connection for size 50 mm or below.

4.01.09 Control valve body shall be selected as per the ISA guideline. Generally control valve body shall be cast and machined for pressure rating up to 1500 lbs. Above 1500 lbs, valve body shall be of forged steel. For Demineralized Water application, valve body shall be Stainless Steel.

4.01.10 The direction of flow shall be clearly engraved on the body .

4.02.00 Valve Body Material (material shall match the process condition for super critical boiler)

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

4.03.00 Valve Size

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

a) The valves shall pass normal flow (MCR condition) with 60 to 70 percent opening for linear characterised valves and between 70 to 80 percent opening for equal percentage characterised valves.

b) The valves shall have adequate rangeability to pass the minimum and maximum flows at 10% and 85% of the valve opening respectively. Valve stem travel range from minimum to maximum flow condition shall not be less than 50% of the total valve stem travel.

c) Valve Cv shall be selected in such a way that the valve shall be capable of handling at least 120% of required maximum flow.

d) The valve selection shall be based on the highest size dictated by the above considerations unless noise, flashing or other factors dictate the final selection.

e) Trim outlet velocity for the control valves shall be no more than 7 m/sec for water service and Mach number less than 1/3 for steam and air service application.

f) The sizing procedure followed shall be as per latest edition of ANSI/ISA or equivalent standard.

4.04.00 Valve Top work

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

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

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

4.05.00 Valve Trim

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

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

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

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

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

4.05.06 Trim Material

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

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

4.06.00 Noise Level

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

4.07.00 Valve Actuators

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

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

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

4.07.03 Nylon reinforced neoprene is preferred as diaphragm material.

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

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

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

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

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

4.08.00 Valve Positioners

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

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

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

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

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

4.09.00 Valve Accessories

Accessories shall include side mounted hand wheels, limit switches, junction boxes, airlock relays etc.. Solenoid valve wherever required shall be furnished.

5.00.00 **CONTROL DESK / PANEL / RACK**

5.01.00 Convenient and logical approach to operational interfaces and aesthetics in the overall view of the panel /desk shall be considered.

5.02.00 For items susceptible to vibration, suitable anti-vibration padding shall be provided to prevent damage or malfunction.

5.03.00 All items inside the panels/cabinets shall be neatly arranged with easy access/ maintenance approach.

5.04.00 Incoming power supply feeders shall be duplicated. Alarm shall be provided for failure of a power supply feed.

5.05.00 Desk / panel shall be provided with interior illumination, utility receptacles with plug and cooling fan.

5.06.00 Panel / Desk shall have gland plate at cable entry to panel. Thickness of gland plate shall not be less than 3 mm.

5.07.00 Wire shall be routed / laid through covered trough.

5.08.00 Crating of the panels and desks shall be suitable for protection against shock, vibration, inappropriate handling and inclement weather conditions during transportation and warehousing. Mounted equipment shall have adequate protection against damage during handling, transit and storage. Suitable desiccant shall be used inside the packing case.

5.09.00 Nameplate

a) Nameplate shall be provided for instrument or device mounted on the panel.

b) Nameplates for panels shall be provided both in front and rear.

5.10.00 Control Desks

5.10.01 Devices mounted on the desks shall be flush type. Devices shall be so mounted that their removal and replacement can be accomplished without interruption of services to others.

5.10.02 Desk shall be ergonomically designed to suit working on a 24 X 7 basis. Aesthetics, ergonomics and illumination shall be considered while positioning of the desk, large video screen and panels in control room.

5.10.03 Control desk shall be free standing floor mounting type of table-top design with compartments for locating the hardware. Desk shall be constructed from aluminum extrusion with high pressure laminate MDF board for work surface of approved colour. Aluminium structure shall be anodized or powder coated paint finish.

5.10.04 Monitors with retractable keyboard, emergency push buttons shall be provided on the desk. Desk shall be arranged in arc-like shape without any sharp edges. Edges shall be extruded PVC or rounded post-formed laminate..

5.10.05 Desks shall be of modular, scalable and industrially ruggedized design and shall have Telephones and Intercom connections.

5.10.06 Desks shall have concealed cable trays for wire dressing.

5.10.07 Design shall include Earthing bolts.

5.10.08 Back installed items shall be suitably concealed from front view.

5.11.00 Back Up Panel

5.11.01 Construction shall be from sheet steel of thickness not less than 3mm.

5.11.02 Electrical upright Panel construction & design shall be similar to back up panel. Control switches, meters, indicators, synchronizer, excitation control switch, annunciation window etc. along with associated mimic diagram, as recommended, shall be provided for manual synchronization of generator.

5.12.00 Cabinets / Enclosure / Panels

01.	Material of construction	:	Cold rolled steel sheet
02.	Thickness of Sheet	:	a) 3.0 mm for faces supporting instruments / terminals. b) 2 mm for other sides and top.
03.	Construction	:	Welded throughout as per approved National Standards.
04.	Panel height	:	2300 mm (approx)
05.	i) Corners	:	7 mm inner radius
	ii) Dimensional Tolerances	:	a) In height & length - 3 mm b) In height between adjacent sections - 2 mm. c) Total for a group - 6 mm
06.	Doors	:	Double, recessed, turned back edges
	i) Thickness of Sheet	:	2 mm
	ii) Hinges	:	Stainless steel
	iii) Door latches	:	Three point type
	iv) Door gaskets	:	Neoprene rubber on fixed frame to result dust proof/weatherproof enclosure.
	v) Opening of the doors	:	Outward
	vi) Louvers	:	With removable wire mesh to ensure dust and vermin proof.
07.	Color of interior	:	Brilliant white
08.	Colour external	:	RAL 7032
09.	Painting	:	Epoxy powder coated or better
10.	Gland plates	:	Removable 4 mm thick (bottom)
11.	Cable entry	:	Bottom
12.	Hardware	:	a) Anti vibration pad- 15 mm b) Predrilled base channel ISMC - 100 or equivalent for all sides.

c) Stainless steel buff- finished 2 mm thick kick plate for all sides.

d) Stainless steel scratch strips along desk edges fixed with pan-head recessed screws.

e) Rubber strips to ensure air tightness between kick plate and finished floor.

f) Lifting hook / Eye bolt

g) Drawing pocket

h) Door switch, lamps, thermostat, heaters and fans

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

5.13.00 Local Instrument Racks & Enclosure

5.13.01 General Requirements

a) Devices located in the field shall be grouped and installed in the enclosure (Open / Closed Rack) in Boiler and TG Building.

b) Racks and enclosure shall be factory prefabricated & painted and shall complete with internal piping, tubing, manifold, isolation valves, blowdown valves, integral junction box, illumination etc.

c) No more than six instruments shall be grouped in a single rack / enclosure.

d) Racks shall be installed above the tapping points for air, flue gas and coal air mixture application whereas for applications such as for water and steam, racks to be installed below the source point.

e) Attention shall be paid in the layout to avoid air traps in liquid piping and water accumulation in air /gas piping.

f) Welding of impulse lines shall comply with the provisions of the latest applicable ANSI Code for Pressure Piping.

g) Instrument piping and tubing shall be hydrostatically tested at one and one-half times the maximum system pressure except for low pressure and vacuum measurement for which the test pressure will be as per piping standard.

h) Service air connection shall be provided for continuous and intermittent purging of impulse pipe in dusty medium. Continuous purging shall be adopted for differential pressure measurement such as flue gas and coal air mixture application. Pressure measurement shall have only intermittent purging whenever required. In case of continuous purging, an air header shall be formed this shall receive service air through isolation valve and air filter regulator. Air shall be fed from the air header to both the impulse pipes near to take off points through isolation valves and flow regulators. Air header shall be constructed from stainless steel. Impulse pipe for such applications shall have a four-way valve. One port of the valve shall have an adaptor to connect flexible stainless steel braided nylon hose to the service air. Rating of the hose shall not be less than 10 Kg/sq.cm.

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

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

j) Drawing K9213R-DWG-I-0200 shall be referred for typical arrangement of Local instrument enclosure and rack.

5.13.02 Closed Instrument Rack

a) Enclosure shall be free standing type. Racks shall be adequately reinforced to ensure true surfaces and to provide support. Major load-bearing posts shall be suitably supported by gusset plates or moment members.

b) Enclosure outer shall be constructed from at least 3 mm thick steel plate and epoxy painted to shade gray. Base frame shall be made of ISMC 100 and black colour finish.

c) 2” NB galvanized pipes shall be laid horizontally and supported at two end channels to mount transmitters at accessible height. Center posts or any member, which would reduce access, shall be avoided.

d) Double leaf interlocking front opening doors with three point locking shall be provided and shall be arranged for maximum possible access to the interior. Key shall be of identical for all enclosures.

e) Doors shall have concealed quick removal type pinned stainless steel hinges and locking handles. Gaskets shall be used between all mating sections to achieve dust and weather proof enclosure rated for IP-65 including the internal junction box.

f) Removable type bulkhead plates of thickness not less than 6 mm shall be mounted at the racks with suitable high temperature gasket Impulse lines within the enclosures shall be properly clamped.

g) All internal wirings between the instruments and junction box shall run through flexible conduits.

h) Racks shall have a common blowdown drain header, which will connect individual instrument blowdown line after suitable pressure breaking through regulating globe type blowdown valves. Header shall be of 2” NB ASTM A 106, Sch-80 Gr. C installed at a slope of 1:25 and extended beyond the rack for connection to plant drain header.

i) Each rack shall be provided with one receptacle, light fixtures each at instrument & Junction box compartments with wire guard.

5.13.03 Open Instrument Rack

a) Rack shall be free standing type constructed from 6 mm thick steel channel frame provided with a canopy to protect the instrument from dripping water or falling objects and shall be epoxy painted. Rack Major load-bearing posts shall be suitably supported by gusset plates or moment members. Suitable protective grill shall be welded to the end-posts of the rack to outline a boundary beyond which no mounted equipment shall project. Canopy shall be of CRCA steel sheet of at least 3 mm thickness. Center posts or any member, which would reduce access, shall be avoided.

b) 2" NB galvanized pipes laid horizontally and supported at two end channels shall be employed at working accessible height for mounting of instruments.

c) All internal wirings between the instruments and junction box shall run through flexible conduits. No exposed wirings are admissible.

d) All racks shall have a common blowdown drain header, which will connect individual instrument blowdown line after suitable pressure breaking through regulating globe type blowdown valves. Header shall be of 2" NB ASTM A 106, Sch-80 Gr. C installed at a slope of 1:25 and extended beyond the rack for connection to plant drain header.

5.13.04 Junction Box

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

a) Junction box shall be provided at a dry compartment at one side of the enclosure / rack with front opening type door. Earth stud shall be furnished at rack for safety grounding.

b) Terminals shall be screwless cage clamp type of reputed make and 20% spare terminals shall be furnished in the junction box.

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

~~6.01.00 System Functional Description~~

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

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

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

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

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

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

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

14. Indication : Processor status and fault display

15. Features : Power fail hold, Automatic restoration on power

7.03.07 Operator's & Engineering Station:

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

a) Operator's Station / Engineering Station (PC Based)

1. Intel Pentium Core 2 Duo processor with latest available speed;
2. Windows XP Professional preloaded with CD media;
3. 2 GB RAM;
4. 320 GB HDD;
5. 64 MB SVGA graphics card;
6. 2 MB L2 Cache;
7. 1 DVD Read / write;
8. Antivirus protection software with license;
9. 1 PCI Express x 1 slot 3 PCI 2.2 slot (5v, 32 bit) on Mini Tower, one PCI Express x 16 graphics slot;
10. 4 x USB ports, 1 Serial Port, 1 Parallel Port, PS/2 Port for Mouse & Keyboard;
11. 1 x 104 keyboard;
12. Integrated sound Blaster Compatible Audio Controller 16-bit along with internal speaker;
13. 10 / 100 / 1000 Mbps embedded Network Interface Card. Additional NIC with 2 nos. Intel Pro / 100S PCI Network Adapter Card;
14. Minitower Chassis;
15. 240 VAC 50 Hz power supply

b) Client Server

In case of Client Server Architecture this shall be of the latest model / version and shall have the following minimum requirements:

1. Two Intel Xeon up to 3.4 GHz Processors, 800 MHz FSB;
2. Windows 2008 Server 10 user license preloaded with CD media;
3. Interaction with at least 10 Clients;
4. 2 GB ECC DDR (1GB Installed in two slots and two slots free) SDRAM;
5. Dual 73 GB Ultra 320 SCSI internal storage; HDD partitioning C: 36 & D: 36;
6. 64 MB SVGA graphics card;
7. 2 MB L2 Cache;

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

c) Monitor

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

d) Key Board

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

graphic, operator guide message etc.

c) Standard Alphanumeric keys

d) Alarm acknowledge keys

e) Cursor keys

f) Mode/loop status switching keys

g) Setting change keys

h) Print-out command keys

i) Other keys as required to operate the system

3.	Key lock	: Lockable type push button mounted on keyboard
4.	Life Expectancy	50 million cycles per key
5.	Version	: To suit industrial application

e) Laser Printer

1.	Type	: Electro-photographic laser, tabletop
2.	Printer Memory	: 256 MB (min.)
3.	Speed	: Monochrome 24 ppm - A4, Color 6 ppm - A4
4.	Resolution	: 1200 x 1200 DPI in color
5.	No. of color (Basic)	: 4 (four) minimum
6.	Duty cycle	: Monochrome 75000 pages / month
7.	Power supply	: 240 V, 50 Hz, 1 phase
8.	Ambient temperature	: 0-50 Deg C
9.	Humidity	: 95% non-condensing
10.	Size of paper	: Letter, A4, Legal, Ledger, A3
11.	Print media	: Plain paper, transparencies, thick stock, glossy stock, envelopes
12.	Accessories	: Adapters, Connector Cable, Multiplexer switch (4 point)

7.03.08 Stackable Managed Switch

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

7.03.09 Furniture

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

7.04.00 Software Specification

~~7.04.01 General~~

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

~~a) The operating system shall be suitable for real time operation both at process as well as HMI end.~~

~~b) The software system shall be fully modular.~~

~~c) The software shall meet the following general requirements.~~

~~i) Simple, easy to learn language for editing and on line operation.~~

~~ii) Wide range of peripheral support.~~

~~iii) Effective task scheduling and support of multiple priority structure including event based interrupt etc.~~

~~iv) Effective debugging.~~

~~v) Provision for on line editing and program development without interrupting on line functions.~~

~~vi) Self diagnostic routines.~~

~~vii) Efficient memory management and effective utilization of system time.~~

~~viii) Quick start up and loading.~~

~~ix) Support of multiprogramming and multi user operation.~~

~~7.05.00 Memory Management / Operating System~~

~~a) The main memory capacity shall be adequate to minimize swapping.~~

~~b) Individual task shall reside in partitions, which can be split into sub partition for parallel task handling.~~

~~c) The operating system shall automatically perform housekeeping functions including file management.~~

~~d) Task swapping shall be dynamic.~~

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

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

~~8.18.03 Shaker table shall be provided for testing & calibration.~~

9.00.00 **INSTRUMENTATION & CONTROL CABLE**

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

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

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

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

9.05.00 Thermocouple Extension & Compensating Cable

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

09.	Drain wire	:	Annealed tinned copper wire, stranded. Size 0.5 Sq. mm. (No. of strands / size:- 7 / 0.3mm)
10.	Inner Sheath	:	Extruded FRLS PVC (anti rodent, anti termite & moisture resistant properties) HR PVC Type ST2 of IS-5831,1984 Thickness as per IS-1554Part-I 1976
11.	Rip Cord	:	Non metallic under sheath
12.	Armouring	:	GI wire / strip as per IS 3975
13.	Outer Sheath	:	Extruded FRLS PVC (anti rodent, anti termite & moisture resistant properties) HR PVC Type ST2 of IS-5831,1984 Thickness as per IS-1554Part-I 1976
14.	Filler	:	Non hygroscopic with FRLS property
15.	Temperature Range	:	Up to 85 °C
16.	Insulation at 20^0 C	:	100 MOhms/Km [Min]
17.	Capacitance at 800 Hz	:	120 nf/km
18.	Cross talk	:	60 dB
19.	Attenuation	:	1.2 dB/Km
20.	Codes & Standards	:	a) IEC 332-1 b) ANSI MC 96.1 c) IS-8784-1987
21.	Tests	:	a) Oxygen Index: Min.29 at room temp. (ASTM-D-2863) b) Acid Gas Gen.: Max.20% by weight as per IEC 754 Part-I c) Temp Index : Min 250 DEG C at 21Oxy. Ind. (ASTM-D-2863) d) Smoke Density Rating : Max.60% (ASTM-D-2843). e) Flammability Test : as per IEC 332 Part-I /IEEE-383 Swedish Chimney Test - SS-424-1475 F3 f) High voltage test Core to core- 1.5 KV for 1 min. Core to screen- 1.0 KV for 1 min. g) Insulation Resistance 100 M Ohm / Km Min

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

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

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

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

9.06.00 Instrumentation multi Paired Signal Cable

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

    * Analog signals- Individual pair & overall shield to be considered.
    * Binary signals- overall shield to be considered.

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

h) High voltage test

Core to core- 1.5 KV for 1 min.

Core to screen- 1.0 KV for 1 min.

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

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

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

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

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

9.08.00 Control & power Cable

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

10.00.00 **ERECTION HARDWARE**

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

10.01.00 Electrical Accessories

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

a) Rigid Steel Conduit

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

ii) Each piece of conduit shall be straight, free from blister and other defects and covered with capped bushing at both ends.

iii) All rigid conduit couplings and elbows shall be hot dip galvanized rigid mild steel in accordance with ANSI C 80.1 and UL6. The conduit interior and exterior surfaces shall have a continuous zinc coating with an over coat of transparent enamel or zinc chromate. Conduits shall be furnished in standard length of 3 meters, threaded at both ends.

iv) All conduit fittings shall conform to the requirements of ANSI C 80.4 and UL-514 where these standards apply.

b) Flexible Conduit

i) Flexible conduit shall be of three layer construction of very high quality of lead coated steel. Outside and inside layer shall be reinforced with heat resistant material.

ii) Lead coating outside and inside of the conduit steel surface shall provide a non-corrosive characteristic particularly in acidic atmosphere. Besides flexibility, this shall be strong enough to stay at the desired profile without support and shall be durable and strong so as to offer sufficient mechanical protection. It shall also be fully liquid dust and air tight and shall withstand a continuous hydraulic pressure up to 2 Kg/Sq. cm and temperature up to 200 °C.

c) Special Fittings

i) Conduit sealing and fittings shall be provided as required and shall be consistent with the area and equipment with which they are installed.

ii) Double locknuts shall be provided on all conduit terminations not provided with threaded lugs and couplings. Locknuts shall be designed to securely bond the conduit to the enclosure when tightened. Locknuts shall not loosen due to vibration.

10.02.00 Electrical Junction Box

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

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

10.03.00 Cable Gland

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

10.04.00 Cable Tray

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

10.05.00 Process Hook Up Accessories & specification

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

10.05.01 Seamless Stainless Steel Pipe

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

10.05.02 Stainless Steel Pipe Fittings

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

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

10.05.03 Seamless Stainless Steel Tube

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

10.05.04 Stainless Steel Tube Fittings

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

10.05.05 C.S. Pipe

1.	Reference	: ASTM-A 106 Gr. C
2.	Material	: Cold drawn seamless black C.S.
3.	Type	: Seamless / Plain ends
4.	Size	: ½" NB
5.	Schedule	: 80, 160, XXS as required
6.	Standard Length	: 5 meter

10.05.06 C.S. Pipe Fittings

1.	Reference	: ASTM-A 105 / ANSI B16.11
2.	Type	: Forged
3.	Rating	: 3000 lbs / 6000 lbs / 9000 lbs
4.	Size	: ½" NB
5.	End connection	: Generally socket weld
6.	Type of Fittings	: Reducing coupling, male-female reducer, straight coupling, equal tee, three piece union, elbow, cap etc.

10.05.07 A.S. Pipe

1.	Reference	: ASTM-A 335 P22 AS PER ANSI B 36.10
2.	Material	: Cold drawn seamless A.S.
3.	Type	: Seamless / Plain ends
4.	Size	: ½" NB
5.	Schedule	: XXS
6.	Standard Length	: 5 meter

10.05.08 A.S. Pipe Fittings

1.	Reference	: ASTM-A 182 F22 AS PER ANSI B 16.11
2.	Type	: Forged
3.	Rating	: 9000 lbs
4.	Size	: ½" NB
5.	End connection	: Generally socket weld

	6.	Type of Fittings	: Reducing coupling, male-female reducer, straight coupling, equal tee, three piece union, elbow, cap etc.

10.05.09 Carbon Steel Globe Valve

	1.	Reference	: ASTM A-105
	2.	Type	: Globe
	3.	Construction	: Forged Body Cadmium Plated
	4.	End Connection	: ½" Socket Weld
	5.	Rating	: Cl. 800 / CL. 2500
	6.	Material	: Body - Carbon steel
			: Stem - Hardened Steel
			: Plug - AISI 316 SS
			: Seat- Stainless steel stellited
	7.	Packing	: Teflon / Grafoil as required
	8.	Yoke	: ASTM A105
	9.	Hand wheel	: Carbon steel
	10.	Design standard	: As per ANSI B 16.34

10.05.10 Stainless Steel Globe Valve

	1.	Reference	: ASTM A-182 F316
	2.	Type	: Globe
	3.	Construction	: Forged Body
	4.	End Connection	: Socket Weld
	5.	Proof Pressure	: 400 Kg/Cm2
	6.	Material	: Body - Stainless steel
			: Stem - Hardened Steel
			: Plug - AISI 316 SS
			: Seat- Stainless steel stellited
	7.	Packing	: Teflon as required
	8.	Yoke	: ASTM A182 F316

	9.	Handwheel	: Carbon steel
	10.	Design standard	: As per ANSI B 16.34

10.05.11 Alloy Steel Globe Valve

	1.	Reference	: ASTM A-182 F22
	2.	Type	: Globe
	3.	Construction	: Forged Body
	4.	End Connection	: ½" Socket Weld
	5.	Rating	: CL. 2500
	6.	Material	: Body - Alloy steel
			: Stem - Hardened Steel
			: Plug - AISI 316 SS
			: Seat- Stainless steel stellited
	7.	Packing	: Grafoil as required
	8.	Yoke	: ASTM A182 F22
	9.	Handwheel	: Carbon steel
	10.	Design standard	: As per ANSI B 16.34

10.05.12 Condensate Pot

	1.	Reference	: ASTM A182 F22 /ASTM A105
	2.	Material	: Alloy steel / carbon steel as per application
	3.	Construction	: Drilled from barstock
	4.	End connection	: 3 nos. ½" socket weld end
	5.	Accessories	: Vent valves

10.05.13 Instrument Valve Manifold

	1.	Type	: Two valve manifold
			: Five valve manifold
	2.	Mounting	: Remote 2" Pipe Mounting
	3.	Construction	: Single block (bar stock)
	4.	Material	: Forged body and bonnet AISI 316 stainless

steel

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

10.06.00 Pneumatic Hook Up Accessories

10.06.01 Air Header

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

10.06.02 Seamless Stainless Steel Tube

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

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

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

11.01.00 Bidder shall supply a complete set of new, unused and reliable type of special tools and tackle and test equipment which are necessary or convenient for erection, commissioning, maintenance and overhaul of the plant and equipment provided under this specification.

11.02.00 The tools & tackle and Test Equipment shall be shipped in separate container, clearly marked with names of the equipment for which they are intended.

11.03.00 Bidder shall furnish list of tools & tackle and test equipment proposed to be supplied along with the bid.

material with suitably colored lettering engraved on the back.

c) The nameplates shall be held by self-tapping screws. The size of nameplate shall be approximately 20 mm x 75 mm for equipment and 40 mm x 150 mm for the panels.

d) Items of plant such as valves, which are subject to handling, are to be provided with an engraved chromium plated nameplate or label with engraving filled with enamel, suitably mounted or affixed with strong rustproof chain.

e) All such nameplates, instruction plates, lubrication charts etc. shall be with English inscriptions.

8.00.00 **METERING BASES AND CHART UNITS**

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

i)	Pressure	: Kg/cm^2
	Differential Pressure	: mm of H_2O column / Kg/cm^2
ii)	Draught	: mm of H_2O column
iii)	Vacuum	: Kg/cm^2 (abs)/mm of Hg column
iv)	Temperature	: Degree Celsius (^{O} C)
v)	Flow (Steam, Water)	: Tonnes / hr, M^3/Hr
vi)	Flow (Oil)	: M^3 / Hr, Litter/Hr
vii)	Flow Air	: Tonnes / hr / M^3 / Hr.
viii)	Density	: gms / c.c.
ix)	Level	: mm /%
x)	Conductivity	: µS / cm or mS/cm
xi)	Gas Analyzer	: Percentage by weight or as specified in respective case.
xii)	Dissolved Oxygen / Silica / Sodium	: ppm /ppb

9.00.00 **PROCESS CONNECTION & INSTRUMENT HOOK UP**

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

9.02.00 Each instrument shall have its own independent connection to the process except for instruments located on standpipe. Each instrument shall be connected independently to the standpipe through isolation valve.

9.03.00 Isolation and blowdown drain valves adequate for duty and capable of withstanding continuous design condition of main process shall be provided. Instrument blow down valve near to the instrument shall be of gradual opening type. For process pressure equal or above 40 kg/ sq.cm double blowdown valves shall be used connecting to blowdown header. Instrument manifold / gauge valve shall be installed close to the instrument.

9.04.00 The nominal size of the takeoff connections on line shall not be less than NPS ½" for source conditions not in excess of either 900 psi or 425OC and NPS ¾" (for adequate physical strength) for design conditions exceed either of these limits. Where the size of the main is smaller than the limits given above, the takeoff connections shall not be less than the size of the main line.

9.05.00 Process connection for instruments lines and vessels shall be in accordance to standards such as ASME or other recognized international standards. Table below indicates the type of connection generally to be used.

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

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

9.06.00 Size of impulse pipe for pressure measurement in air and flue gas duct path of boiler shall not be less than ¾" NB.

9.07.00 Separate stubs and take-off points with thermo well / root vlves shall be provided for performance guarantee test.

9.08.00 Impulse pipes shall be clamped at suitable interval not exceeding 1.5 meter. Process pipe shall not be used for supporting the impulse pipe.

9.09.00 Fittings shall conform to ANSI B 16.11. Threads of piping component shall be of tapered construction.

9.10.00 Instrument blowdown header shall in no case be lower than the material grade ASTM A 106 Gr. C.

9.11.00 Impulse pipe shall be laid at least with slope of gradient 1:10 to avoid any air pocket or water accumulation.

9.12.00 Expansion loop shall be provided at least at every 2.5 meter interval without affecting the gradient of slope in long run impulse pipe to avoid stress on the piping.

9.13.00 Siphon shall be provided in the impulse pipe or tube to protect the instruments where fluid temperature is 100 OC or more.

9.14.00 Orientation of tappings shall be as follows :

a) For liquid service within 45 ^{O} at lower half of the pipe horizontal plane.

b) For gas service within 90 ^{O} at upper half of the pipe horizontal plane.

c) For steam service within 45 ^{O} at upper half of the pipe horizontal plane.

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

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

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

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

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

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

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

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

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

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

~~11.00.00~~ ~~**ENVIRONMENTAL CONSIDERATIONS**~~

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

~~11.01.00~~ ~~Temperature~~

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

~~11.02.00~~ ~~Humidity~~

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

PLC SPECIFICATION

~~3.12.07~~ ~~Individual gauge board (as per manufacturer's standard) shall be provided near each Air Drying plant for local indication of all important parameters such as pressure, temperature, flow related to the driers.~~

~~3.12.08~~ ~~Bidder shall provide all measuring instruments with required accessories for control, monitoring, protection and interlock of the compressors and driers. Electronic analog signal transmission from field transmitters to area control rooms shall be 4-20 mA DC. All process switches, limit switches and drive feed back signals shall be provided with potential free contact. Temperature detector will be provided at each stage of the compressed air system and cooling water system of compressors for monitoring in the local control panel.~~

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

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

~~3.12.09~~ ~~Dew point measurement shall be provided for each Air drying plant of compressed air system. The output of the instrument shall be 4-20 mA DC to be connected to the master controller panel.~~

~~3.13.00~~ ~~Fuel Oil Unloading System~~

~~3.13.01~~ ~~The Fuel Oil Unloading System shall be controlled from PLC based local control system or relay based system. No operator work station has been envisaged for this system. The system shall be operated from Lamp / Pushbuttons, selector switches etc located on the panel. Integral type hardware annunciation system shall be provided at the top of the panel for alarm monitoring. Important parameters i.e. tank levels, oli flow, oil termperature etc.from this panel shall be monitored in the station DCS via RIO considered for Fuel Oil Pressurising & Heating System. Facility shall be provided in the PLC for connecting laptop for programming.~~

~~3.13.02~~ ~~Level signals from HFO/LDO day tank shall be connected to DCS via hardwired link for control of HFO/LDO transfer pumps. Bidder shall keep these signals terminated in suitable terminal blocks of the local panel.~~

~~3.14.00~~ ~~Ventilation And AC System~~

~~3.14.01~~ ~~For~~ detail Instrumentation systems, operation & control philosophy refer Vol IIB.

4.00.00 **TECHNICAL SPECIFICATION – CONTROL SYSTEM**

4.01.00 Brief technical specification of the PLC based control systems are delineated below.

4.01.01 Programmable Logic Controller (PLC) based control system shall have 1:1 hot redundant configuration. Central Processing Units (CPUs) shall have word length of 32 bits minimum.

4.01.02 Following components shall be redundant as well : communication processors, memory modules, rack power supply units, bulk IO power supply units, IO communication modules, data highway and high speed (100Mbps) data network connecting the operator stations.

4.01.03 Two CPUs shall operate on fault tolerant mode with continuous self and cross-monitoring. Failure of the active CPU shall not affect the operation of the plant. In the event of failure of active CPU, tasks shall be transferred to the standby CPU within fastest possible transfer time (< 5m sec.) without causing any relays to drop out during the transfer.

4.01.04 CPUs shall not be loaded to over 60% of their capacity even under worst data loading conditions. It shall be possible to make a manual transfer from the active to the back-up CPU from engineering station and as well as from the front panel of CPU module.

4.01.05 Modules shall have adequate status and diagnostic indication on the front panel.

4.01.06 System shall be of modular construction and expandable by adding hardware modules. Bidder shall provide at least 20% or a minimum of one off, spare channels as hot-on-rail spares in each configured cards / modules. In addition to this, 10% or minimum of one off, extra assigned complete spare modules mounted on rails in racks for each type of I / O modules shall also to be provided. The spare channel and cards shall be fully wired and terminated.

4.01.07 Memory unit of the CPU shall be field expandable at least by 25%. Operating system / application program / sequence logic etc. shall be stored in nonvolatile memory for automatic re-booting. Dynamic memories shall be provided with battery back up at least for 360 hours.

4.01.08 Number of input / output points per card shall not exceed 16 (sixteen) for digital and 8 (eight) for analog / thermocouple / RTD signals. Individual input and Output channels shall have galvanic / optical isolation. Merely fusing of individual or a group of channels is not acceptable.

4.01.09 Data communication system of the PLC shall not be limited to the following:

a) Internal bus and external data network loading shall in no case be more than 60% of its capacity.

b) Disrupted message shall be automatically retransmitted when the system is restored.

c) Failure or physical removal of any module connected on the system bus shall not lead to any loss of communication.

d) Diagnostics message shall be issued on fault detection.

e) Bus change over from active bus to stand by bus, during failure of active bus, shall be performed automatically and bumplessly. Such event shall be suitably logged or alarmed.

f) Noise immunized and reliable highspeed dual fault tolerant optic fiber cable communication with standard communication protocol shall be provided between PLC s and remote or extended I/O modules.

g) Main data network shall comply with the International Standard IEEE-802.3 (Ethernet) for data exchange and communication.

4.02.00 Operator workstation shall be complete with latest user friendly operating system, 24" colour LCD monitor, membrane KB, mouse, colour laser printer and dot matrix printer. In addition, a laptop unit loaded with engineering software shall be furnished.

4.02.01 The functions performed from the HMIs shall not be limited to the following:

a) Selection of auto/Manual, open/close, sequence auto, start/stop operation.

b) Dynamic Mimic display depicting the process.

c) Alarm monitoring, report & log generation, printing of trends etc.

d) On line / historical trending, historical storage and retrieval of data.

4.03.00 Software

a) Necessary software for implementation of the control logics, operational displays & logs, data storage, retrieval and other functional requirements, shall be provided.

b) Licensed version of required software including operating system, configuration and HMI software shall be provided.

c) Detail documentation on the programming softwares as part of the O&M manual.

4.04.00 Power Supply

a) Power supply to the PLC system shall be provided from solid-state 240V AC ± 1% packaged UPS (Uninterruptible Power Supply) units to be placed local to the control systems. UPS system shall be complete Ni-Cd type battery & battery chargers. UPS shall have adequate capacity to cater 100% load without overloading. UPS system shall be adequate to provide back up power for not less than 30 minutes.

b) UPS shall be complete with AC Distribution board. Two feeders shall be extended from ACDB to PLC.

c) Bulk power supply units for interrogation, relay and solenoid voltage shall be separate from system power supply units and shall be redundant.

4.05.00 System shall have MTBF better than 99.7% and shall be hot maintainable. System hardware shall be designed to be `fault avoidant' by selecting high-grade components of proven quality and properly thermally de-rated design. The network shall have extensive fault monitoring, self-surveillance & on-line self-diagnostic capability so that failure is immediately detected.

4.06.00 System shall automatically check & correct gain & drift for ADCs on-line.

4.07.00 Data exchange in a bus shall be fully monitored and checked for validity.

4.08.00 Response time consisting of IO scan time, data communication time, processing time etc. shall be equal to or less than the following :

a) OLCS & sequence control inputs : 100 ms.

b) CLCS inputs : 250 ms.

c) Monitoring analog parameters : 500 ms.

d) Monitoring digital parameters : 100 ms.

4.09.00 Following operations will be performed on I/Os, as required:

a) Square root extraction

b) Pressure & temperature compensation

c) Reasonability check of all inputs, validation and quality tagging like good, bad, suspect etc.

d) Channel wise engineering unit conversion

e) Contact bounce filtering with adjustable time constant.

4.10.00 The controllers shall be time synchronized to GPS master clock via IRIG-B or Ethernet port. Software capability shall be provided to implement closed loop control functions as follows:

a) PID control and their variations.

b) On-off control

c) Cascade control

d) Ratio and bias control

4.11.00 Features for Open Loop Control shall not be limited to following:

a) Logic functions like AND/OR/NOT gates, timers (on-delay, off-delay), shift registers, counters, latches, flip-flops, mono-shots etc.

b) Automatic sequence control for start up and shutdown of auxiliaries / equipment in functional groups initiated by command from operator's console. A sequence shall be made of steps executed in predetermined order according to logic criteria. For each step there shall be a provision for `waiting time' and `monitoring time'. System shall have the capability to bypass a step, if desired, from the operator's station. Such action however shall be registered as an exception.

c) Inputs for protection system shall be of high priority. In the event of either loss of control power or control signal input to the drive, the drive shall remain in its last position unless specifically required otherwise. The

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

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

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

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

4.14.00 Updating time and reaction time shall be as follows:

a) Calling up a mimic : 2 sec or better

b) Updating status signal in mimic : 1 sec or better

c) Updating variables in a mimic : 1 sec. or better

d) Issuance of command to output : 1 sec. or better

(without considering process lag)

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

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

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

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

a) Input filters to attenuate noise.

b) Isolation of 1500V AC for the input & output module.

c) Comm. Mode Noise rejection for analog inputs of 120 db at 50 Hz.

d) Normal mode noise rejection for analog inputs of 60 db at 50 Hz.

e) LED indicators on each card to show status of input.

f) All the outputs shall be with individual fuse.

g) J/K type thermocouple mV input where applicable.

h) Pt-100 three / four wire resistance thermometer input where applicable.

i) 24 V DC power supply to field mounted two wires transmitters.

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

a) Watch dog timer : Periodical reset. Alarm and interruption, if not reset within stipulated time.

b) Max. scan time for inputs: 1 sec. max.

c) Maximum Scan Rate : 1 ms (Per K Word) or better

d) Memory capacity : 25% spare capacity after full utilization. Expandable in multiples of 16 K.

e) Comm. processor : Separate

f) Battery back up for RAM : 360 hrs continuous operations.

g) Diagnostic feature : Periodic, automatic self- diagnostic.

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

a) All modules

1. Surge withstand capability : IEC-255.4

b) Digital General

1. No. of channels / module : 16
2. Interrogation voltage : 24V DC or 48 V DC
3. Status indicator : LED type.
4. Isolation : Optical

c) Digital Input Module

1. Contact bounce filtering : Adjustable time constant of 15 m. sec.
2. Diagnostic : Module fault

d) Digital Output Module

1. Output protection : Short ckt. Proof & Individual fuse
2. Diagnostic : Module fault

e) Analog General

1. No. of channels / module : 8
2. Isolation : Galvanic/Optical

f) Hi-level Analog Input Module

1.	Type of input	:	4-20 mA DC / 1-5V DC
2.	A/D Converter	:	11 bits + Sign (or better)
3.	Accuracy	:	0.1% or better
4.	Diagnostic	:	Module fault
5	Powering of transmitter	:	24 V DC 2 W type

g) Low Level Analog Input Module

1.	Type of input	:	PT-100; T/C(As required)
2.	C-J-C	:	On Module
3.	Accuracy	:	0.1% or better
4.	A/D converter	:	15 bits + Sign (or better)
5.	Diagnostic	:	Module fault

h) Analog Output Module

1.	Type of output	:	4-20 mA DC
2.	Accuracy	:	+ 0.1% or better
4.	A/D Converter	:	11 bits + Sign (or better)
5.	Load	:	600 OHM
6.	Diagnostic	:	Module fault

5.00.00 **OPTICAL FIBRE CABLE**

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

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

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

5.04.00 Fiber optic cable shall be of loose tube design. Typically, fibers shall be housed in-groups of 6 (minimum) within gel-filled buffer tubes to protect against ingress of moisture and vibration. The tubes shall be manufactured with industry standard material like Poly-Butelene Terathylate (PBT). They shall be colored for easy identification. Buffer tubes shall be approachable with industry standard tools and practices. The buffer tubes shall be stranded around the Central Strength Member utilizing Reverse Oscillating Lay (ROL). Blank fillers shall be used as necessary to maintain circular cable structure. Cable shall withstand water penetration when tested with a one meter static head or equivalent continuous pressure applied at one end of a one meter length of filled cable for one hour. No water shall leak through the open cable end.

5.05.00 The central strength member of the cable shall be Fiberglass Reinforced Plastic (FRP) or other material with equivalent mechanical strength to provide both tensile and anti buckling strength to the cable.

5.06.00 In addition to central strength member, additional strengthening substance like aramid yarns shall be helically applied over the cable core to provide additional tensile strength to the cable.

5.07.00 The cable shall be of dual jacket & armoured. Inner sheath consists of a medium density polyethylene (MDPE) jacket extruded over the cable core. Two highly visible ripcords are placed under the jacket to aid in sheath removal. A co-polymer coated steel tape is corrugated and wrapped around the inner jacket to provide additional cable compression strength and rodent protection. The armor is covered with an outer black FRLS MDPE jacket. A ripcord is also placed underneath the armor for easy outer jacket removal.

5.08.00 Minimum bending radius shall be equal or more to 15 D. A continuous strength member shall be provided for the entire length of the cables. Every tube and fiber shall be colour coded to provide easy identification. The outer sheath shall be marked to show fiber type and cable classification at suitable intervals.

5.09.00 Entire length of the cable shall be marked with the following at regular intervals:

a) Manufacturer’s Name

b) Month and year of manufacturer

c) Coded description of the cable based on Telcordia’s (Bellcore) SR-2014 Suggested Optical Cable Code (SOCC).

d) Sheath Identification Number

e) Sequential Length Marking in meter

f) A Telephone Handset symbol to distinguish communication from power cable as per NESC section –35 G.

5.10.00 Fiber optic cable shall provide a long life expectancy of minimum 25 years and shall meet the industrial standard of continuous operation at temperature

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

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

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

5.12.00 Cable Assembly

5.13.00 Optical Fiber Environmental Splice Enclosure

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

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

5.14.00 Fiber Optic Distribution Patch Panel

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

5.15.00 Pigtail and Patch Cord

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

5.16.00 Fiber Optic Tool Kit

5.16.01 Optical Time Domain Reflectometer

a) A recording optical time domain reflectometer (OTDR) will be utilized to test for end-to-end continuity and attenuation of each optical fiber. The OTDR shall be equipped with data storage, printer, help feature, compare trace features and OTDR software. The data storage unit must include a built-in floppy disk drive capable of storing a minimum of 100 test traces.

b) Data traces saved to disk shall include the following labels:

- Fiber Identification (ID) with a minimum of 10 characters
- Cable ID with a minimum of 10 characters
- OTDR location with a minimum of 20 characters
- Far End location with a minimum of 20 characters
- Test Operator initials with a minimum of 3 characters

c) The printer shall preferably be internal. The printer shall be able to print data traces within 30 seconds or less. The machine settings used to repeat tests at a later time shall include: index, range, wavelength, average time,

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

d) The requirements for the compare trace feature include the ability to recall two historical traces from a diskette and display them simultaneously for analysis and printing. The compare trace must compute and display a single graph representing any differences between two traces. The compare trace must be able to recall historical traces from a diskette and perform the same tests on connected live fibers. The compare trace shall perform a two point loss measurement test for any two particular fibers in a comparison analysis. The losses between the two points on each fiber shall be displayed, and the differences between the two readings clearly shown.

e) The OTDR must be equipped with software to support all of the required functions. The software shall provide for printing of whole set of traces (batch print) with minimal commands eliminating the time spent for printing traces individually.

f) Contractor shall provide all mounting accessories, cables and connectors required to establish data communication.

5.16.02 Fiber Optic Splicer, Terminator And Tool Kit Box

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

5.16.03 Tests

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

a) Attenuation And Dispersion Characteristics Tests

b) Proof Tests

c) Macro-Bend Resistance Test

d) Mechanical Tests

e) Low And High Temperature Cable Bend Test

f) Impact Resistance Test

g) Compressive Strength Test

h) Tensile Strength Test

i) Cable Twist Test

j) Cable Cyclic Flexing Test

k) Environmental Characteristics Test

l) Temperature Cycling Test

m) Color Permanence Test Cable Aging Test

n) Water Penetration Test

o) Lightning Test

p) Routine Test / Sample Test

q) Site Test (Like Continuity & Attenuation)

PEM :: C&I

STANDARD QUALITY PLAN FOR PROGRAMMABLE LOGIC CONTROLLER

QUALITY PLAN NO.: **PE-QP-999-145-I036___**

VOLUME IIB

SECTION D

REV. NO. 01 DATE: 24.08.2007

SHEET 1 OF 8

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $			Remarks
									P	W	V	
1.0	**Materials /Components**											
1.1	Panels & Control Desks	Physical Inspection for Dimensions, Painting, Cutouts, Lifting / Locking Arrangements, Components, Drawing Pocket, Mounting accessories, Plinth & AV Pads, Cable Gland Plates, Hardwares, Hinges, Louvers & Filters, Fans & Panel Lamps	MA	Visual	100%	Contract specifications, Approved GA Drawings, BOQ	As per ref documents. No physical damage.	BHEL Quality Inspection Report.	3/2	2	1	
1.2	Power Supply/Packs, Battery & Battery charger, Transformer, UPS.	Physical Inspection Physical Damages Dimensions Mounting Accessories	MA	Visual	100%	Contract specifications, BOQ.	As per reference documents, Test Report	BHEL Quality Inspection Report.	3/2	2	1	
1.3	Indicating Lamp, Annunciator, Meters, Transducers, Signal Converters, Instruments, Single Loop Controllers	Physical Verification Physical Damages Dimensions Accessories	MA	Visual	100%	Contract specifications, BOQ.	As per ref documents No physical damage. Test/ Calibration report.	BHEL Quality Inspection Report	3/2	2	1	
1.4	PLC processors, I/O modules, Power Supply modules, Communication modules, Mounting Racks, Ethernet	Physical Inspection • Identification Labels • Physical Damages • Quantity • Spare Capacity	MA	Visual	100%	Product Catalogue, Data sheets, Approved Configuration diagram, BOQ	As per ref documents. Test Certificates	BHEL Quality Inspection Report.	3/2	2	1	

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

$ P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test.

1 - BHEL 2 - Vendor 3 - Sub-vendor

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

LEGEND: * CR - Critical characteristics; MA - Major characteristics; MI - Minor characteristics
$ P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test.
1 - BHEL 2 - Vendor 3 - Sub-vendor

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

LEGEND: * CR - Critical characteristics; MA - Major characteristics; MI - Minor characteristics
$ P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test.
1 - BHEL 2 - Vendor 3 - Sub-vendor

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $			Remarks
									P	W	V	
3.0	**Factory Acceptance Test (FAT)**											
3.1	Input Output Functional Verification	I/O configuration, I/O operation	MA	Visual/ Eletrical	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.2	Processor Verification	Processor configuration, Powering up, standby operation (as applicable) and Loading	MA	Visual	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.3	Power Supply Module Verification	Redundancy Operation	MA	Electrical	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.4	Communication System Verification	Redundancy operation of Communication System, Measurement of Response Time, Communication with third party system	MA	Electrical	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.5	Diagnostic Verification	Self Diagnostic features of PLC system	MA	Visual	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.6	Control Panel/Desk Verification	Operation of PLC driven annunciation system, Mosaic, Push buttons & selector switches, Indicating lamps	MA	Visual	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.7	Software Verification	(i) Control Logics (ii) Engineering Features (iii) HMI Features	MA	Visual	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	

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

$ P - Agency Performing the Test.
W - Agency Witnessing the Test.
V - Agency Verifying the Test.

1 - BHEL
2 - Vendor
3 - Sub-vendor

FACTORY ACCEPTANCE TEST (FAT) PROCEDURE

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

a) Technical Specification of PLC.

b) PLC System Configuration

c) General Assembly Drawings.

d) Panel Wiring Diagrams.

e) Bill of Quantity for PLC System.

f) Logic Diagram.

g) HMI Schematics.

h) Input / Output List.

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

APPLICABLE TEST PROCEDURE:

1. Input/Output Functional Verification.

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

2. Processor Verification

PLC Configuration drawing to be referred for ascertaining

i) Redundancy

ii) Type (Hot or Cold)

Both the processors are to be checked for healthiness in case of redundant configuration as per vendor's standard practice. In case of hot redundancy, switchover of control from primary processor to standby processor shall be demonstrated for uninterrupted control and data processing as per vendor's standard practice. Switchover shall be witnessed, by manual power off or resetting the Primary CPU or simulating failure of primary processor. Checking should be by witnessing the lighting up of Processor's LEDs as per manufacturer's product standard.
Vendor shall demonstrate, as per Vendor's standard practice, adequate Loading (Spare Capacity) of Processors, as mentioned in contract specs. This shall be done, by simulating worst load operation of fully integrated PLC system.

3. Power Supply Module Verification

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

4. Communication System Verification

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

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

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

5. Diagnostic Verification

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

6. Control Panel /Desk Verification

i) PLC driven annunciation system should be checked by alarm signal simulation.

ii) Push Button and selector switch operation should be checked by verification of corresponding change of status of Data Base point.

iii) Indicating lamp / MIMIC should be checked by corresponding Data Base point simulation.

7. Software Verification

i). Control Logics:– Software switches, lamps and Analog sources shall be used for simulation of field conditions .Control logics shall be checked for its correct functionality as per approved logic schemes

ii). Engineering features:-
a) Online changing of parameters, set points.
b) Online modification in Control Logic Diagrams.
c) Online configuration of Graphics, Trends, Logs, HSR.

iii). HMI features:-
Check for configuration & operation of Graphics, Trends, Logs, HSR and Alarms, in the form of Displays and Printouts, by simulation of Inputs as per approved documents.

8. Burn in Elevated Temperature test

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

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

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

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

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

A Device Specific :

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

B Electrical Spcific :

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

C Application Specific : *

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

D Hardware Specific :

1	Cable type	☐ Boolean cable	☐ Twisted pair cable	
2	Cable Details Enclosed	☐ Yes ☐ No		
3	Any specific Converter required	☐ Yes ☐ No	☐ Details enclosed	

E Device Documents :

1	Manufacturer's Documents*	☐ Tech., Spec.	☐ Operating Manual	

***Notes:**

A6 To identify converter requirement and cable length.

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

C1 What is the primary purpose of the communications link?

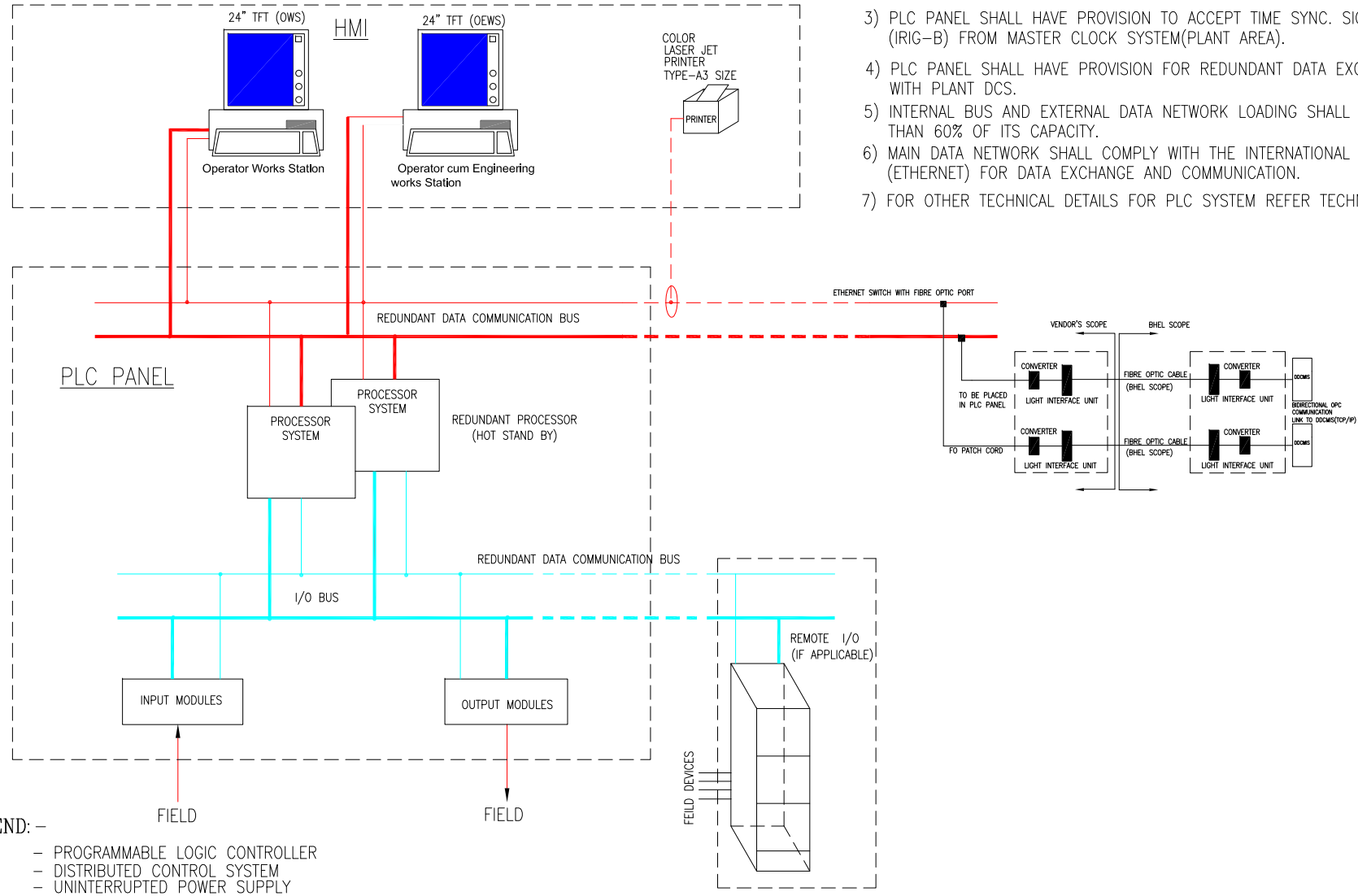
E1 Reqd. Contents : This document must provide an overview of the device including its intended use(a general technical,communication & electrical details)

Format for vendor to furnish signal
Exchange list between DCS-PLC

Tag Name	Tag Description	Modbus address	Point type	Range	Alarm Setpoint	Alarm priority	History reqd	Function code	

NOTES:

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



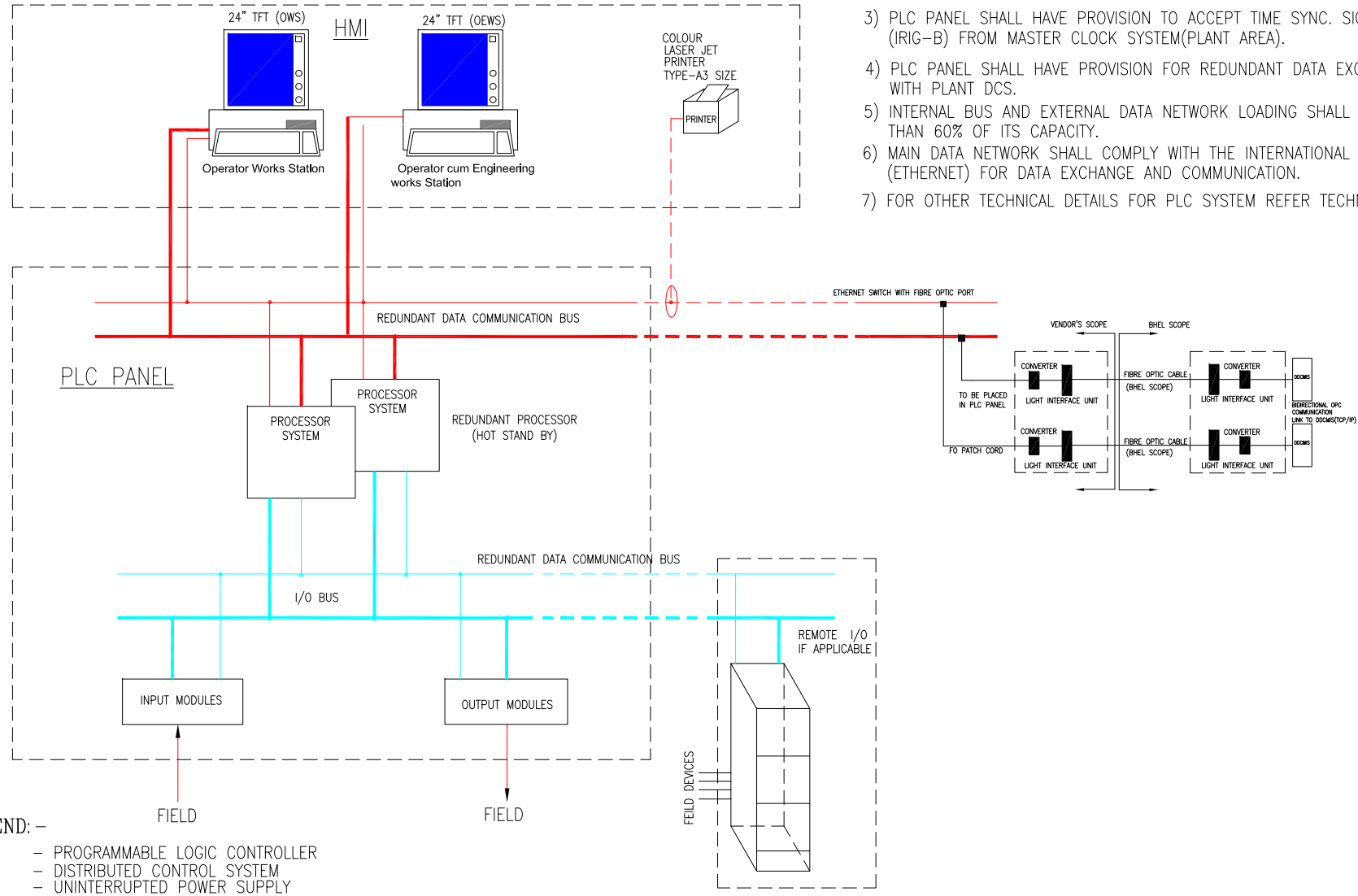
LEGEND: –

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

	PLC SYSTEM CONFIGURATION RW CHLORINATION	DRG. NO.	
		REV. No.	DATE
		SHEET	0 OF 01

NOTES:

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

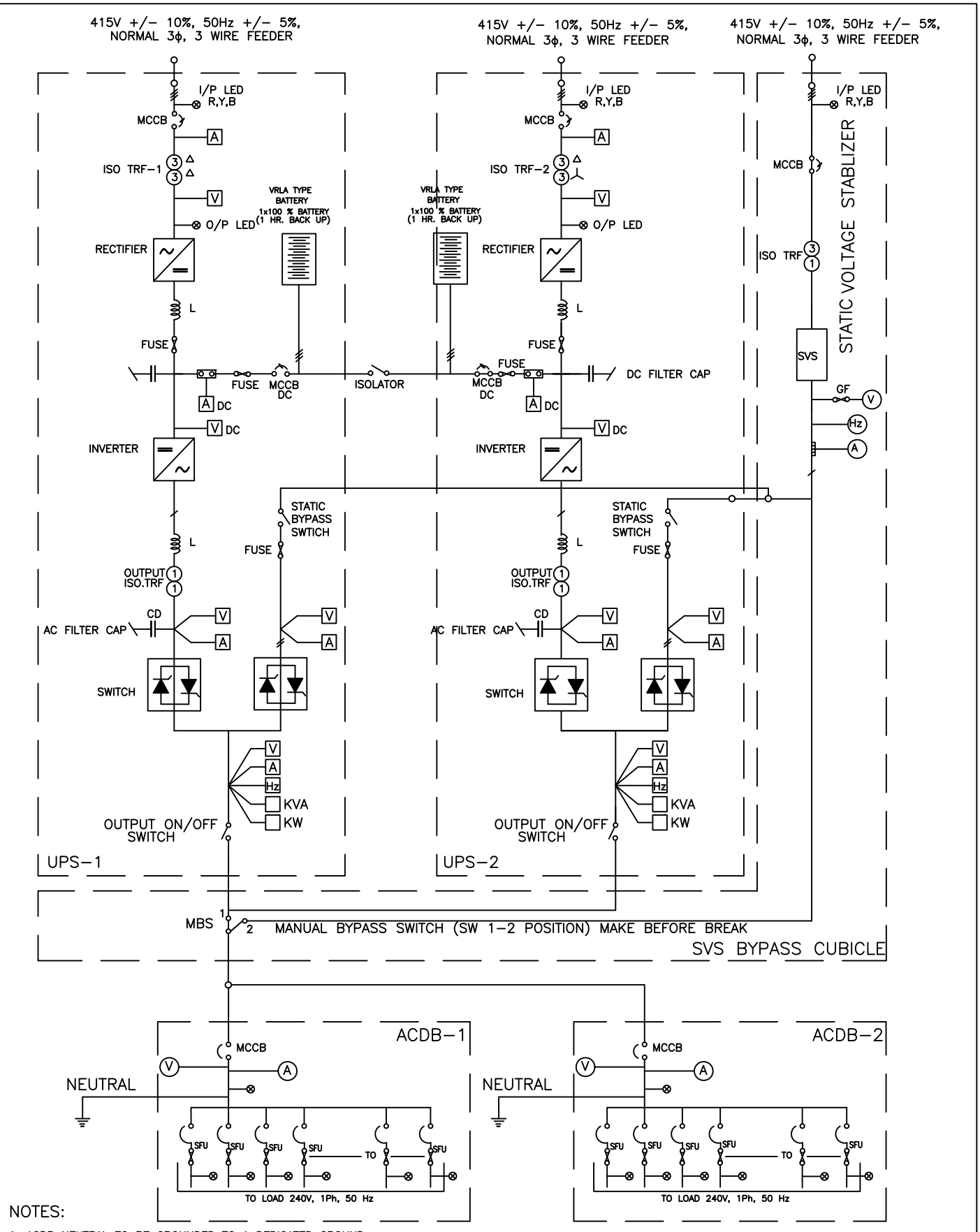


LEGEND: –

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

	PLC SYSTEM CONFIGURATION CW CHLORINATION	DRG. NO.	
		REV. No.	DATE
		SHEET	0 OF 01

UPS SPECIFICATION



NOTES:

1. ACDB NEUTRAL TO BE GROUNDED TO A DEDICATED GROUND.
2. ALL OUTPUT FEEDERS OF ACDB SHALL BE PROVIDED WITH AN LED AFTER THE FUSE FOR FEEDER ON INDICATION WITH FEEDER DESCRIPTION.
3. PLC BASED SYSTEM WHICH ARE LOCATED IN TG BUILDING SHALL BE POWERED FROM MAIN PLANT UPS.

BHEL		DRG. No.			
TITLE:- UPS SCHEME		REV. No.		DATE	
		SHEET			

CONTENT

ATTACHMENTS

SECTION-XIV

TECHNICAL SPECIFICATION FOR UNINTERRUPTIBLE POWER SUPPLY

1.00.00 SCOPE OF WORK

1.01.00 Scope of Supply

The scope of supply shall include Uninterruptible Power Supply (UPS) Systems with parallel redundant arrangement as specified below.

i) Each set of UPS system will consist of :

a. 2x100% capacity static inverter & input isolation transformer

b. 100 % capacity static switches (2 nos.)

c. One manual bypass switch

d. 2x100% capacity float-cum-boost chargers

e. 2x100% capacity UPS system battery (VRLA Type) with back up time of 1 hour

f. One step down transformer; (415 V three phase to 240 V single phase) for bypass

g. One static voltage regulator

h. Two AC distribution boards (ACDB-1A and ACDB-1B)

i. Interconnecting cable between UPS Equipment, battery and ACDB.

j. Two (2) nos. input output isolation transformer

Any other equipment necessary for complete of the system

ii) One (1) set of special tools and tackle.

iii) Mandatory Spare parts.

iv) List of recommended spare parts for three (3) years satisfactory and trouble-free operation of the equipment.

v) All relevant drawings, data and instruction manuals.

2.00.00 CODES AND STANDARDS

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

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

c) The electrical installation shall meet the requirements of Indian Electricity Rules as amended up to date and relevant IS Codes of Practice. In addition, other rules or regulations applicable to the work shall be followed.

3.00.00 DESIGN CRITERIA

3.01.00 Design Basis

a) UPS System provides a regulated and uninterrupted single phase A.C. power, within specified tolerances, to critical station loads during normal and emergency operation. Capacity of inverter output shall be computed by the contractor considering the above requirement. 25% spare margin shall be kept on the total of above requirement.

b) The UPS system excluding its battery shall be installed indoors in A.C. environment.

c) UPS shall be worked at its full capacity even battery is not connected with the system.

d) UPS system shall be compatible for satisfactory and well-coordinated operation with other related equipment as well as with input and output systems.

e) Energizing or de-energizing any portion of the system serviced by the UPS shall not cause output changes which will affect the operation or integrity of the remaining portions of the system in any way.

f) The equipment shall be self-protecting against all A.C. and D.C. transients, voltage surges and steady state abnormal voltages and currents.

g) The circuit protection shall be coordinated with UPS short circuit capacity and protective device characteristics so that a fault on any circuit shall result in minimum loss of function.

h) All non-interrupting components of UPS system shall be capable of withstanding the prevailing short circuit current without damage.

i) All circuit interrupting components shall be capable of withstanding and interrupting the prevailing short circuit currents without damage.

j) The procedure for battery sizing calculation shall be generally as per IS 15549, considering design margin as 15% and aging factor as 1.25

k) For continuous operation at specified ratings, temperature rise of the various components of UPS system shall be limited to the permissible values stipulated in the relevant standards and/or this specification.

l) The chargers, inverters, static switches, regulating transformers and voltage stabilizers should be arranged in such a way that any equipment can be fully isolated for maintenance without affecting in any way the operation of other panels/components.

m) The chargers, inverters, static switches, regulating transformers and voltage stabilizers should be arranged in such a way that any equipment will be fully isolated for maintenance without affecting in any way the operation of other panels/ components.

n) In the A.C. Distribution Board, the Bidder shall provide 10% or minimum one (1) no. spare feeder of each size and type of the outgoing feeders.

3.02.00 **System Concept**

A D.C. power source and an A.C. power source are available to the UPS system. The system is so designed that its load shall be served without interruption as long as one of the above power sources is available within specified limit of voltage and/or frequency.

Two inverters, each of 100% capacity will normally work, each sharing 50% UPS load. On failure of any inverter, its load gets automatically transferred to the other inverter through static transfer switch.

If one inverter is out of service for any reason then the second inverter will be working with 100% UPS load. On failure of this inverter the standby A.C. source will back up to supply the 100% UPS load automatically through static transfer switch.

3.03.00 **Layout Criteria**

The UPS system will be located indoor.

The Contractor shall indicate the space requirement for the equipment offered by them separately for UPS cabinet, UPS battery and UPS distribution board.

Battery room ventilation shall be under the scope of the Contractor.

4.00.00 **SPECIFIC REQUIREMENTS**

4.01.00 **Static Inverter**

a) The static inverters shall be static type consisting of IGBT PWM type inverter, static filters, integrated control modules including necessary oscillators, voltage regulators, current limiting and surge suppression.

b) The inverter equipment shall include all necessary circuitry and devices to conform requirements like voltage regulation, soft start, transient recovery, protection, automatic synchronisation, wave shaping, etc. as specified herein.

c) Upon transfer of full load, the inverter output voltage shall not drop below 80% of nominal voltage during the first half cycle after transfer and 90% of nominal voltage in the next half cycle. The recovery to within ± 2% of voltage shall be in less than 50 milli-seconds.

d) On occurrence of a fault in branch circuit, the inverter shall be capable of clearing the highest rated branch circuit fuse in 4 milli-seconds or less.

e) The inverter shall be protected against overload, short circuit, 100% loss of load, as well as excursions, loss or restoration of D.C. input voltage and synchronising voltage. The overload capacity shall be 125% for 10 mins., 150% for 60 secs. and 300% for 4 msecs.

f) The D.C. input current shall never exceed twice the full load current except for a short circuit within the inverter.

g) For any value of the load and load power factor drawn by the equipment served, the inverter shall not impose on D.C. source any voltage oscillations in excess of 5 volts (RMS total all frequencies) or any current oscillations in excess of 3 percent (RMS total all frequencies) of the D.C. current at full load.

h) The inverter will be self protecting against A.C. and D.C. Transients, voltage surges and steady state abnormal voltage and currents likely to be encountered in the plant.

4.02.00 **Automatic Synchronisation**

a) Inverter equipment shall include stable solid state oscillator devices designed to automatically maintain the inverter output in phase and in synchronism with the stand-by A.C. source.

b) Facility shall be provided for automatic transfer to internal oscillator operation when the stand-by source frequency is beyond specified limits and the frequency shall be automatically controlled within 50 Hz plus or minus 0.5 Hz when the inverter operates in this mode.

c) Retransfer to stand-by A.C. source for synchronisation shall be automatic after the stand-by source frequency is restored to permissible limits and remains within this limit for an adjustable time delay period (up to 5 seconds).

d) Provision shall be made for stepless adjustment of synch- disconnect frequency range from 50 Hz ± 0.5 Hz to 50 Hz ± 2 Hz.

e) Automatic adjustment of phase relationship between inverter output and stand-by A.C. source shall be gradual at a controlled slow rate, which shall not exceed one hertz per second.

4.03.00 **Static Transfer Switch**

a) The static transfer switch shall be solid-state type using SCR for automatic/manual transfer of load from "inverter" to "stand-by" source and vice-versa.

b) Stand-by source can be either of the inverter or A.C. source depending on whether both the inverters are supplying 50% load each or one of the inverter is carrying 100% load.

c) The transfer time including sensing shall not be more than one-fourth cycle. Further the transition shall be make-before-break in both directions.

d) The capacity of static transfer switch shall be equal to the continuous full-load capacity of the inverter. The switch shall be provided with protective devices in both normal and alternate power source.

e) Static transfer switch shall be furnished with contact to alarm failure of the alternate source or opening of any fuse protecting the static switch.

f) Static transfer switch shall include all necessary circuitry and devices to meet the functional requirements of transfer initiation, transfer inhibit and re-transfer back to normal as detailed below

g) Transfer Initiation

i) The transfer of static switch from normal 'Inverter' position to 'stand-by' position shall be initiated by one of the following causes.

- Inverter failure and UPS system trouble
- Inverter output voltage failure.
- Manual push button operation

ii) The UPS bus shall be monitored by two voltage detectors. One fast acting circuit shall be used for detecting a complete and instantaneous voltage loss while the other slower acting averaging circuit with adjustable trip level shall be employed to detect voltage deviation beyond selected limits. Both voltage detector circuits shall automatically initiate operation of transfer switch.

iii) The static switch shall automatic transfer the load from inverter to stand-by source when the maximum I^2t capability of the inverter is reached and when the inverter output drops below 90%.

h) Transfer Inhibit

Automatic or manual transfer from inverter to stand-by A.C. source vice versa shall be inhibited when the inverter frequency is not synchronised to the alternate source.

i) Retransfer to Normal

1) The return to inverter mode shall be manual in all cases.

2) Manual transfer shall be initiated by push button actuation.

4.04.00 **Manual By-pass Switch**

a) Manual by-pass switch is used to isolate any static transfer switch for maintenance or repair without interruption to the UPS load.

b) The switch has also the facility of by-passing both the static transfer switches during start-up at the option of the operator.

c) Switch contact shall be make-before-break type.

d) The switch shall have current rating equal to the full load inverter current and necessary short time load carrying and interrupting capacity to meet the requirement of UPS system.

4.05.00 **Battery**

a) General

i. Each set of battery shall consist of number of cells assembled together on mounting racks.

ii. The battery shall be Valve Regulated Lead Acid (VRLA) maintenance free batteries. Each battery set will have sufficient capacity to maintain output at full rated load. The battery in normal case is not allowed to discharge beyond 80% of rated capacity at 10 hrs rate of discharge.

iii) The battery sets will meet the requirement of IS 15549 and will be suitable for continuous operation. The batteries will be suitable for float /boost charging

b) Constructional Requirement

The design of battery will be as per field proven practices. Partial plating of cells is not permitted. Paralleling of cells externally for enhancement of capacity will not be permitted. Protective transparent front covers with each module will be provided to prevent accidentally contact with lie module / electrical connections.

c) Container

Each cell will be assembled in heat resistant, acid resistant, shock absorbing robust, clear glass or lead lined wooden container having chemical and electro-chemical compatibility. The material will meet all the requirements of VRLA batteries and be consistent with the life of the battery. The container will be fire retardant. The porosity of the container will be such as not to allow any gases to escape except from the regulation valve. The tensile strength of the material of the container will be such as to handle the internal cell pressure of the cells in the worst working conditions. The container will be capable of withstanding the rigours of transport, storage and handling.

d) Cell covers

The cell covers will be made of suitable compatible with the container material and permanently fixed with the container it will be fire retardant. Fixing of Pressure Regulated Valve terminal posts in the cover will be such that the seepage of electrolyte gas escapes and entry of electro static spark are prevented.

e) Plates

Positive grid will be of pure lead calcium tin alloys and maintenance free characteristics. Positive plate will be free from cadmium. The positive & negative plates will be flat pasted.

Both positive & negative plates will be tanked formed to ensure that plates are fully formed.

f) Grid Growth Provision

This Provision should be made in the cell design to prevent failure due to internal shorting / rupture of cell because of grid growth.

g) Separators

The separators cells will be glass mat or synthetic material having high acid absorption capability, resistant to Sulphuric acid and good insulating properties. Proper arrangement to keep the separator plates in position will be furnished.

h) Pressure Regulating Valve

Each cell will be provided with a pressure-regulating valve. The valves will be self re-sealable and flame retardant. The valve unit will be such that it cannot be opened without a proper tool. The valve will be capable to withstand the internal cell pressure specified by the manufacturer.

i) Terminal posts

Both the positive and the negative terminals of the cells will be capable of proper termination and will ensure its consistency with the life of the battery. The surface of the terminal post extending above the cell cover including bolthole will be coated with an acid resistant and corrosion and retarding material. Terminal posts of any other metal part, which is in contact with the electrolyte, will be made of same alloy as that of the plates or of a proven material that does not have any harmful effects on cell performance. Both positive and negative posts will be clearly and unambiguously identifiable.

j) Connectors, Nuts, Bolts, Heat Shrinkable Sleeves

Nuts and bolts for connecting the cells will be made of copper, brass or stainless steel. Copper or brass nuts and bolts will be lead coated.

Wherever required separate non-corroding lead or copper connectors of suitable size will be provided to enable connection of the cells. Copper connections will be suitable lead coated to withstand corrosion due to Sulphuric acid.

All inter cell connectors will be protected with heat shrinkable silicon sleeves for reducing environmental impact including a corrosive environment.

k) Flame Arrestors

Each cell will be equipped with a Flame Arrestor to defuse the Hydrogen gas escaped during charge and discharge.

l) Battery Bank Stand and cell orientation

All batteries will be mounted in a suitable metallic trays / frame. Cells will be housed in a ventilated & protected modular steel tray to facilitate airflow between the cells. The partitions will have grooves to facilitate airflow. The steel tray will have partitions for each cell to maintain consistent compression & single cell replacement. The steel trays will be powder coated for acid resistance. The Cell orientation in the steel trays will be horizontal (i.e. the positive & negative plates should be parallel to ground.

m) Capacity requirements

The battery will be capable to deliver the rated load of the UPS for 60 minutes.

When the battery is discharged at 10 hours rate, it will deliver 80% of rated capacity corrected at 27^{o}C before any of the cells in the battery bank reaches 1.85 V / Cell.

4.06.00 **Float-cum-Boost Charger**

4.06.01 The charger shall be solid-state type with full wave fully controlled, bridge configurations. It shall be suitable for the inverter of IGBT type.

4.06.02 The charger shall be provided with automatic voltage regulation, current limiting, smoothing filter circuit and soft-start feature.

4.06.03 The charger shall have the provision of float, equalizing and boost charging. Further the charger shall be suitable for single and parallel operation.

4.06.04 Suitable circuitry shall be provided to ensure that the charging current is voltage regulated and current limited.

4.06.05 Each charger shall be rated to meet 100% UPS load plus recharge the fully discharged UPS battery within 8 hours.

4.06.06 Voltage control shall be stepless smooth and continuous. Float & equalizing control shall have an adjustable range of ± 5%.

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

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

a) A three phase to single phase transformer along with associated voltage stabilizer shall be furnished with the UPS system.

b) The transformer and stabilizer shall be sized for 100% UPS load and shall coordinate with the largest branch circuit protection device for feeder short circuit current without sacrificing voltage regulation.

c) The voltage stabilizer shall employ silicon solid state circuitry and shall maintain the specified output voltage for 0 to 100% load with maximum input voltage variation as indicated in the annexure.

d) Provision shall be kept for dead closing of static transfer switch from stabilizer circuit to inverter when the output of the stabilizer is zero, but at that time the inverters are running.

4.08.00 **A.C. Distribution Boards**

a) The distribution boards shall be fixed type, of modular design in freestanding gasketted sheet steel enclosure conforming to IP-52. Sheet steel thickness shall be 2 mm minimum for load bearing members and 1.6mm for non-load bearing members.

b) Each module shall be housed in a separate compartment complete with individual front access door. Working height shall be limited to 1800 mm from floor level.

c) A full height vertical cable alley shall be provided in each panel to facilitate module wiring. The alley shall be liberally sized and shall have removable cover at the front. Removable back covers shall be provided at the back of the panels.

d) Incomer shall be provided with Moulded Case Circuit Breaker (MCCB) and outgoing feeders shall be provided with Switch-fuse units.

MCCB shall be suitable to make & break rated short-circuit current (25kA minimum) having in-built short circuit & over-load (adjustable type) protections.

e) Switches shall be double pole, air break, heavy duty (AC 22) type, capable of safely making and breaking the full load current of associate circuit.

f) Switch handle shall have position indicator and provision of padlocking in ON & OFF positions. Further it shall be interlocked with access door for safety.

g) Fuses shall be HRC, preferably link type, design to permit easy & safe replacement. Visible indication shall be provided for indication of fuse.

h) Incomer feeder shall be provided with Ammeter, Voltmeter, Power factor meter & bus energizes indicating lamp with fuse and outgoing feeders with feeder energizes indicating lamp with fuse.

i) All indicating meters are 96 mm sq. digital type with LED display and all indicating lamps are clustered LED type so that lamp can be replaceable from front of the panel.

4.09.00 **UPS Cabinets/Enclosures**

a) The UPS system components shall be housed in a sheet steel freestanding IP-42 enclosure with all access from the front. Sheet steel thickness shall be 2 mm minimum.

b) The enclosure shall consist of vertical cabinets housing modules in rack type sub-assemblies, connected mechanically and electrically to form a rigid, self-supporting, metal enclosed structure.

c) The modular units shall be mounted in pull out and/or swing trays. Each module shall be capable of being easily removed to provide for the ready inspection of major solid-state devices.

d) Vertical wiring trough shall be provided for the entire height of the UPS cabinet. Cable entry shall be from bottom only.

e) Adequate ventilating louvers and screens shall be provided. The top of the panel shall be protected by a suitable drip cover to prevent entrance of falling liquid and foreign material.

f) If the equipment supplied requires forced air cooling, the cooling system furnished shall meet the following requirement :

   i) Two (2) nos. 100% cooling fans shall be provided for each vertical panel.

   ii) Completely independent duplicate protection, control and wiring systems shall be provided for the cooling fans for redundancy.

   iii) The cooling fans shall be powered from the output of the associated inverter. Normally one fan will be running while the other is on stand-by.

   iv) Each cooling fan shall be equipped with an airflow switch having an alarm contact that closes upon failure of airflow.

4.10.00 **Alarms**

a) Solid state audio-visual annunciation system shall be provided for inverters, static transfer switch, battery charger.

b) Alarm facia shall be provided on each charger and inverter panel, complete with proper actuating devices, circuitry and legends.

c) The arrangement shall be such that on occurrence of a fault the corresponding window will light up and stays lighted until the fault is cleared and reset button pressed.

d) Each time a window lights up a master relay will get energized to provide group alarm signals for remote DCS alarm system.

e) The requirements of indication/metering/alarms are given in the annexure.

f) Alarm contacts shall be rated 0.5 A at 220 V DC and 5A at 240 V A.C.

g) All indicating meter shall be digital type with in-built transducers (4-20mA) for hooking up with DCS.

4.11.00 **Lamp / Space Heaters / Receptacles**

a) The panels shall be provided with :

i) Internal illumination lamp with door switch.

ii) Space heater with thermostat control.

iii) 3-pin 6A receptacle with plug.

b) Lamp, heater and receptacle circuits shall have individual switch fuse units.

4.12.00 **Wiring / Cabling**

a) The panels shall be completely wired up. All wiring shall be done with flexible, 1100V grade, fire resistance PVC insulated wires with stranded 2.5 Sq.mm. copper conductors and routed through wiring troughs. Each wire shall be ferruled by plastic tube with indelible ink print at both end having terminal block No., terminal number as per approved wiring diagram.

b) Panels shall have removable gland plate for cable entry. All incoming/ outgoing cables shall be terminated in suitable terminal block.

c) Control terminal blocks shall be box-clamp type, minimum 10 Sq.mm. 20% spare terminals shall be furnished.

4.13.00 **Nameplate**

a) Engraved nameplates shall be provided for each panel and for each equipment/device mounted on it.

b) The material shall be anodised aluminium / lamicoid, 3 mm thick, with white letters on black background.

c) Nameplates shall be held by self-tapping screws. The size of nameplates shall be approximately 20 mm x 75 mm for equipment and 40 mm x 150 mm for panels.

d) Nameplates for panels shall be provided both on the front and rear.

e) Control and meter selection switches shall have integral nameplates. Nameplates for all other devices shall be located below the respective devices.

f) Instruments and devices mounted on the face of the panels shall also be identified on the rear with the instrument/device number. The number may be painted on or adjacent to the instrument or device case.

g) Caution notice on suitable metal plate shall be affixed at the back of each panel.

4.14.00 **Grounding**

a) Normal 3-phase A.C power supply will be grounded at the source. For grounding other than this, isolation transformer shall be furnished with the U.P.S.

b) The inverter D.C. input and A.C. output shall be electrically isolated from each other and from cabinet ground.

c) Panels shall have fully rated ground bus with two ground terminals, one at each end.

d) Each terminal shall comprise two-bolt drilling M10 G.I. bolts and nuts to receive ground connection of 50 x 6 mm G.S. flat.

e) Separate electronic grounding shall be provided for each UPS system.

4.15.00 **Tropical protection**

a) All equipment accessories and wiring shall have fungus protection, involving special treatment of insulation and metal against fungus insects and corrosion.

b) Screens of corrosion resistant material shall be furnished on all ventilating louvers to prevent the entrance of insects.

4.16.00 **Painting**

a) The panels shall be finished in light grey shade (RAL 7032) two coats of synthetic enamel paint. The panels shall have a matt finish to prevent any glare from surface due to illumination.

5.00.00 **TESTS**

5.01.00 **Shop Tests**

5.01.01 Type and routine test for various components

5.01.02 Functional tests to demonstrate compliance with all specified requirements and published specifications such as frequency regulation, voltage regulation,

current limiting, fuse clearing capability of inverters, demonstration of phase and frequency control of inverter for synchronisation with range of adjustments, transfer and re-transfer of static switches under influence of under voltage and over current, tests on chargers, batteries and other system component to confirm compliance with specification.

5.01.03 All equipment provided under the specification shall be operated under rated conditions and maximum ambient temperature for not less than 120 hours prior to release of shipment.

In addition static switches shall be subjected to not less than 1000 transfer/re-transfer cycles at full load.

5.02.00 **Test Witness**

Tests shall be performed with presence of Owner's representative if so desired by the Owner. The Contractor shall give at least thrity (30) days' advance notice of the date when the tests are to be carried out.

5.03.00 **Test Certificates**

5.03.01 Certified reports of all the tests carried out at the works shall be furnished in six (6) copies for approval of the Owner.

5.03.02 The equipment shall be despatched from works only after receipt of Owner's written approval of the test reports.

5.03.03 Type test certificates on any equipment, if so desired by the Owner, shall be furnished. Otherwise the equipment shall have to be type tested, free of charge, to prove the design.

6.00.00 **DRAWINGS, DATA & MANUALS**

6.01.00 **To be submitted with the Bid**

6.01.01 UPS panels, Battery Charger and Battery layout drawing with dimensions

6.01.02 General Arrangement drawing of UPS panels

6.01.03 Bill of Material

6.01.04 Schematic drawing of UPS circuits

6.01.05 Battery cell voltage characteristics and data for different discharge rates

6.01.06 Technical leaflets on :

a) UPS System

b) Battery

c) Battery charger

d) Inverter

e) Static Switch

f) Manual bypass Switch

6.01.07 Duty cycle diagram and battery sizing calculation in the format of relevant IS Standard

6.01.08 Sizing calculation of UPS system, charger main equipment, viz. SCRs, rectifier transformers etc

6.01.09 Type test certificates for similar equipment.

6.02.00 **To be submitted after Award of Contract**

6.02.01 Dimensional UPS, battery layout diagram in plan & section.

6.02.02 Connection details of take-off terminals.

6.02.03 Dimensional general arrangement drawings of UPS, battery charger, battery clearly showing device dispositions, cable entry, space requirement, etc.

6.02.04 Sectional views of UPS System panels

6.02.05 Panel foundation plan and loading

6.02.06 UPS system schematics and wiring diagrams

6.02.07 Test reports

6.02.08 Detailed bill of materials

6.02.09 Any other relevant drawing or data necessary for satisfactory installation, operation, and maintenance.

5.02.10 Cable schedule & Inter-connection charts.

6.02.11 Instruction manuals of UPS system

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

6.03.00 The Tenderers may note that the drawings, data and manuals listed above are minimum requirement only. Tenderers shall ensure that all other necessary write-ups, curves and information required to fully describe the equipment offered are submitted with their bids.

ANNEXURE-A

RATINGS & REQUIREMENTS

1.00.00	STATIC INVERTER		
1.01.00	Application	:	UPS System for MMI, SWAS and CEMS etc.
1.02.00	Type	:	static IGBT PWM type
1.03.00	Duty	:	Continuous
1.04.00	Enclosure	:	Sheet steel, IP42
1.05.00	Cooling	:	Natural convection or forced cooling using redundant fans.
1.06.00	Design Ambient temperature	:	50 Deg.C
1.07.00	Inverter capacity	:	To be decided by the Bidder
1.08.00	Overload capacity	:	300% for 4 m secs. 150% for 60 secs 125% for 10 mins 110% for continuous
1.09.00	Voltage		
	a) Inverter input, Battery output	:	To be decided by the Bidder
	b) Nominal output	:	240 V, 50 Hz, 1-phase
1.10.00	Voltage Regulation :		
	a) Steady state (0-100% load at all input voltages and all power factors)	:	$\pm$ 1.5%
	b) Transient voltage (On application or removal of 100% load)	:	$\pm$ 10%
	c) Time to recover from transient to normal voltage	:	50 milliseconds.
1.11.00	Wave form :		
	a) Nominal frequency	:	50 Hz

	b) Frequency range for all conditions of input supplies, loads & temperature occurring simultaneous or in any combination (automatically controlled)	:	± 0.05 Hz.
	c) Synchronisation limits (for maintenance of synchronism between inverter and standby A.C source)	:	49 Hz to 51 Hz (factory set)
	d) Field adjustment range for (c) above	:	50± 0.05 Hz to 50± 2 Hz
	e) Total Harmonic Content	:	5% maximum at rated load
	f) Harmonic content for any single harmonic	:	3% maximum
1.12.00	Rated output current at rated output voltage with current limit not operating		
	a) Current	:	200%
	b) Duration	:	100 milliseconds.
1.13.00	Efficiency at full load (Watt output/watt input)	:	90% or better.
1.14.00	SCR derating from peak voltage and peak rating	:	50%
2.00.00	STATIC SWITCH		
2.01.00	Type	:	Solid-state, SCR
2.02.00	Duty	:	Continuous
2.03.00	Enclosure	:	Sheet Steel, IP42
2.04.00	Cooling	:	Natural convection or forced cooling using redundant fans.
2.05.00	Ambient Temperature	:	50 Deg.C
2.06.00	Capacity		
	a) Continuous	:	Equal to full load capacity of the inverter.
	b) Overload	:	300% for 4 m secs. 150% for 60 secs 125% for 10 mins 110% for continuous

	c) Peak	:	1000% of continuous rating for 5 cycle.
2.07.00	Normal Voltage	:	240V, 50 Hz, 1-phase.
2.08.00	Transient Voltage Tolerance	:	340V peak above the nominal line voltage.
2.09.00	Transfer Time	:	less than 4 m secs.
3.00.00	MANUAL BY-PASS SWITCH/BREAKER		
3.01.00	Type	:	Maintained, make before break.
3.02.00	Voltage	:	600V
3.03.00	Rated Current	:	To meet the requirement as specified in clause no.: 3.04.00 d)
4.00.00	BATTERY		
4.01.00	Application	:	UPS Battery
4.02.00	Design Ambient Temperature	:	50 Deg.C
4.03.00	Type	:	VRLA type
4.04.00	Nos. of Cells per Battery	:	To be decided by the Bidder
4.05.00	Battery nominal voltage	:	To be decided by the Bidder
4.06.00	Battery AH rating	:	Bidder to compute considering 100% UPS load for 1 hour.
4.07.00	Method of working		
	a) Float charge (Normal)	:	2.23 Volts / Cell
	b) Boost charge (After complete discharge)	:	2.30 Volts / Cell
4.08.00	Mounting	:	Steel Rack
4.09.00	Connection	:	Cables
5.00.00	BATTERY CHARGER		
5.01.00	Charger	:	Float + Boost
5.02.00	Type	:	Solid-state, full wave, fully controlled.
5.03.00	Duty	:	Continuous
5.04.00	Enclosure	:	Sheet Steel, IP42

5.05.00	Cooling	:	Natural convection or forced cooling using redundant fans.
5.06.00	Design Ambient Temperature	:	50 Deg.C
5.07.00	A.C. input :		
	a) Supply	:	415V, 3-phase, 50 Hz
	b) Voltage variation	:	±10%
	c) Frequency variation	:	± 5%
	d) Combined volt frequency variation	:	10% (absolute sum)
	e) Short-circuit level	:	50 KA
	f) System earthing	:	Solidly grounded
5.08.00	D.C. output	:	100% UPS load plus restoring fully discharged battery to full charge condition in 8 hours.
5.09.00	Blocking Diode, Peak inverse voltage	:	800 V (minimum)

5.10.00 Performance Requirement

a) The output voltage of the charger shall be regulated within ± 1% of the set value for any load variation from 0 to 100% and A.C input voltage and frequency variation as indicated above in 4.06.00

b) The ripple content in charger D.C. output shall be limited to less than ± 1% with battery and less than ± 2% without battery.

6.00.00 DISTRIBUTION BOARDS

6.01.00	Type	:	Fixed, Modular construction.
6.02.00	Enclosure	:	Sheet Steel, IP52
6.03.00	Mounting	:	Free standing (can be attended from both front & back)

ANNEXURE-B

SET OF ACCESSORIES TO BE PROVIDED FOR EACH BATTERY BANK

a) One battery log book.

b) Two copies of printed instruction sheet.

c) One no. cell testing voltmeter (3-0-3 volts) complete with leads.

d) One no. rubber syringe type hydrometer suitable for specific gravity reading.

e) Three nos. pocket thermometer.

f) One no. thermometer (0 to 100°) with specific gravity correction scale.

g) One set cell bridging connector.

h) Battery racks suitable for accommodating the cells coated with paint.

i) Delrin insulator (with 5% extra), rubber pad etc. for rack.

j) Two nos. plastic filling bottle for filling up.

k) One pair of spanners.

l) Two pairs of rubber hand gloves.

m) Two nos. cell lifting straps.

n) One set of inter cell, inter tie and inter bank connectors as required for complete installation.

o) Apron.

p) Goggles.

q) 'No Smoking' Notice Board

NOTE: Any other accessories if required for satisfactory operation of the complete battery system shall also be included under the Scope of Contractor without any price implication.

CONTROL PANELS SPECIFICATION

7.12.00 Panels, Cubicles and Enclosures

7.12.01 General

a) All panels, cubicles and enclosures shall be furnished complete with integral piping, internal wiring, convenience outlets, internal lighting, grounding, ventilation, space heating, vibration isolating pads and other accessories.

b) Unless otherwise specified cable entry for panels / desks / cabinets shall be through bottom via glanding plate. Fireproof seal shall be used to seal the bottom to prevent entry of dust.

c) Panels and cabinets shall be constructed from steel sheet reinforced as required to provide true surface and adequate support for devices mounted thereon. Thickness of the steel plate shall conform to the requirements of UL 50 or equivalent standard. Panels and cabinets shall be of adequate strength to support mounted components during shipment and to support a concentrated load of 100 Kilograms on their top after erection.

d) Panel /cabinet shall have eyebolt on top for lifting.

7.12.02 Surface Preparation and Painting

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

a) Suitable filler shall be applied to all pits, blemishes and voids in the surface. The filler shall be sanded so that surfaces are level and flat; corners are smooth and even. Exposed raw metal edges shall be ground burr-free. The entire surface shall be blast clean to remove rust and scale. Oil, grease and salts etc. shall be removed from by one or more solvent cleaning methods prior to blasting.

b) Two spray coats of epoxy primer surfacer shall be applied to all exterior and interior surfaces, each coat of primer surfacer shall be of dry film thickness of 1.5 mil. A minimum of two spray coats of final finish color (Catalyzed epoxy or polyurethane) shall be applied to all surface of dry film thickness 2.0 Mil. The finish colors for exterior and interior surfaces shall conform to the following shades:

i) Exterior – RAL 7032.

ii) Interior - Brilliant White.

c) Paint films, which show sags, cheeks, blisters, teardrops, fat edges or other painting imperfections shall not be acceptable.

7.12.03 Wiring

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

a) All spare contacts of relays, switches and push buttons shall be wired up to the terminal blocks.

b) Each wire shall be identified at both ends with wire designation as per approved wiring diagram. Heat shrinkable type ferrules with indelible computerized print shall be used with cross- identification.

c) Wire termination shall be made with insulated sleeve and crimping type lugs. All external connections shall be made with one wire per terminal. Wire shall not be spliced or tapped between terminals. Open-ended terminal lugs shall not be used.

d) Internal wiring should be terminated uniformly on one side of the terminal block leaving the other side available for termination of outgoing cables.

e) Thermocouple lead wires, analyzer measuring lead wires, or any other lead wires carrying measuring signal of the order of low milli volt or micro volt shall be electrically and physically isolated from other AC and DC wiring.

f) All low-level signal cables shall be separately bundled from control cable.

g) Wires shall be dressed and run in troughs with clamp-on type covers. Wirings shall be neatly bunched in groups by non-metallic cleats or bands. Each group shall be adequately supported along its run to prevent sagging or strain on termination.

h) Shield wires shall be terminated on separately.

i) Common connections shall be limited to two wires per terminal.

j) Wiring to door mounted devices shall be provided with multi-strand wires of (49 strands minimum) adequate loop lengths of hinge-wire so that multiple door openings will not cause fatigue to the conductor.

k) Wiring shall be arranged to enable instruments or devices to be removed and/or serviced without disturbing the wiring. No wire shall be routed across the face or rear of any device in a manner, which will impede the opening of covers or obstruct access to leads, terminals or devices.

l) Panel internal wiring shall follow distinct color-coding to segregate different voltage levels viz. 24V DC, 48V, 110V AC, 240V AC, 220V DC etc.

m) Panels /cabinets /desks shall be provided with removable gasketted cable gland plates and cable glands. Split type grommets shall be used for prefab cables.

n) Wire shall be multistranded annealed flexible high purity copper conductor with heat resistant FRLS PVC insulation and shall pass vertical flame test per IPCEAS-1981.

o) Wire sizes used for internal wiring shall not be lower than the followings :

Control wiring (switches, pushbuttons etc.)	: 1.5 Sq.mm
Power supply/receptacle /illumination wiring	: 2.5 sq. mm or higher as per load
4-20mA DC current and low voltage signal upto 48V DC	: 1.0 Sq. mm

p) Identification of conductors shall be done by insulation color-coding identified on drawings or by printed wiring lists.

7.12.04 Grounding

a) System cabinet AC and DC ground shall be electrically isolated from each other and also electrically isolated from the Instrumentation signal ground. All the above ground shall be individually connected to the single point on the ground pit. Dedicated redundant earth pit shall be provided which shall be away from the HV equipment. This earth pit shall not be shared with other electrical equipment ground and shall also be insulated from other electrical system ground to ensure single point grounding of the system. Grounding resistance shall be better than 1.0 ohm. IEEE guideline shall be followed while designing the grounding system.

b) Panels and cabinets shall be provided with a continuous tinned copper ground bus bar of minimum 25 mm x 3 mm cross section, extending along the entire length of the panel / desk / cabinet assembly. The ground bus shall be bolted to the panel structure and effectively ground the entire structure.

c) The panel /desk /enclosure /JB ground shall have two (2) bolt drilling with GI bolts and nuts at each end to connect to GI/ copper flat ground riser by means of insulated copper ground cable of required cross section with lug.

d) Circuits requiring grounding shall be individually and directly connected to the panel ground bus.

e) For electronic system cabinets, the electronic system ground bus shall be similar but insulated from the cabinet and shall be separately connected to the system ground. Signal cable shields shall be grounded at the panel end only and shall not be left open. The ground in between panels of a shipping section shall be firmly looped.

f) Electrical meters, relays, transmitters and switching devices, operating at a voltage less than 50V may be grounded through the steel structure.

7.12.05 Panel / Cabinet/ Desk/Enclosures Environmental Protections

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

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

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

7.12.06 Terminal Blocks

a) Terminals shall be chromated galvanized DIN rail mounted screwless cage clamp type. Terminals shall have screwed connection for conductor cross-section above 2.5 mm^2. Terminal blocks shall conform to IEC 947-7-1.

b) The characteristics of the terminal blocks shall be as follows.

i) High contact force, independent of conductor cross-section and large contact surface area.

ii) Self-loosening protection.

iii) Resistant to thermal aging and vibration.

iv) Low and constant voltage drop

c) Tension spring shall be made of high quality, non-rusting, acid-resistant steel. The current bar shall be of tin-lead plated copper or brass.

d) Terminals shall be of non flammable suitable thermoplastic material such as polyamide.

e) Terminal blocks shall be mounted vertically in panels and cubicles with clearance for at least 100 mm between two sets and between wall and terminal block.

f) Terminal blocks shall be provided with white marking strips / self-adhesive marker cards. Power terminals shall have protection covers.

g) At least 10%percent spare unwired terminals shall be provided for all panels /cabinets /desks /junction box etc.. This shall be in addition to 10%spare wired terminals of spare IO channels and 10% wired spare modules.

h) Bottom of the terminal block shall be at least 200 mm above the cable gland plate for bottom entry type panels.

i) For extending 24 V / 48 V DC supply to panels, the size of the terminals shall be decided based on voltage drop and not based on current.

j) Other requirements of the terminal blocks are as follows:

i) The last block in a rail-mounted assembly shall be closed with an end plate and end bracket.

ii) For visual and electrical separation of terminal groups, partition plates shall be provided, which can be push fitted after forming an assembly.

iii) Design shall permit testing of incoming and outgoing signals by using suitable test plug and socket without disconnecting the cable connections.

iv) It shall be possible to use jumper plugs through the test plug socket to connect adjacent terminals.

v) Where more than one connection to a terminal block is required, two tier terminals shall be used.

vi) Terminal blocks shall be of different colors depending on voltage levels.

7.12.07 Nameplates and Labels

a) Each item shall have permanently attached to it, in a prominent position, a rating plate of non-corrosive material upon which is to be engraved the manufacturer's name, equipment, type / model number, range, serial number, together with details of the loading conditions under which the item of plant in question has been designed to operate.

b) Such nameplates or labels are to be of white non-hygroscopic material with engraved black lettering, or alternatively of transparent plastic

material with suitably colored lettering engraved on the back.

c) The nameplates shall be held by self-tapping screws. The size of nameplate shall be approximately 20 mm x 75 mm for equipment and 40 mm x 150 mm for the panels.

d) Items of plant such as valves, which are subject to handling, are to be provided with an engraved chromium plated nameplate or label with engraving filled with enamel, suitably mounted or affixed with strong rustproof chain.

e) All such nameplates, instruction plates, lubrication charts etc. shall be with English inscriptions.

8.00.00 **METERING BASES AND CHART UNITS**

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

i)	Pressure	: Kg/cm^2
	Differential Pressure	: mm of H_2O column / Kg/cm^2
ii)	Draught	: mm of H_2O column
iii)	Vacuum	: Kg/cm^2 (abs)/mm of Hg column
iv)	Temperature	: Degree Celsius (^{O} C)
v)	Flow (Steam, Water)	: Tonnes / hr, M^3/Hr
vi)	Flow (Oil)	: M^3 / Hr, Litter/Hr
vii)	Flow Air	: Tonnes / hr / M^3 / Hr.
viii)	Density	: gms / c.c.
ix)	Level	: mm /%
x)	Conductivity	: µS / cm or mS/cm
xi)	Gas Analyzer	: Percentage by weight or as specified in respective case.
xii)	Dissolved Oxygen / Silica / Sodium	: ppm /ppb

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

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

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

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

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

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

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

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

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

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

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

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

11.00.00 **ENVIRONMENTAL CONSIDERATIONS**

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

11.01.00 Temperature

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

11.02.00 Humidity

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

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

11.03.00 Atmospheric Contamination

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

11.04.00 Vibration

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

11.05.00 Lightning

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

12.00.00 **SECURITY**

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

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

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

13.00.00 **ACCEPTANCE TESTS**

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

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

(a) Factory Acceptance Test (FAT)

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

The FAT shall include the following activities:

- Complete hardware inspection;

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

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

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

(b) Site Acceptance Test (SAT)

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

a) Complete hardware and installation inspection;

b) Testing of redundancy facilities by simulating data highway, power supplies and control processor failures. All such units shall be tested to demonstrate of the automatic operation of the standby units and initiation of the relevant system alarms;

c) Demonstration of system diagnostic facilities; by the simulation of the appropriate fault conditions. The system fault reporting techniques shall also be demonstrated;

d) Testing of data highway integrity using continuity test equipment based on signal injection / reflection techniques;

e) Demonstration of data logging, sequence of events and trending system operation.

f) Pre-commissioning checks shall include the following:

i) Calibration of all field instruments, analysers and equipment, in the scope of supply of this package, at site;

ii) Loop checking, for all open and close loops, between source and destination with manual signal injection as well as from Operating Consoles for entire DCS I/Os;

iii) Logic sequence check with the manual signal injection at signal source as well as checking of feed back signals.

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

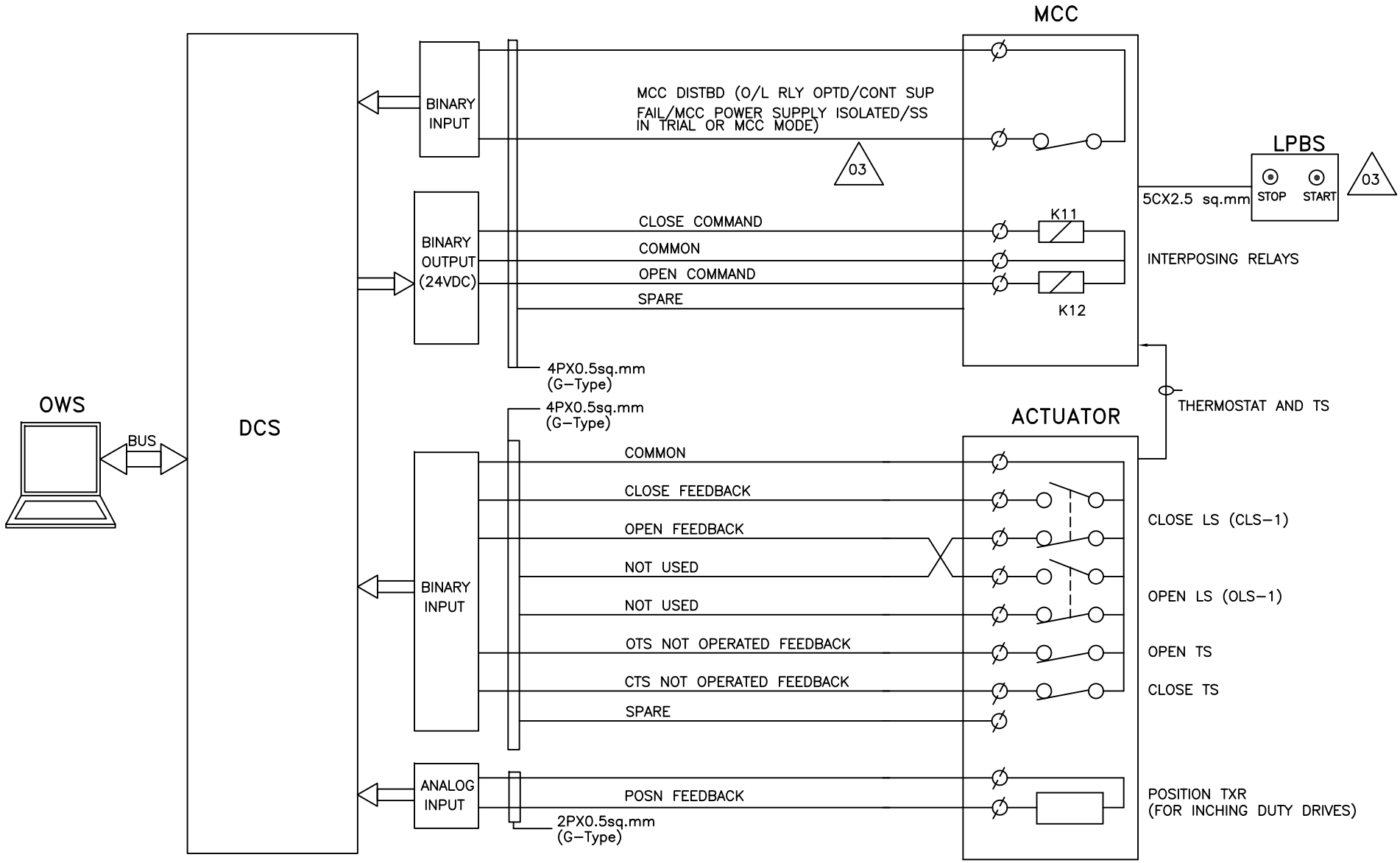
The Owner shall be notified at least 2 weeks before the commencement of the test. The procedures shall be issued and agreed before notification.

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

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

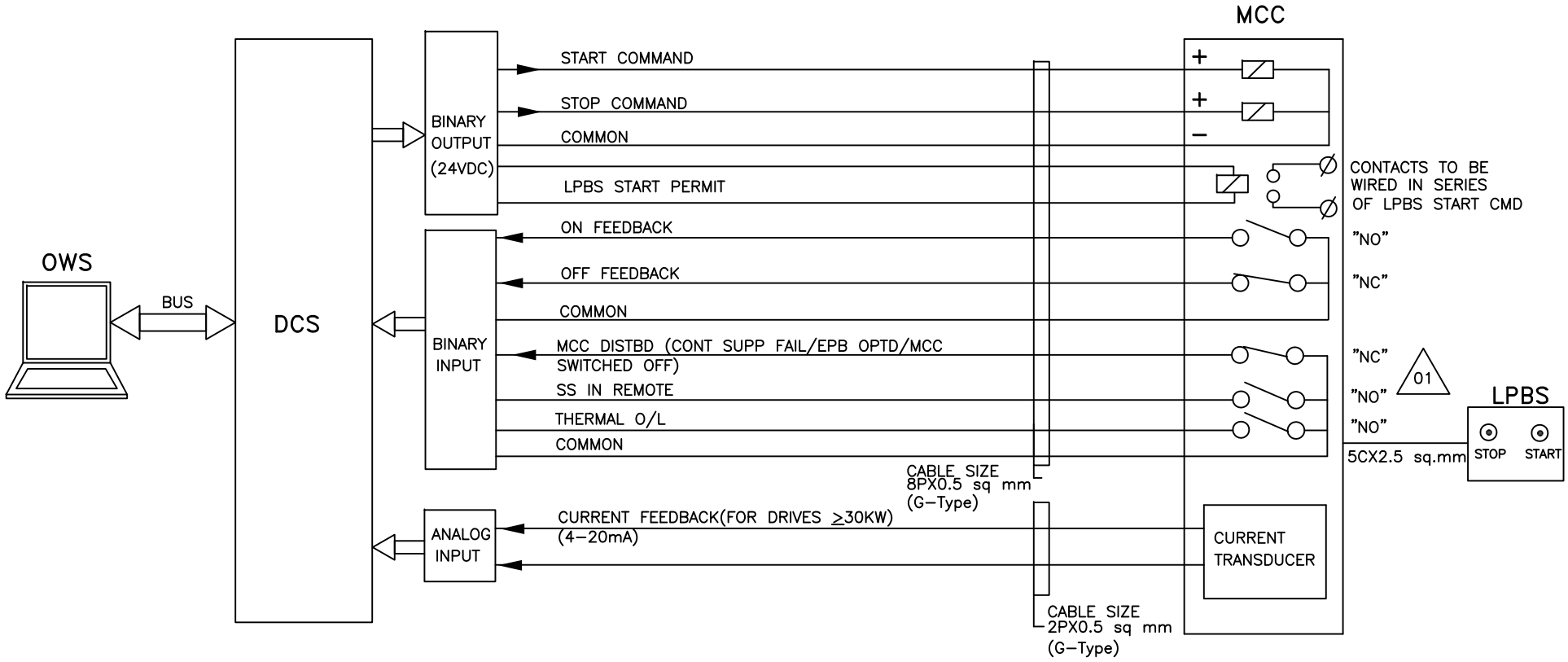
DRIVE CONTROL PHILOSOPHY

DCS INTERFACE FOR BIDIRECTIONAL DRIVE(WITH MCC)



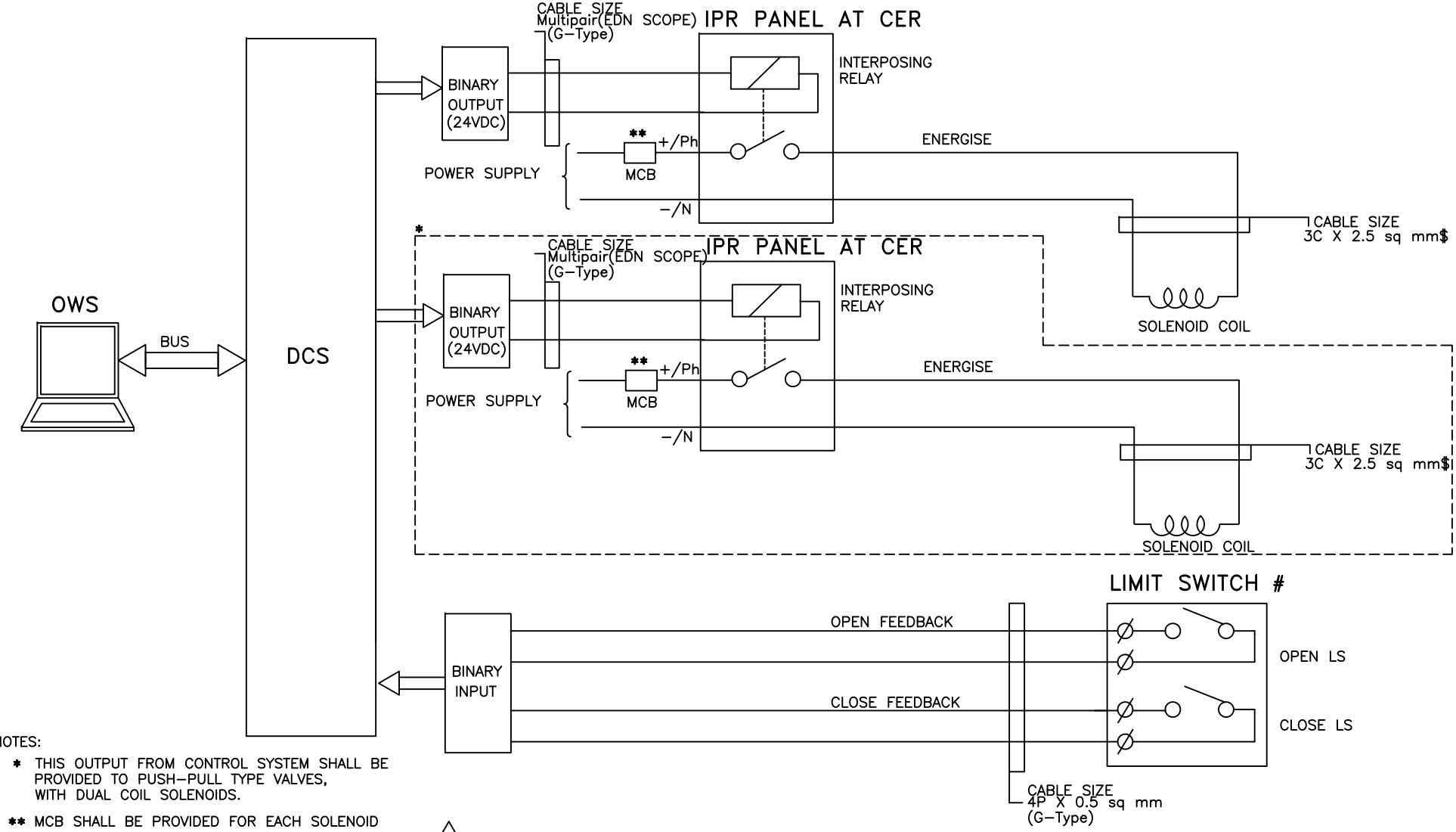
BHEL	PROJECT: 1X800MW WANAKBORI THERMAL POWER STN. EXTN. UNIT–8	DRG.NO.	PE–DM–408–145–I002
		DATE	15.06.15
	TITLE : 01 DCS INTERFACE FOR BIDIRECTIONAL DRIVE	REV.NO.	03
		SHT	8 OF 12

DCS INTERFACE FOR UNIDIRECTIONAL LT DRIVE



BHEL	PROJECT: 1X800MW WANAKBORI THERMAL POWER STN. EXTN. UNIT–8	DRG.NO.	PE–DM–408–145–I002
	TITLE : 01 DCS INTERFACE FOR UNIDIRECTIONAL LT DRIVE	DATE	16.02.15
		REV.NO.	01
		SHT	8 OF 11

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



NOTES:

* THIS OUTPUT FROM CONTROL SYSTEM SHALL BE PROVIDED TO PUSH-PULL TYPE VALVES, WITH DUAL COIL SOLENOIDS.

** MCB SHALL BE PROVIDED FOR EACH SOLENOID

\# FOR ON/OFF TYPE, SOLENOID ACTUATED CONTROL VALVE.

CER:-CONTROL EQUIPMENT ROOM

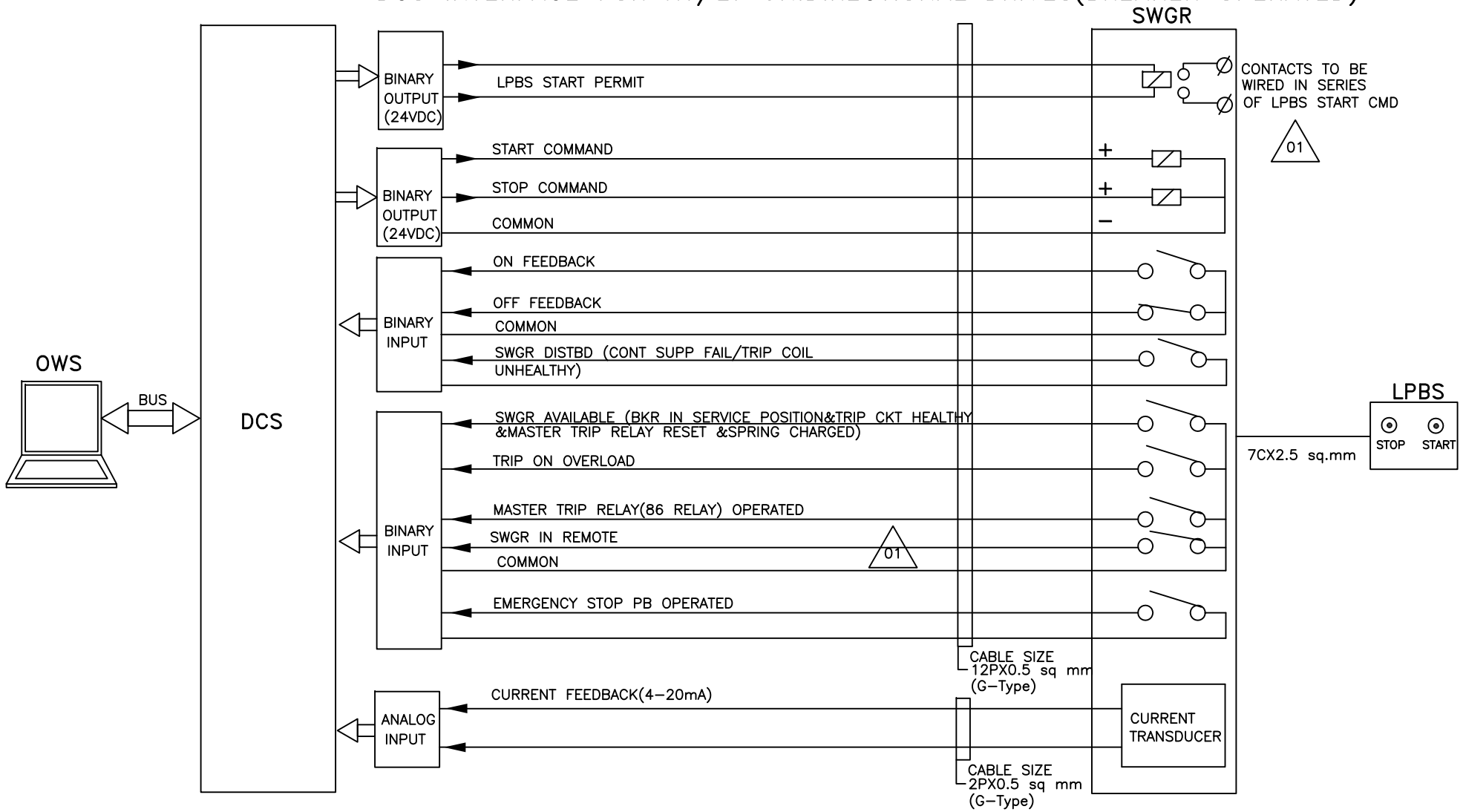
IPR:-INTER POSING RELAY

$ SYSTEMS WHERE EVER MULTIPLE SOLENOIDS CAN BE GROUPED,MULTI CORE CABLE SHALL BE USED.

01

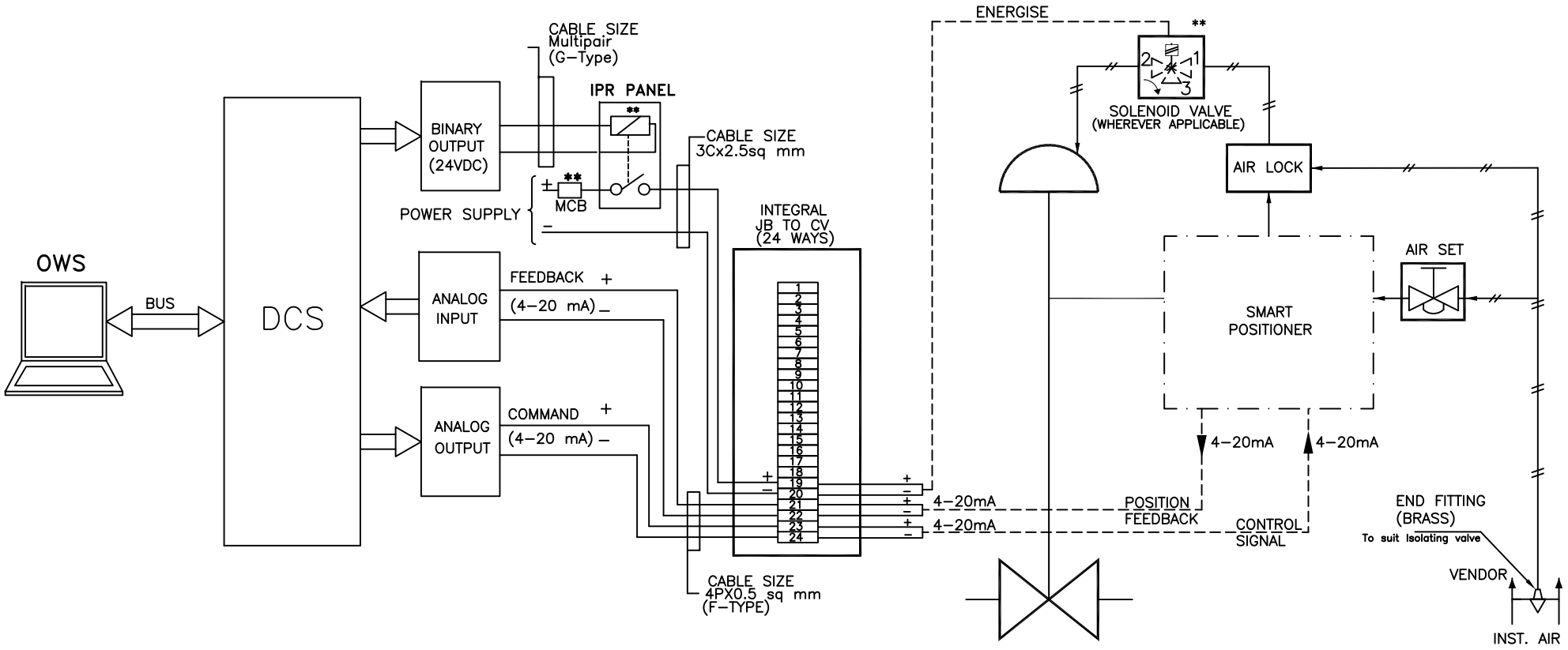
BHEL	PROJECT: 1X800MW WANAKBORI THERMAL POWER STN. EXTN. UNIT-8	DRG.NO.	PE-DM-408-145-I002
		DATE	16.02.15
	TITLE : 01 DCS INTERFACE FOR SOLENOID DRIVE	REV.NO.	01
		SHT	9 OF 11

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



BHEL	PROJECT: 1X800MW WANAKBORI THERMAL POWER STN. EXTN. UNIT-8	DRG.NO.	PE-DM-408-145-I002
		DATE	16.02.15
	TITLE : 01 DCS INTERFACE FOR UNIDIRECTIONAL HT DRIVE	REV.NO.	01
		SHT	10 OF 11

DCS INTERFACE FOR ANALOG DRIVE (WITH SMART POSITIONER)



NOTES:

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

BHEL	PROJECT: 1X800MW WANAKBORI THERMAL POWER STN. EXTN. UNIT–8	DRG.NO.	PE–DM–408–145–I002
		DATE	16.02.15
	TITLE : TYPICAL HOOK–UP DIAGRAM ANALOG DRIVE (WITH SMART POSITIONER)	REV.NO.	01
		SHT	11 OF 11

APPLICABLE CODES AND STANDARDS

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

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

~~5.00.00~~ ~~**PROVEN PRODUCT**~~

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

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

~~Latest system from following vendors~~

~~M/s Siemens~~

~~M/s Yokagawa~~

~~M/s Honeywell~~

~~M/s ABB~~

~~Ovation.~~

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

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

6.00.00 **CODES AND STANDARDS**

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

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

1) Temperature Measurement

a) Instrument and apparatus for temperature measurement - ASME PTC 19.3 (1974).

b) Temperature Measurement - Thermocouples - ANSI - MC 96.1 - 1982.

c) Temperature Measurement by electrical resistance thermometers - IS: 2806

d) Thermometer-element-Platinum resistance - IS: 2848 / DIN 43760.

2) Pressure Measurement

a) Instrument and apparatus for pressure measurement - ASME PTC 19.2 (1964).

b) Bourdon tube pressure and vacuum gauges - IS: 3624/1996.

3) Flow Measurement

a) Instruments and apparatus for flow measurement - ASME PTC 19.5 (1972) Interim supplement, Part-II

b) Measurements of fluid flow in closed conduit - BS 1042.

4) Electronic Measuring Instruments and Control Hardware

a) Automatic null balancing electrical measuring instruments -ANSI C 39.4 (Rev. 1973), IS 9319

b) Safety requirements for electrical and electronic measuring and controlling instrumentation - ANSI C 39.5 / 1974.

c) Compatibility of analog signals for electronic industrial process instruments - ISA-S 50.1: ANSI MC 12.1 / 1975.

d) Dynamic response testing of process control instrumentation - ANSI MC 4.1 (1975) - ISA -S26 (1968).

e) Surge withstand capability (SWC) tests - ANSI C 37.90A (1989), IEC-255.4.

f) Printed circuit boards - IPC TM-650, IEC 326C.

g) General requirements and tests for printed wiring boards - IS-7405 (Part-I)/1973.

h) Edge socket connectors - IEC 130-11.

i) Requirements and methods of testing of wire wrap terminations--DIN 41611 Part-2.

j) Dimensions of attachment plugs and receptacles- ANSI C73-1973.(Supplement ANSI C73a – 1980)

5) Instrument Switches and Contacts

a) Contact Rating - AC services NEMA ICS Part-2 125, A-600

b) Contact Rating - DC services NEMA ICS Part-2 125, N-600

6) Enclosures

a) Enclosures for Industrial Controls and Systems–NEMA ICS-6-110.15 through 110.22

b) Racks, panels and associated equipment -EIA: RS-310-B-1983 (ANSI C83.9 - 1972).

7) Apparatus, Enclosures and Installation Practices in Hazardous Area

a) Classification of hazardous area - NEMA Article 500, Volume-6, 1978.

b) Electrical Instruments in hazardous dust locations - ISA-RP 12.11.

c) Intrinsically safe apparatus - NFPA Article 493 Volume-4 1978.

d) Purged and pressurized enclosure for electrical equipment in hazardous location - NFPA Article 496 Volume-4, 1978.

8) Sampling System

a) Stainless Steel material of tubing and valves, for sampling system - ASTM A 269-79 GRTO-316.

b) Submerged helical coil heat exchangers for sample coolers -- ASTM D11-98.

9) Annunciators

a) Specifications and guides for the use of general-purpose annunciators - ISA RP 18.1.

b) Surge withstand capability tests -ANSI C37.90 a -1971 and IEEE Standard 472-1974.

10) Interlocks, Protections

a) Relays and relay system associated with electric power apparatus - IEEE Standards 3.13.

b) Surge withstand capability tests - ANSI C37.90 a - 1971 and IEEE Standard 472-1974.

c) General requirements and tests for switching devices for control and auxiliary circuits including contactor relays - IS-6875 (Part-I)/1973.

d) Turbine water damage prevention - ASME-TDP-1-1980.

e) Boiler safety interlocks - NFPA Section 85B, 85D, 85E, 85F, 85G.

11) UPS System

a) Practice and requirements for semi-conductor power rectifiers - ANSI C34.2.

b) Relays and relay systems associated with electrical power apparatus IEEE Standard - 3.13.

c) Surge withstand capability tests - ANSI C 70.90 A/1971, IEC-255.4.

d) Recommended practice for sizing large lead storage batteries for generating stations and sub-stations - -IEEE-485.

12) Control Valves

a) Control valve sizing (Incompressible fluids) - ISA-S39.2 / 1972.

b) Control valve sizing (Compressible fluids) - ISA-S39.4 / 1972.

c) Control Valve seat leakage – ANSI / FCI 70.2

d) Face to face dimensions of Control Valves - ANSI B16.10

e) Control Valve Capacity Test Procedure – ISA – S75.02

13) Instrument Tubing

a) Seamless Carbon Steel Pipe - ASTM-A-106.

b) Forged carbon steel fittings - ASTM-A-105.

c) Dimensions of fittings - ANSI-B16.11.

d) Code for pressure piping, welding, hydrostatic testing - ANSI-B 31.1.

e) Nomenclature for instrument tube fittings - ISA-RP 42.1 / 1982.

f) Seamless Stainless Steel Tube ASTM A-213 TP 316 / ASTM A-269 TP 316

g) Seamless Alloy Steel Pipe ASTM A 335 P22

h) Seamless Stainless Steel Pipe ASTM A-312 TP 316

14) Cables

a) Thermocouple extension wires / cables - ANSI MC96.1.

b) Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy-IPCEA S-61-402

c) Guide for design and installation of cable system in power generating station (insulation, jacket materials) -IEEE Standard 422.

d) Requirements of vertical tray flame test - IEEE 383

e) Standard specification for tinned soft or annealed copper wire for electrical purpose - ASTM B33.

15) Electronic Cards, Subassemblies and Components

a) Unpackaged

i) Vibration : IEC-68.2.6

ii) Shock : IEC-68.2.27

iii) Drop & Topple : IEC-68.2.31

b) Packaged

Vibration, Drop & Static Compression - NSTA.

c) Electromagnetic Compatibility

i) Electrical Fast Transient : IEC-801.4

ii) Surge Withstand : IEC-255.4

iii) Radiated Electromagnetic Field : IEC-801.3

iv) Electrostatic Discharge : IEC-801.2

v) Electromagnetic Emissions : VDE 0871, Class-B

16) Cable Trays, Conduits

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

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

~~7.00.00~~ ~~**DESIGN CRITERIA**~~

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

~~7.01.00~~ ~~General Requirements~~

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

~~a)~~ ~~Stable in spite of temperature fluctuations.~~

~~b)~~ ~~Able to withstand high humidity.~~

~~c)~~ ~~Weather proof.~~

~~d)~~ ~~Dust proof.~~

~~e)~~ ~~Corrosion resistant.~~

~~f)~~ ~~Erosion resistant.~~

SPECIFICATION FOR QUALITY ASSURANCE & TESTING

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

~~11.03.00~~ ~~Atmospheric Contamination~~

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

~~11.04.00~~ ~~Vibration~~

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

~~11.05.00~~ ~~Lightning~~

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

~~12.00.00~~ ~~**SECURITY**~~

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

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

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

13.00.00 **ACCEPTANCE TESTS**

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

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

(a) Factory Acceptance Test (FAT)

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

The FAT shall include the following activities:

- Complete hardware inspection;

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

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

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

(b) Site Acceptance Test (SAT)

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

a) Complete hardware and installation inspection;

b) Testing of redundancy facilities by simulating data highway, power supplies and control processor failures. All such units shall be tested to demonstrate of the automatic operation of the standby units and initiation of the relevant system alarms;

c) Demonstration of system diagnostic facilities; by the simulation of the appropriate fault conditions. The system fault reporting techniques shall also be demonstrated;

d) Testing of data highway integrity using continuity test equipment based on signal injection / reflection techniques;

e) Demonstration of data logging, sequence of events and trending system operation.

f) Pre-commissioning checks shall include the following:

i) Calibration of all field instruments, analysers and equipment, in the scope of supply of this package, at site;

ii) Loop checking, for all open and close loops, between source and destination with manual signal injection as well as from Operating Consoles for entire DCS I/Os;

iii) Logic sequence check with the manual signal injection at signal source as well as checking of feed back signals.

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

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

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

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

DRAWINGS

GA DRAWING
TRANSMITTER RACK

PRELIMINARY
TENDER PURPOSE ONLY

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

GA DRAWING–TRANSMITTER RACK

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

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

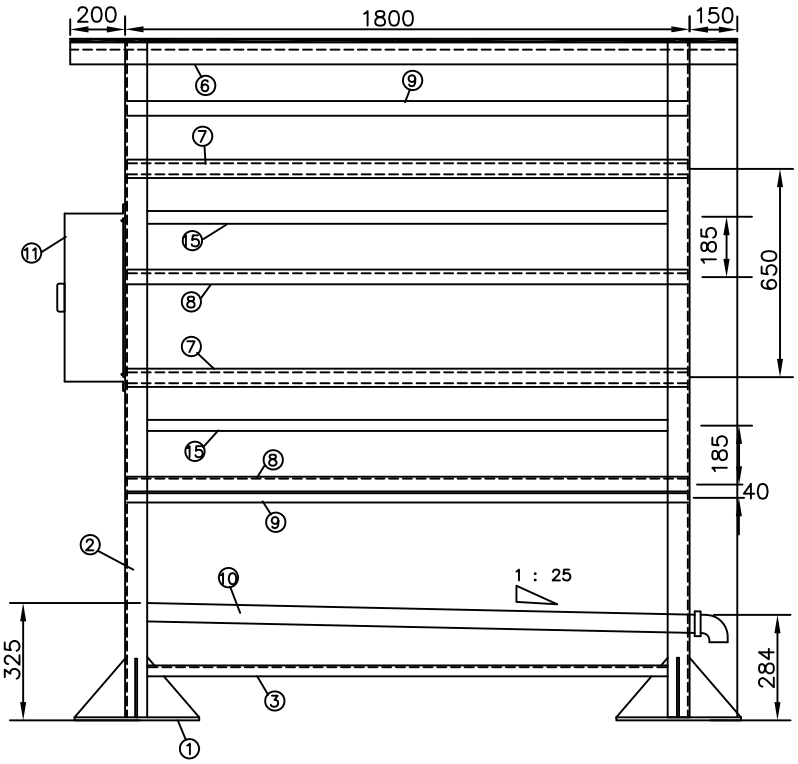
DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS
KOLKATA · MUMBAI · CHENNAI · NEW DELHI

JOB NO. DCPL–K9213R | SCALE NIL | SHT. 1 OF 10

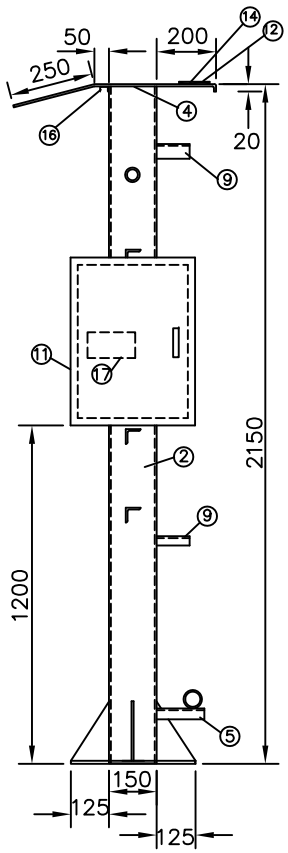
DWG. NO. K9213R–DWG–I–0200 | REV. 0

K9213-DWG-I-0200-1-10

A4_H (08–'06) [297 x 210]



FRONT VIEW



RH SIDE VIEW

LEGEND:

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

NOTES:

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

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN MM

PRELIMINARY
TENDER PURPOSE ONLY

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

G.A.DRAWING FOR LOCAL INSTRUMENT RACK

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

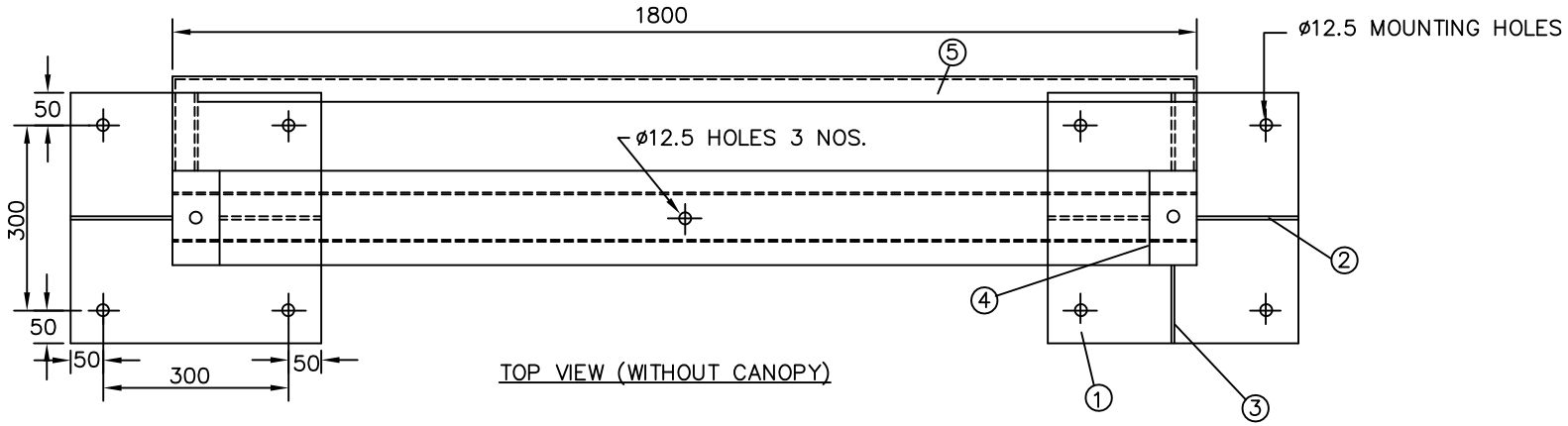
GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

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

JOB NO. DCPL-K9213R | SCALE NIL | SHT. 2 OF 10
DWG. NO. K9213R-DWG-I-0200 | REV. 0

K9213-DWG-I-0200-2-10

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



NOTES:

1..M.S. PLATE 400 X 400 X 10 mm.

2..RIB M.S. PLATE 162.5 X 170 X 5 mm THICK.

3..RIB M.S. PLATE 125 X 170 X 5 mm THICK.

4..RIB M.S. PLATE 134 X 165 X 5 mm THICK.
(CANOPY MOUNTING PLATE SUPPORT)

5..BRACKET FOR IMPULSE PIPE SUPPORT.

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN MM

PRELIMINARY
TENDER PURPOSE ONLY

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

VIEW OF
LOCAL INSTRUMENT RACK W/O CANOPY

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

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

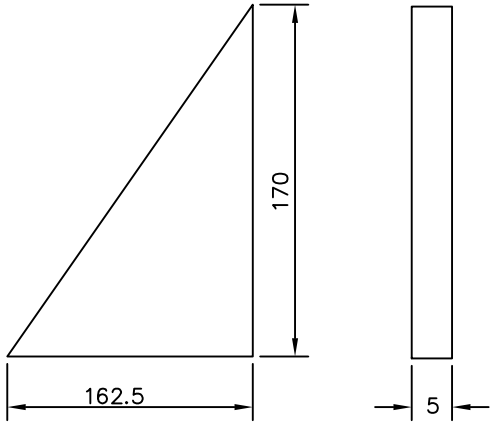
DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS
KOLKATA · MUMBAI · CHENNAI · NEW DELHI

JOB NO. DCPL–K9213R | SCALE NIL | SHT. 3 OF 10

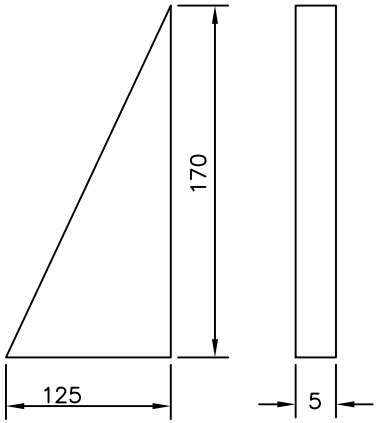
DWG. NO. K9213R–DWG–I–0200 | REV. 0

K9213-DWG-I-0200-3-10

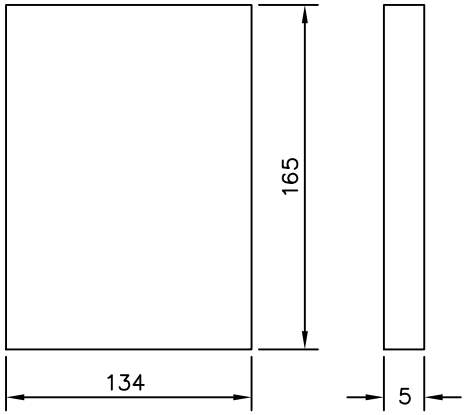
A4_H (08–'06) [297 x 210]



DETAIL OF–1



DETAIL OF–2



DETAIL OF–3

NOTES:

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

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN MM

PRELIMINARY
TENDER PURPOSE ONLY

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

G.A. DRAWING OF CLEATS FOR LOCAL INSTRUMENT RACK

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

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

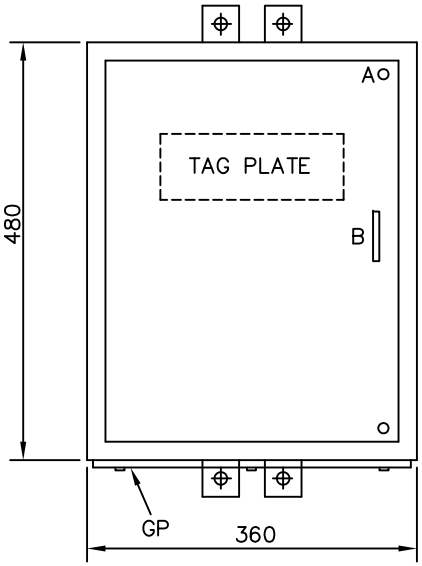
DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS
KOLKATA · MUMBAI · CHENNAI · NEW DELHI

JOB NO. DCPL–K9213R | SCALE NIL | SHT. 4 OF 10

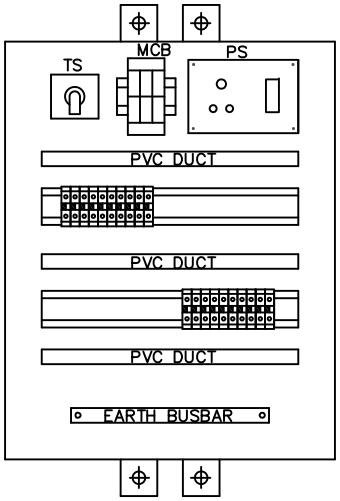
DWG. NO. K9213R–DWG–I–0200 | REV. 0

K9213-DWG-I-0200-4-10

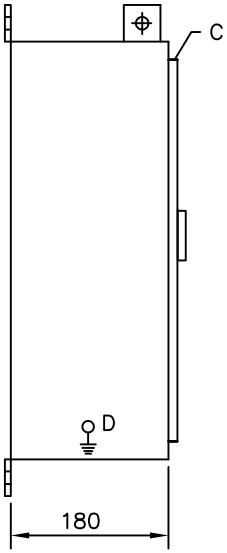
A4_H (08–'06) [297 x 210]



FRONT VIEW



INTERNAL FRONT VIEW



SIDE VIEW

LEGEND:

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

NOTES:

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

PRELIMINARY
TENDER PURPOSE ONLY

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

G.A. DRAWING OF JUNCTION BOX FOR LOCAL INSTRUMENT RACK

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

GUJARAT STATE ELECTRICITY CORPORATION LIMITED VADODARA, GUJARAT

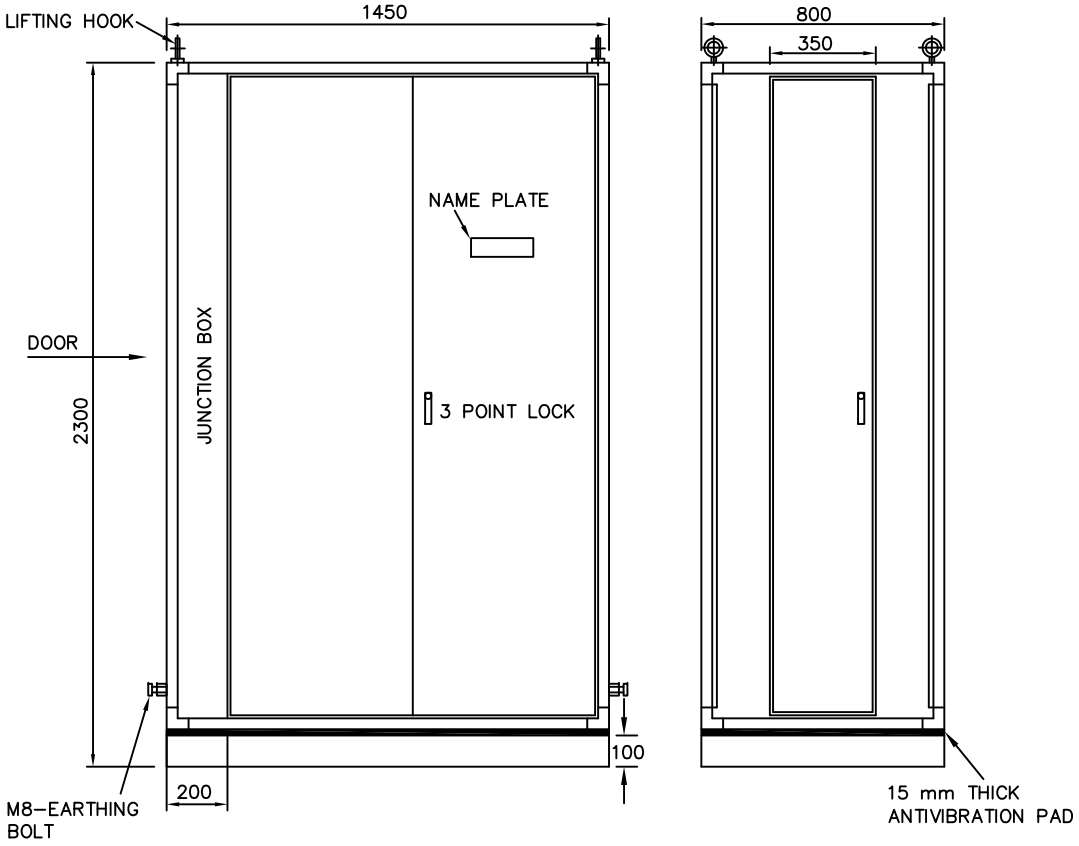
DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS
KOLKATA · MUMBAI · CHENNAI · NEW DELHI

JOB NO. DCPL–K9213R | SCALE NIL | SHT. 5 OF 10
DWG. NO. K9213R–DWG–I–0200 | REV. 0

K9213-DWG-I-0200-5-10

A4_H (08–'06) [297 x 210]

LOCAL INSTRUMENT ENCLOSURE



FRONT VIEW

LH SIDE VIEW

NOTES:

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

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN MM

PRELIMINARY
TENDER PURPOSE ONLY

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

G.A. DRAWING FOR
LOCAL INSTRUMENT ENCLOSURE

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

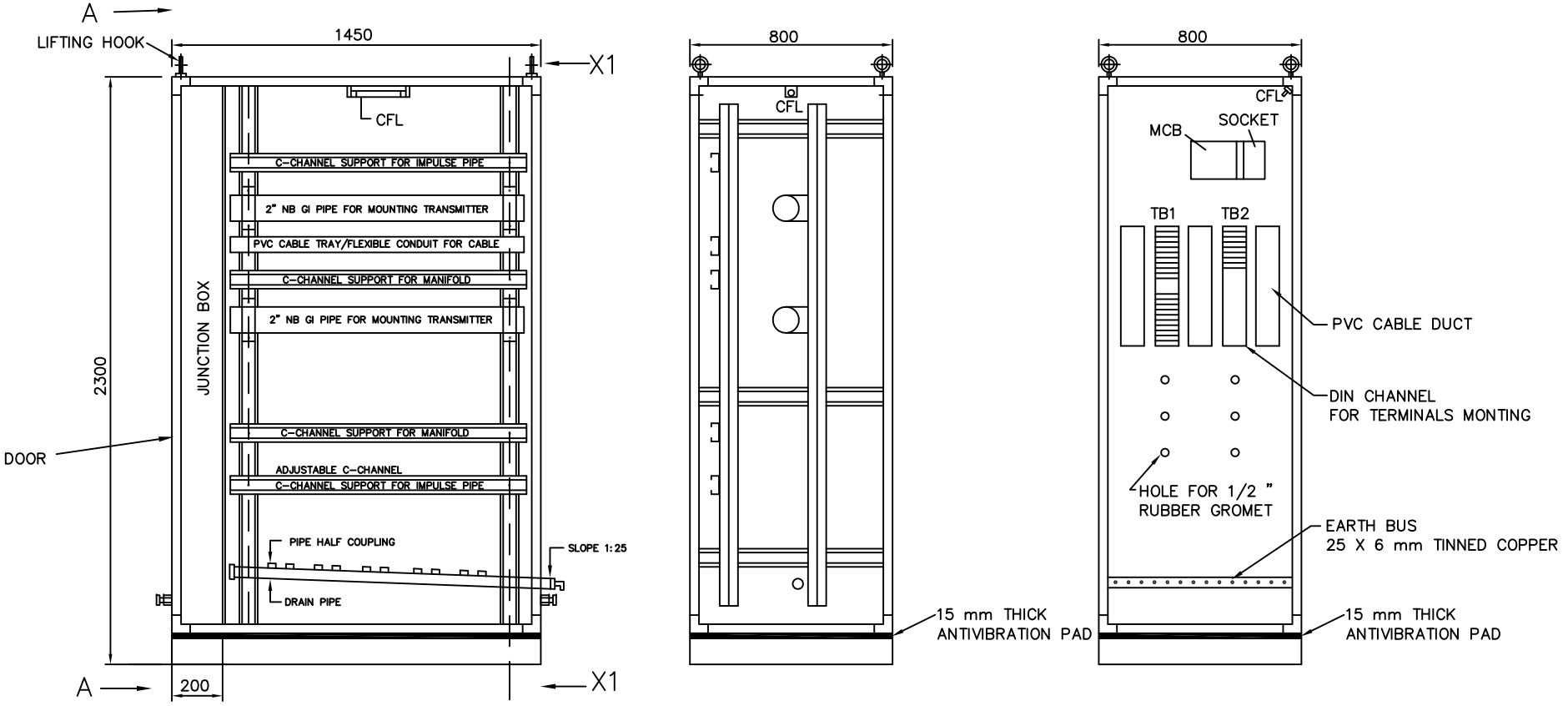
GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

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

JOB NO. DCPL–K9213R | SCALE NIL | SHT. 6 OF 10
DWG. NO. K9213R–DWG–I–0200 | REV. 0

K9213-DWG-I-0200-6-10

A4_H (08–'06) [297 x 210]



FRONT INNER VIEW

SIDE VIEW FROM X1–X1

SIDE VIEW FROM A–A

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

PRELIMINARY
TENDER PURPOSE ONLY

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

INNER G.A. DRAWING FOR
LOCAL INSTRUMENT ENCLOSURE

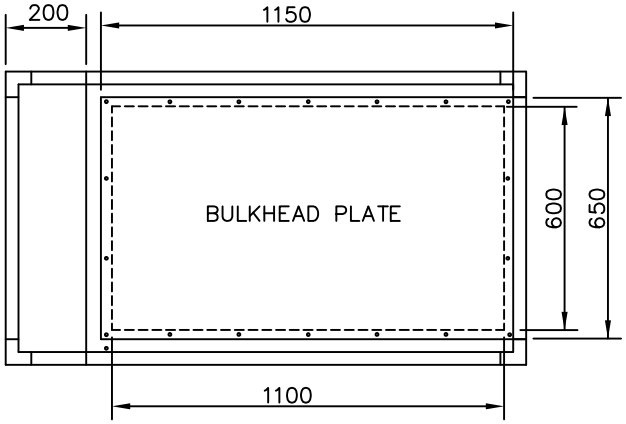
1x800MW SUPER CRITICAL THERMAL POWER PROJECT
(UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

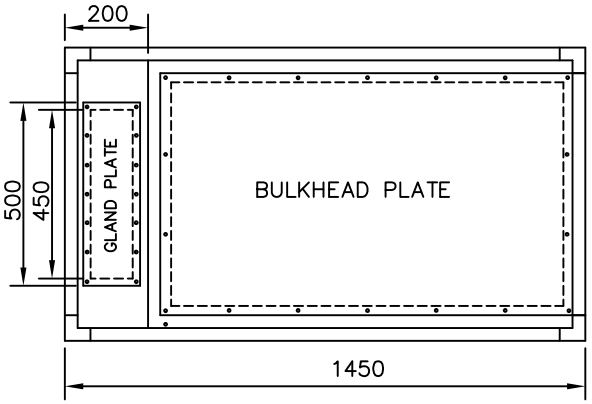
DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS
KOLKATA · MUMBAI · CHENNAI · NEW DELHI

JOB NO. DCPL–K9213R | SCALE NIL | SHT. 7 OF 10

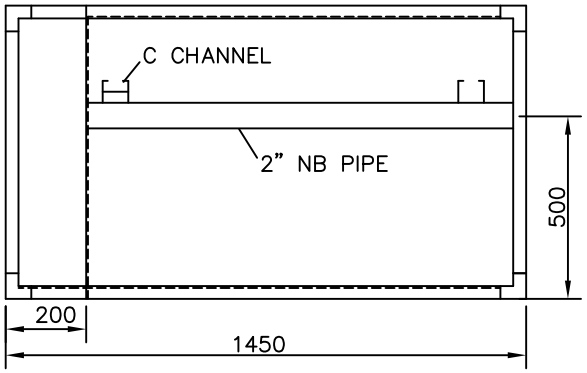
DWG. NO. K9213R–DWG–I–0200 | REV. 0



TOP VIEW



BOTTOM VIEW



TOP VIEW WITHOUT BULKHEAD PLATE

NOTES:

1..BULK HEAD PLATE DIMENSION ARE AS FOLLOWS: 1150 X 650 X 6 mm.

2..IMPULSE PIPE ENTRY : BOTTOM ENTRY FOR AIR/FLUE GAS APPLICATIONS.

3..IMPULSE ENTRY : TOP ENTRY FOR STEAM/WATER APPLICATIONS.

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN MM

PRELIMINARY
TENDER PURPOSE ONLY

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

BULKHEAD PLATE DETAILS FOR LOCAL INSTRUMENT ENCLOSURE

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

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

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

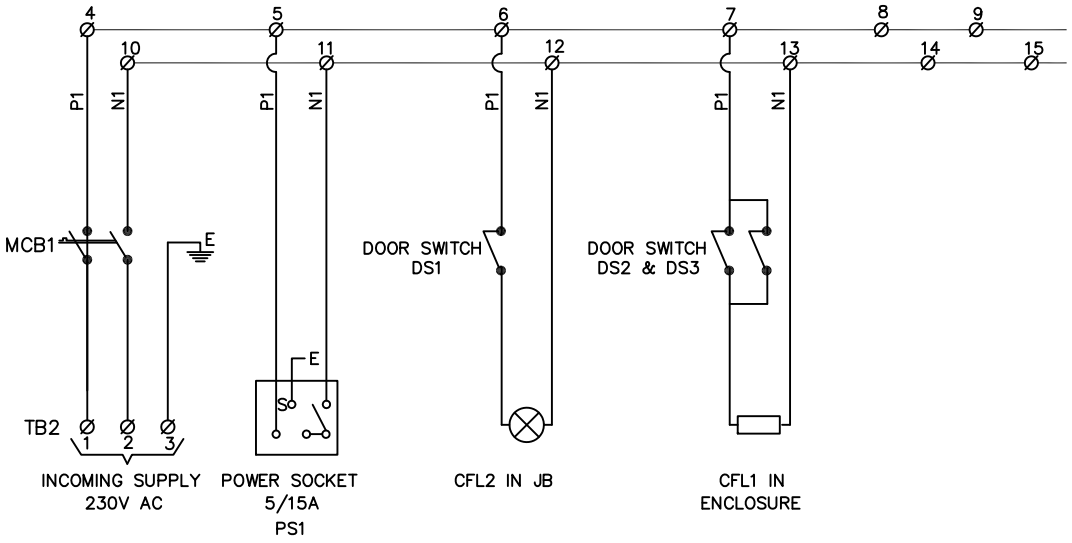
JOB NO. DCPL–K9213R | SCALE NIL | SHT. 8 OF 10

DWG. NO. K9213R–DWG–I–0200 | REV. 0

K9213-DWG-I-0200-8-10

A4_H (08–'06) [297 x 210]

POWER WIRING CIRCUIT

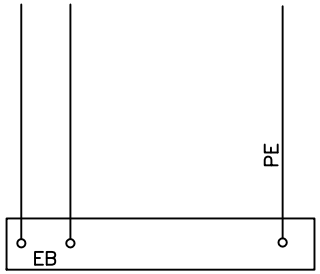


NOTES :

1.. COLOUR CODING FOR POWER SUPPLY : PHASE – RED, NEUTRAL– BLACK, EARTH–GREEN

2.. CABLE ROUTING FROM TB TO PANEL LIGHT WILL BE 1.5 Sq.mm 1100V AC GRADE.

3.. SIGNAL WIRING WILL BE DONE BY 4 PAIR X 0.5 Sq.mm ANNEALED TINNED COPPER, PAIR TWISTED OVERALL & SHIELDED, VOLTAGE GRADE 1100V, UNARMOURED FRLS PVC SHIELDED CABLE.



PRELIMINARY
TENDER PURPOSE ONLY

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

ELECTRICAL WIRING AND TERMINATION DRAWING FOR LOCAL INSTRMENT ENCLOSURE

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

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

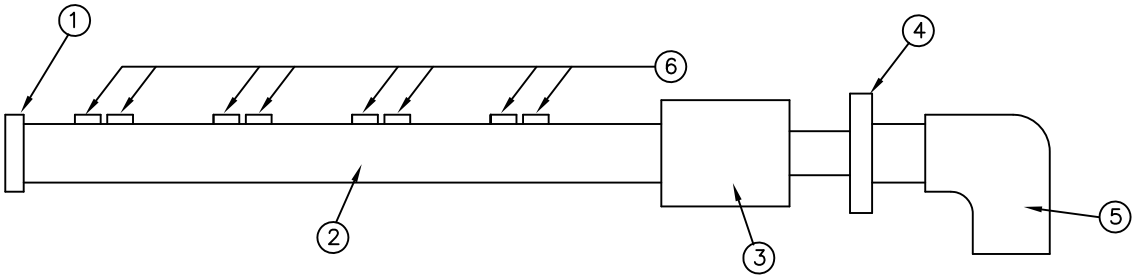
DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS
KOLKATA · MUMBAI · CHENNAI · NEW DELHI

JOB NO. DCPL–K9213R | SCALE NIL | SHT. 9 OF 10

DWG. NO. K9213R–DWG–I–0200 | REV. 0

K9213-DWG-I-0200-9-10

A4_H (08–'06) [297 x 210]



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

PRELIMINARY
TENDER PURPOSE ONLY

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

DRAIN HEADER DETAILS FOR
LOCAL INSTRUMENT ENCLOSURE

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

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

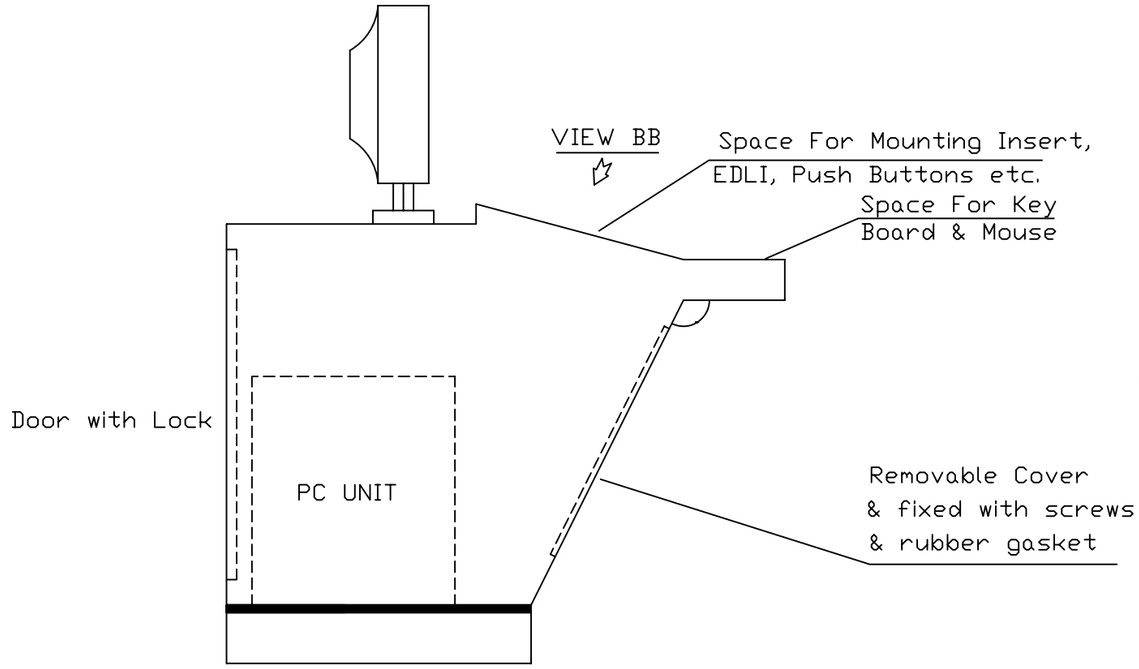
DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS
KOLKATA · MUMBAI · CHENNAI · NEW DELHI

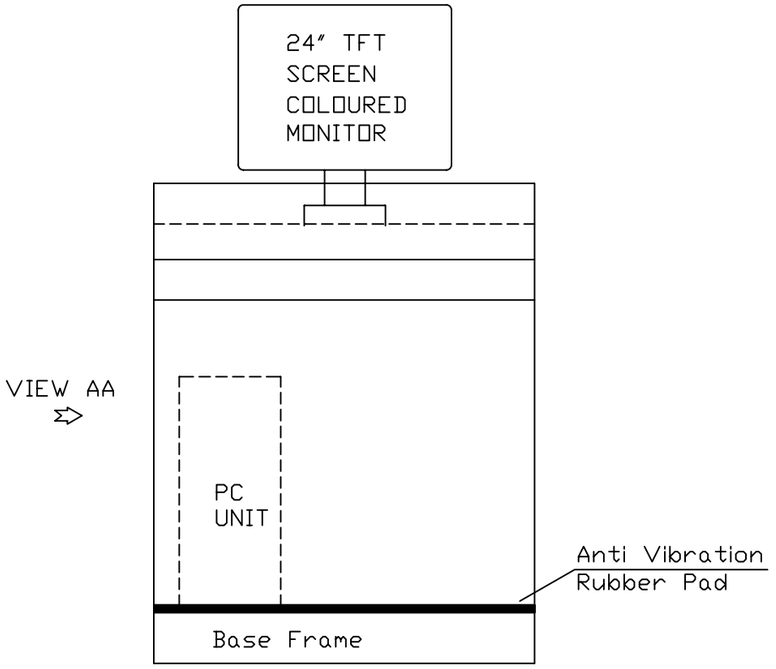
JOB NO. DCPL–K9213R | SCALE NIL | SHT. 10 OF 10

DWG. NO. K9213R–DWG–I–0200 | REV. 0

K9213-DWG-I-0200-10-10

A4_H (08–'06) [297 x 210]





VIEW AA

NOTES:

1. THIS DRAWING IS FOR DESIGN CONCEPT AND DETAIL OF FABRICATIONS SHALL BE VENDOR'S RESPONSIBILITY SUBJECT TO USER'S APPROVAL.
2. DESK PORTION i.e. SPACE FOR KEY BOARD SHALL BE FABRICATED FROM STAINLESS STEEL SHEET. REMAINING PARTS FROM CRCA SHEET STEEL. SHEET TKICKNESS SUBJECT TO USER'S APPROVAL.
3. SUITABLE LOUVERS (WITH WIREMESH REMOVEABLE FILTER), GLAND PLATES, DRAWING POCKET (METALLIC WELDED / SCREWED) SHALL BE PROVIDED.
4. OUTER COLOUR SHADE SHALL BE RAL 7032.
5. FILLER PANEL AS PER CONTROL ROOM LAYOUT SHALL BE PROVIDED.

FOR TENDERING PURPOSE ONLY

REVIEWED											
			APPROVED	REVIEWED	CHECKED	DRAWN	DESCRIPTION	RELEASE STATUS	REV.	DATE

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

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

TITLE: OPERATING STATION DESK PROFILE

PROJECT: 1x800 MW SUPERCRITICAL THERMAL POWER PLANT (UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)

JOB NO. K9213R | SCALE : NONE

DWG. NO. K9213R-DWG-I-0161 | REV. A

C:\Documents and Settings\4471\Local Settings\Temporary Internet Files\Content.IE5\NPFVB2QT\K9213R-DWG-I-0161, Rev A.dwg

A3 (9-96) [420x297]

NOTES :

1..PROVISION OF SINGLE OR DOUBLE ROOT VALVE AND DRAIN VALVE SHALL BE IN ACCORDANCE WITH THE PRESSURE/TEMPERATURE REQUIREMENT. FOR LINE PRESSURE EQUAL TO OR GREATER THAN 40 KG/SQ.CM 2 NOS ROOT VALVE AND 2 NOS DRAIN VALVE SHALL BE REQUIRED.

2..MATERIAL, SIZE AND RATING OF THE PROCESS HOOK UP ITEMS SHOWN IN THE DRAWING ARE INDICATIVE ONLY. ACTUAL REQUIREMENT SHALL BE AS PER PROCESS CONDITION & SPECIFICATION VOL.II–E.

3..DRAIN PIPE IN RACK AND ENCLOSURE SHALL BE 2" NB SCH 80.

PRELIMINARY
TENDER PURPOSE ONLY

						TYPICAL INSTRUMENT INSTALLATION DIAGRAM
						1x800MW SUPER CRITICAL THERMAL POWER PROJECT (UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)
GP	AT	SD		0	21.04.10	GUJARAT STATE ELECTRICITY CORPORATION LIMITED VADODARA, GUJARAT
APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE	

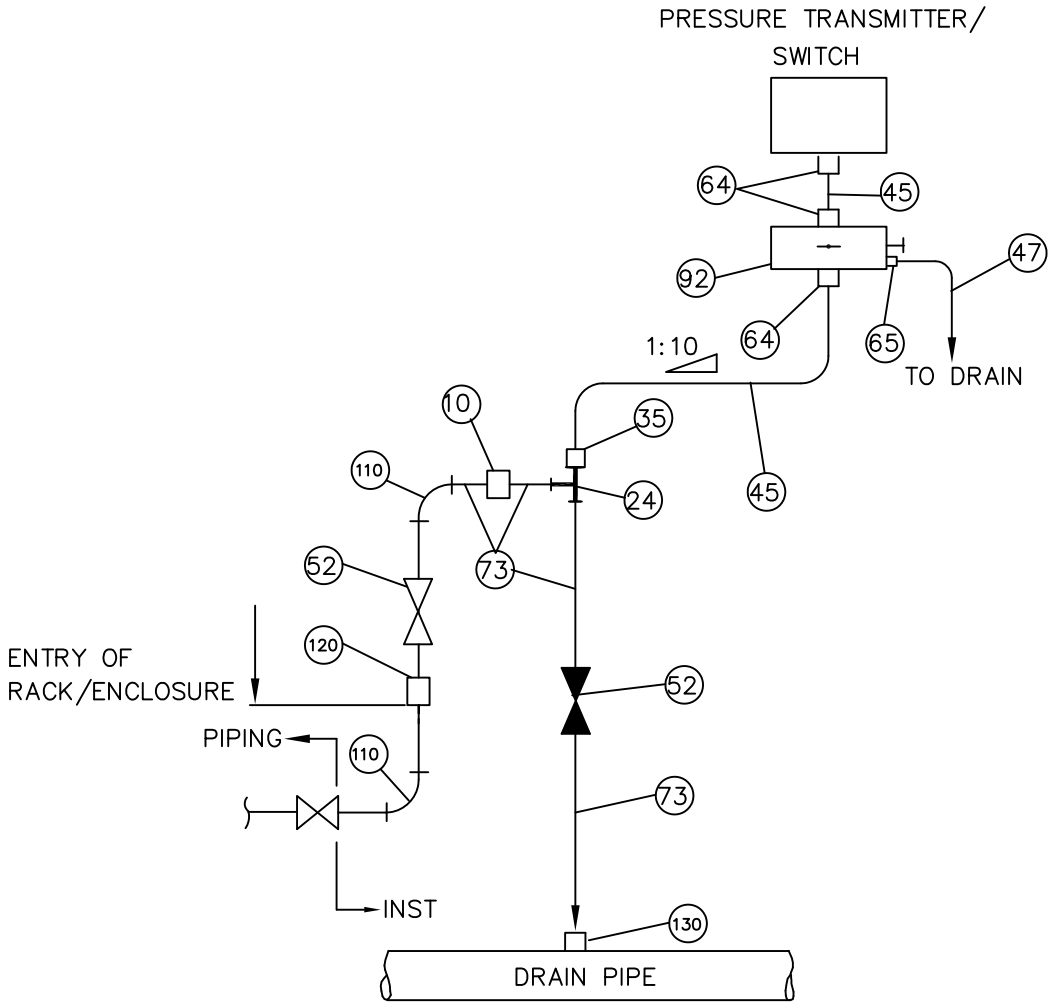
DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS
KOLKATA · MUMBAI · CHENNAI · NEW DELHI

JOB NO. DCPL–K9213R | SCALE NIL | SHT. 2 OF 20

DWG. NO. K9213R–DWG–I–0060 | REV. 0

K9213-DWG-I-0060-2-20-REV-0

PRESSURE TRANSMITTER/PRESSURE SWITCH MOUNTED ABOVE SOURCE POINT



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

SERVICE : CONDENSER PRESSURE, INSTRUMENT AIR ETC.

PRELIMINARY
TENDER PURPOSE ONLY

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

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

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

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

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

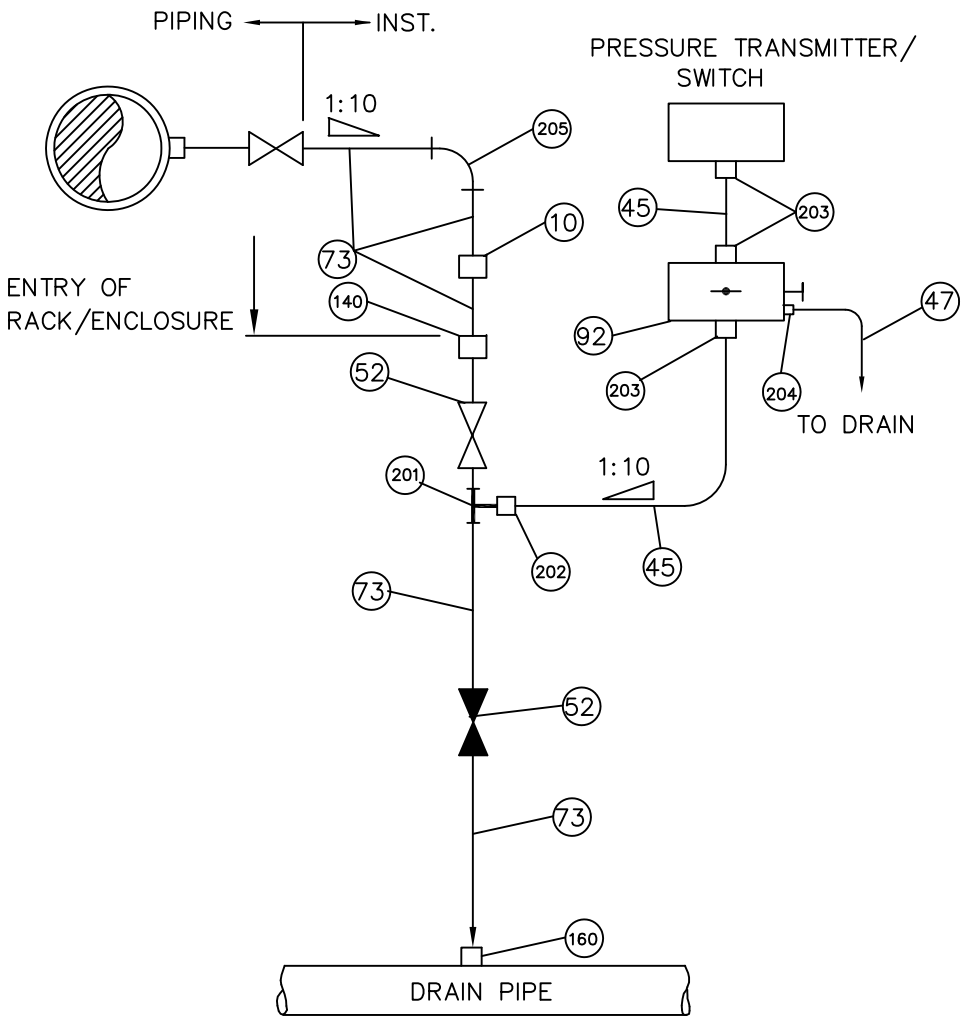
DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS
KOLKATA · MUMBAI · CHENNAI · NEW DELHI

JOB NO. DCPL-K9213R | SCALE NIL | SHT. 3 OF 20

DWG. NO. K9213R-DWG-I-0060 | REV. 0

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

PRESSURE TRANSMITTER/PRESSURE SWITCH MOUNTED BELOW SOURCE POINT



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

SERVICE : CONDENSATE, FEED WATER ETC.

PRELIMINARY
TENDER PURPOSE ONLY

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

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

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

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

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

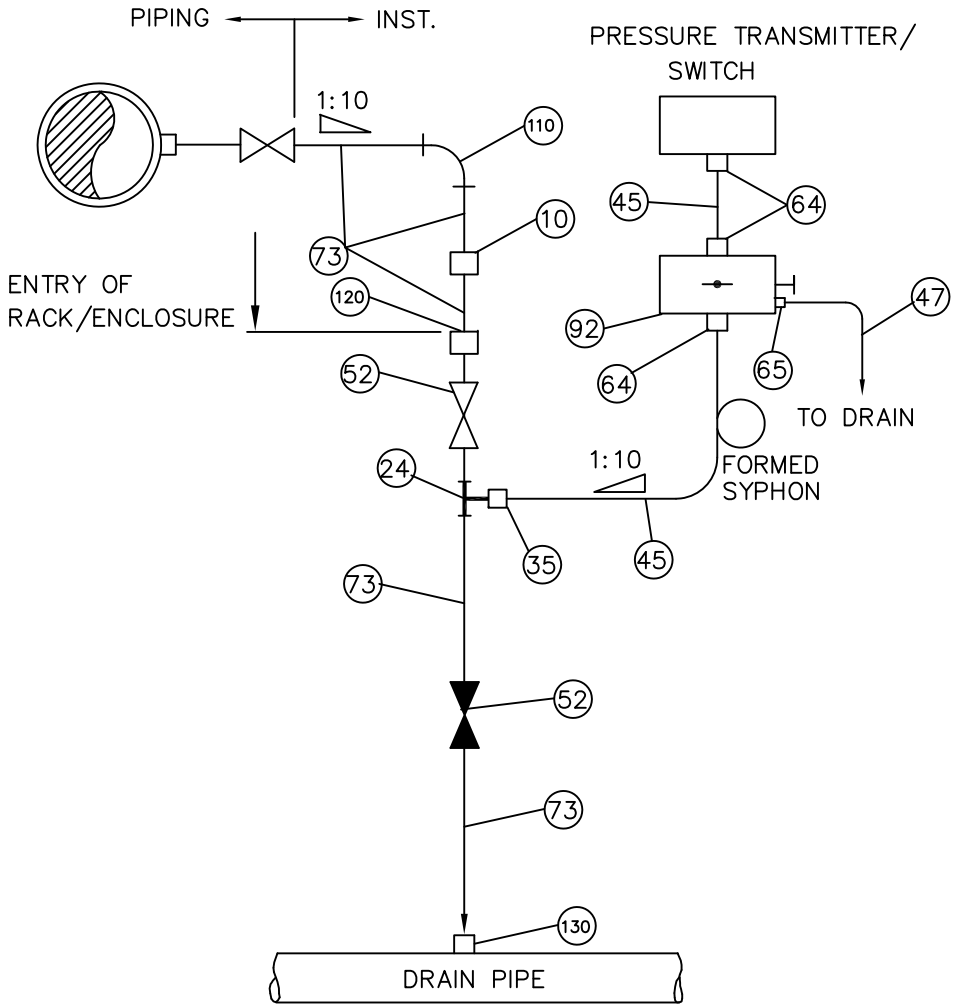
JOB NO. DCPL-K9213R | SCALE NIL | SHT. 4 OF 20

DWG. NO. K9213R-DWG-I-0060 | REV. 0

K9213-DWG-I-0060-4-20-REV-0

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

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



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

SERVICE : LOW PRESSURE STEAM

PRELIMINARY
TENDER PURPOSE ONLY

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

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

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

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

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

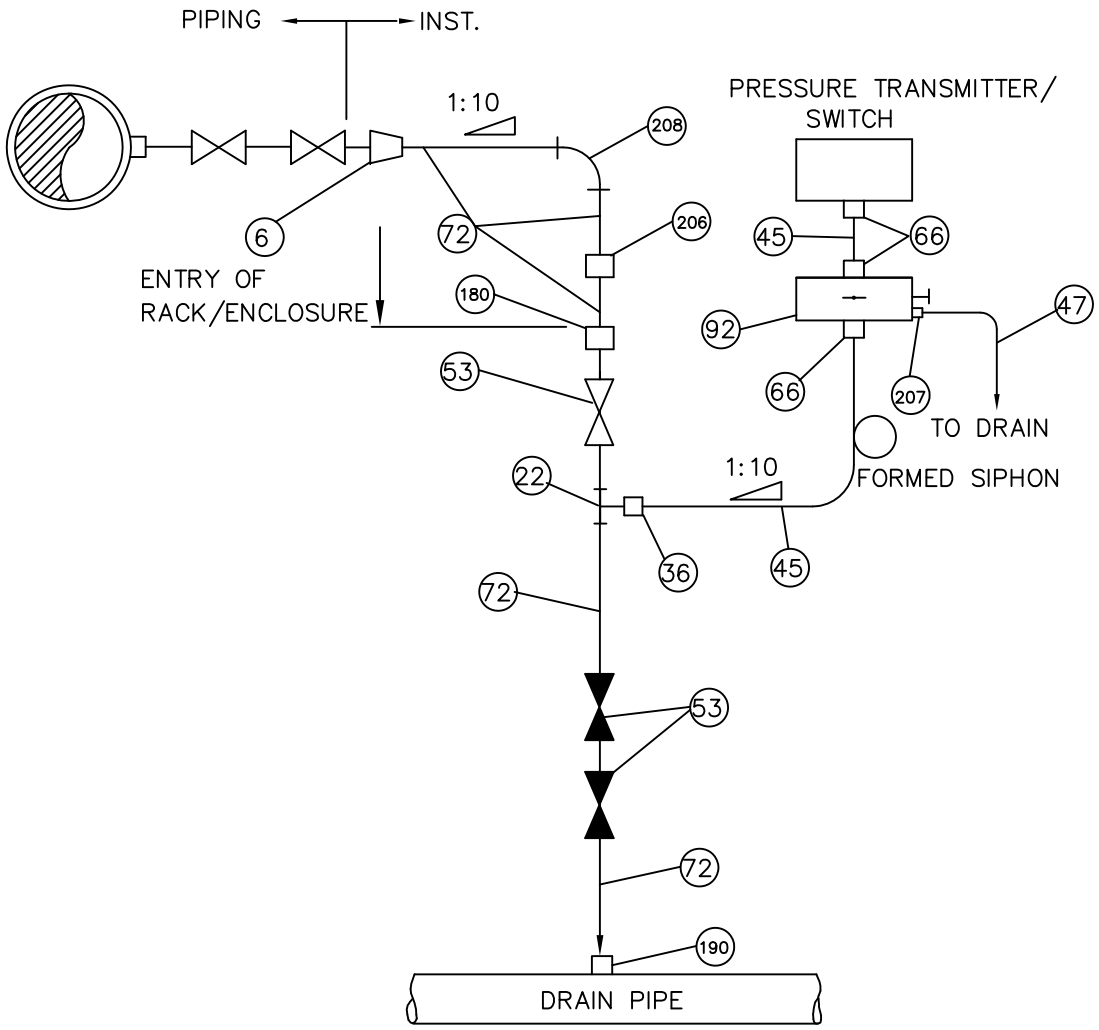
JOB NO. DCPL-K9213R | SCALE NIL | SHT. 5 OF 20

DWG. NO. K9213R-DWG-I-0060 | REV. 0

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

K9213-DWG-I-0060-5-20-REV-0

PRESSURE TRANSMITTER/PRESSURE SWITCH
MOUNTED BELOW SOURCE POINT(WITH CONDENSATE POT)



BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
6	1	REDUCER 1"SW X 1/2"SW 9000lbs
22	1	EQUAL TEE (FEMALE)1/2" SW 9000lbs
36	1	MALE CONNECTOR 1/2" PE X 1/2" OD 9000 lbs
53	3	GLOBE VALVES 1/2" SW 1500 lbs
45	3 Mtrs	TUBE 1/2" OD 2.1 MM THICK
66	3	MALE CONNECTOR 1/2" NPT(M) X 1/2" OD 9000 lbs
72	15Mtrs	IMPULSE PIPE 15 NB SCH. 80
92	1	2 VALVES MANIFOLD 1/2" NPT(F)
206	1	FULL COUPLING 1/2" SW 9000lbs
47	0.15Mtrs	TUBE 8 MM OD 1.0 MM THICK
207	1	MALE CONNECTOR 1/4" NPT(M) X 8 MM OD 9000 lbs
180	1	BULK HEAD UNION/COUPLING CL:9000 LBS–AS PER ANSI B16.11,1/2" NB–SW
190	1	HALF COUPLING CL:9000LBS/ 1/2" NB–SW AS PER ANSI B16.11
208	1	90° ELBOW 1/2" SW CL:9000 lbs

SERVICE : MEDIUM & HIGH PRESSURE STEAM

PRELIMINARY
TENDER PURPOSE ONLY

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

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

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

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

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

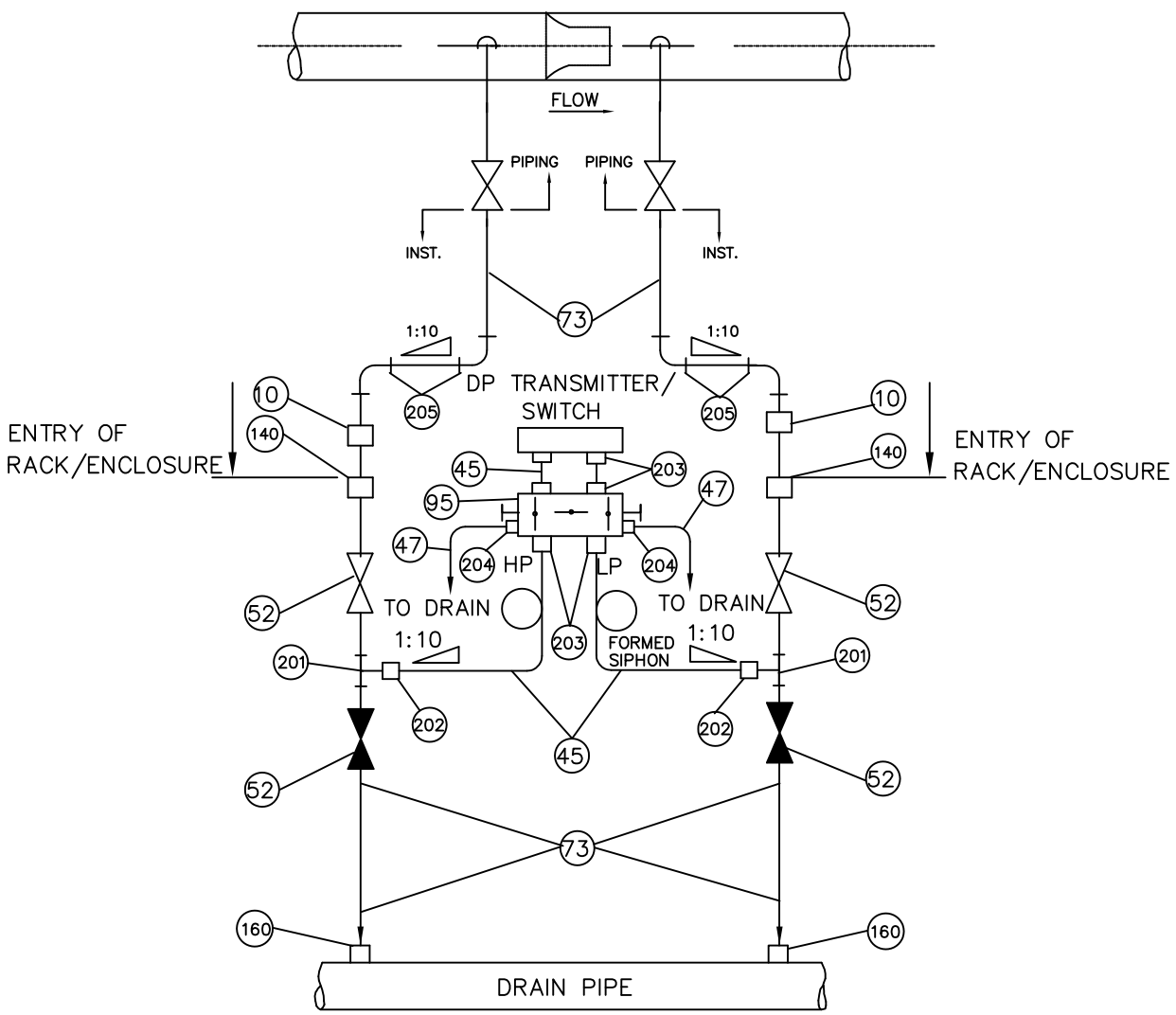
JOB NO. DCPL–K9213R | SCALE NIL | SHT. 6 OF 20

DWG. NO. K9213R–DWG–I–0060 | REV. 0

K9213-DWG-I-0060-6-20-REV-0

A4_H (08–'06) [297 x 210]

DIFF. PRESS.TRANSMITTER/DIFF.PRESS.SWITCH MOUNTED BELOW SOURCE POINT



BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
201	2	EQUAL TEE (FEMALE)1/2" SW 6000lbs
202	2	MALE CONNECTOR 1/2" PE X 1/2" OD 6000 lbs
52	4	GLOBE VALVES 1/2" SW 600lbs
45	6 Mtrs	TUBE 1/2" OD 2.1 MM THICK
203	6	MALE CONNECTOR 1/2" NPT(M) X 1/2" OD 6000 lbs
73	30Mtrs	IMPULSE PIPE 15 NB GR.B SCH 80
95	1	5 VALVE MANIFOLD 1/2" NPT(F)
10	2	FULL COUPLING 1/2" SW 6000lbs
47	0.3Mtrs	TUBE 8 MM OD 1.0 MM THICK
204	2	MALE CONNECTOR 1/4" NPT(M) X 8 MM OD 6000 lbs
205	4	90° ELBOW 1/2" SW 6000lbs
140	2	BULK HEAD UNION/COUPLING CL:6000 LBS/ 1/2" NB-SW AS PER ANSI B16.11
160	2	HALF COUPLING CL:6000 LBS/ 1/2" NB-SW AS PER ANSI B16.11

SERVICE : CONDENSATE,FEED WATER ETC.

PRIMARY ELEMENT : FLOW NOZZLE/ORIFICE

PRELIMINARY
TENDER PURPOSE ONLY

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

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

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

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

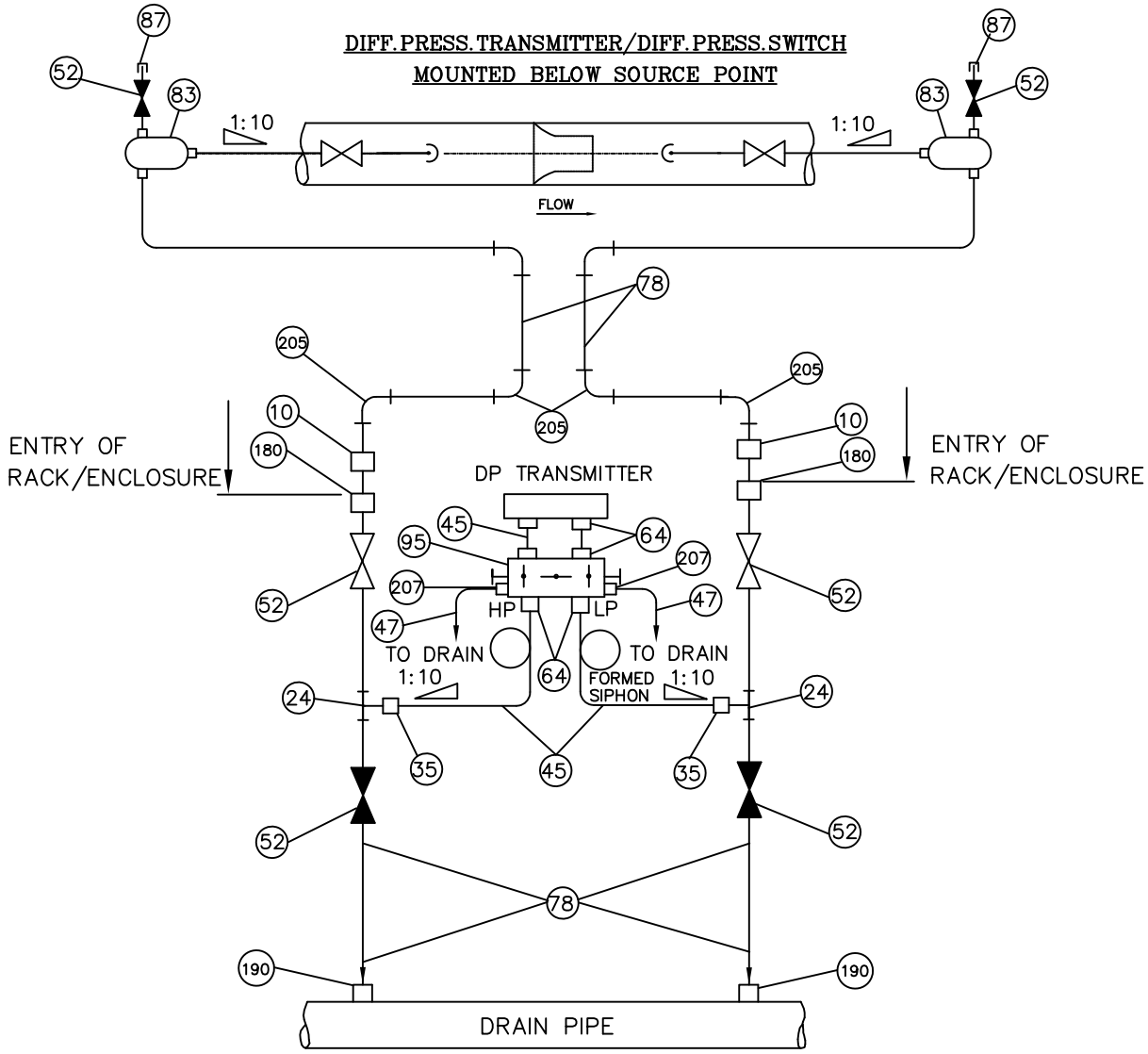
DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS
KOLKATA · MUMBAI · CHENNAI · NEW DELHI

JOB NO. DCPL-K9213R | SCALE NIL | SHT. 7 OF 20

DWG. NO. K9213R-DWG-I-0060 | REV. 0

K9213-DWG-I-0060-7-20-REV-0

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



BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
24	2	EQUAL TEE (FEMALE)1/2" SW 9000lbs
35	2	MALE CONNECTOR 1/2" PE X 1/2" OD 9000 lbs
52	6	GLOBE VALVES 1/2" SW 600lbs
45	6Mtrs.	TUBE 1/2" OD 2.1 MM THICK
64	6	MALE CONNECTOR 1/2" NPT(M) X 1/2" OD 9000 lbs
78	30Mtrs	IMPULSE PIPE 15 NB SCH 80
95	1	5 VALVES MANIFOLD 1/2" NPT(F)
10	2	FULL COUPLING 1/2" SW 9000lbs
83	2	CONDENSATION POT 1/2" SW NPT(F) 9000 lbs
87	2	PLUG 1/2" NPT(F) 9000lbs
47	0.3Mtrs	TUBE 8 MM OD 1.0 MM THICK
207	2	MALE CONNECTOR 1/4" NPT(M) X 8 MM OD 9000 lbs
205	6	90° ELBOW 1/2" SW 9000lbs
180	2	BULK HEAD UNION/COUPLING CL:9000 LBS–AS PER ANSI B16.11,1/2" NB–SW
190	2	HALF COUPLING CL:9000 LBS/ 1/2" NB–SW AS PER ANSI B16.11

SERVICE : STEAM

PRIMARY ELEMENT : FLOW NOZZLE/ORIFICE

PRELIMINARY
TENDER PURPOSE ONLY

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

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

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

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

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

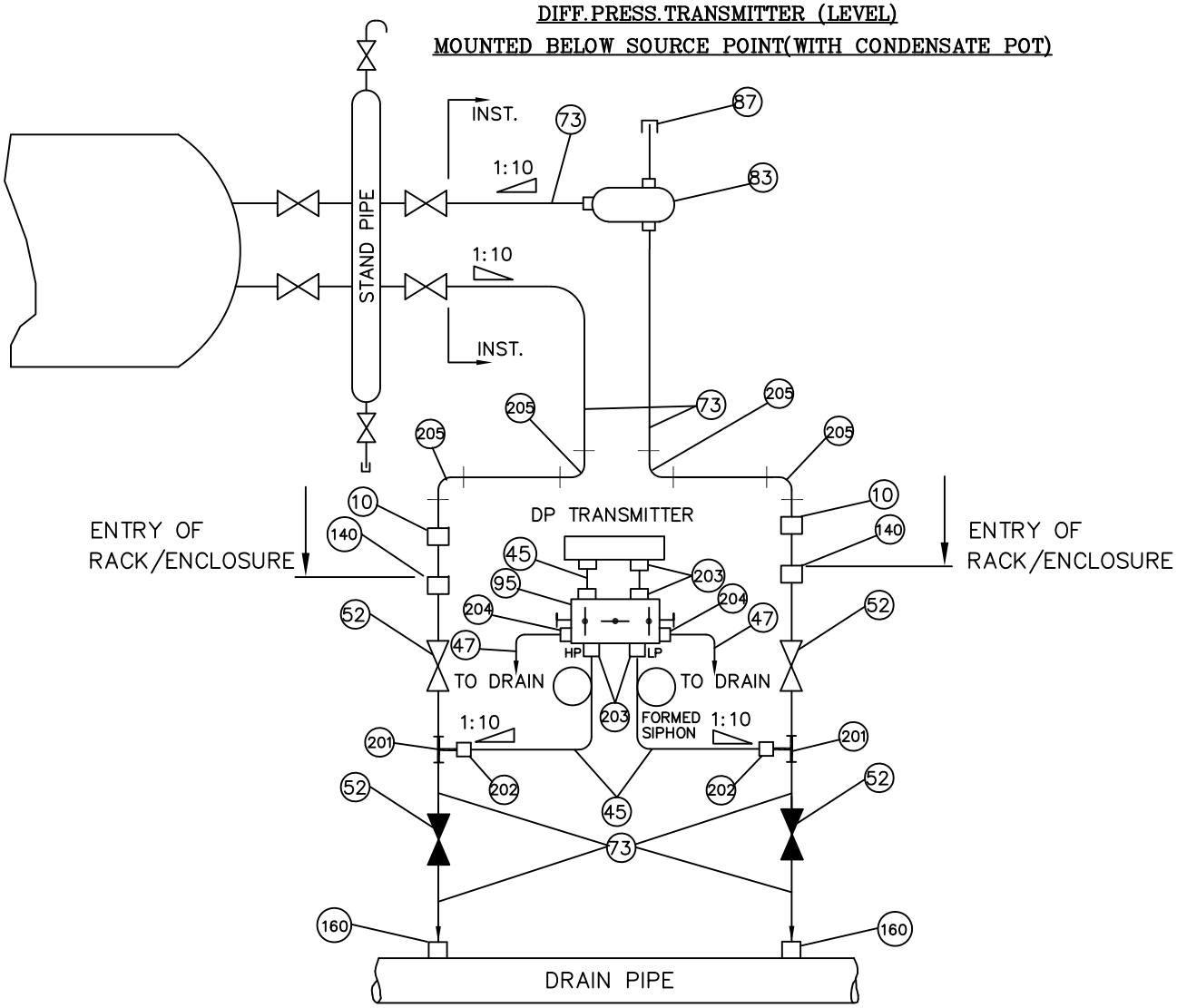
JOB NO. DCPL–K9213R | SCALE NIL | SHT. 8 OF 20

DWG. NO. K9213R–DWG–I–0060 | REV. 0

K9213-DWG-I-0060-8-20-REV-0

A4_H (08–'06) [297 x 210]

DIFF. PRESS. TRANSMITTER (LEVEL)
MOUNTED BELOW SOURCE POINT(WITH CONDENSATE POT)



BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
201	2	EQUAL TEE (FEMALE)1/2" SW 6000lbs
202	2	MALE CONNECTOR 1/2" PE X 1/2" OD 6000 lbs
52	4	GLOBE VALVES 1/2" SW 600lbs
45	6Mtrs.	TUBE 1/2" OD 2.1 MM THICK
203	6	MALE CONNECTOR 1/2" NPT(M) X 1/2" OD 6000 lbs
73	30Mtrs	IMPULSE PIPE 15 NB SCH 80
95	1	5 VALVES MANIFOLD 1/2" NPT(F)
10	2	FULL COUPLING 1/2" SW 6000lbs
83	1	CONDENSATE POT 1/2" SW 6000lbs
87	1	PLUG 1/2" NPT(M) 6000lbs
205	4	90° ELBOW 1/2" SW 6000lbs
47	0.3Mtrs.	TUBE 8 MM OD 1.0 MM THICK
204	2	MALE CONNECTOR 1/4" NPT(M) X 8 MM OD 6000 lbs
140	2	BULK HEAD UNION/COUPLING CL:6000 LBS–AS PER ANSI B16.11,1/2" NB–SW
160	2	HALF COUPLING CL:6000 LBS/ 1/2" NB–SW AS PER ANSI B16.11

SERVICE : BOILER DRUM, DEAERATOR, HEATERS

PRELIMINARY
TENDER PURPOSE ONLY

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

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

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

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

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

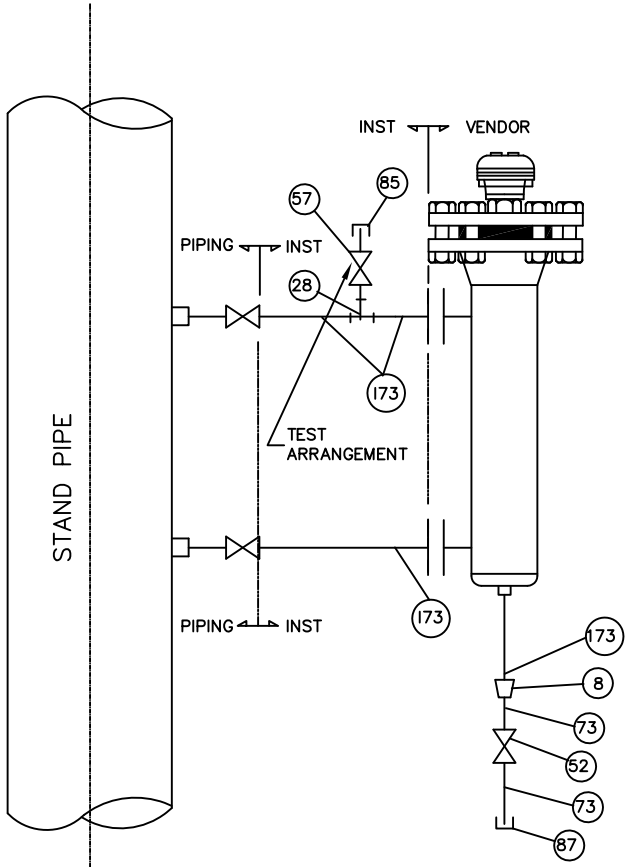
JOB NO. DCPL–K9213R | SCALE NIL | SHT. 9 OF 20

DWG. NO. K9213R–DWG–I–0060 | REV. 0

A4_H (08–'06) [297 x 210]

K9213-DWG-I-0060-9-20-REV-0

FLOAT OPERATED LEVEL SWITCH



BILL OF MATERIALS		
ITEM NO	QTY/ INST	DESCRIPTION
52	1	GLOBE VALVE 1/2" SW 600lbs
73	0.5Mtrs	IMPULSE PIPE 15 NB SCH.80
87	1	PULG 1/2" NPT(M) 3000lbs
28	2	EQUAL TEE (FEMALE) 1" SW 3000lbs
173	1 Mtrs	IMPULSE PIPE 25 NB SCH.80
8	1	REDUCER 1" SW X 1/2" SW 3000lbs
57	1	GLOBE VALVE 1" SW 600 lbs
85	1	PLUG 1" NPT(F) 3000 lbs

SERVICE : CONDENSATE

PRELIMINARY
TENDER PURPOSE ONLY

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

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

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

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

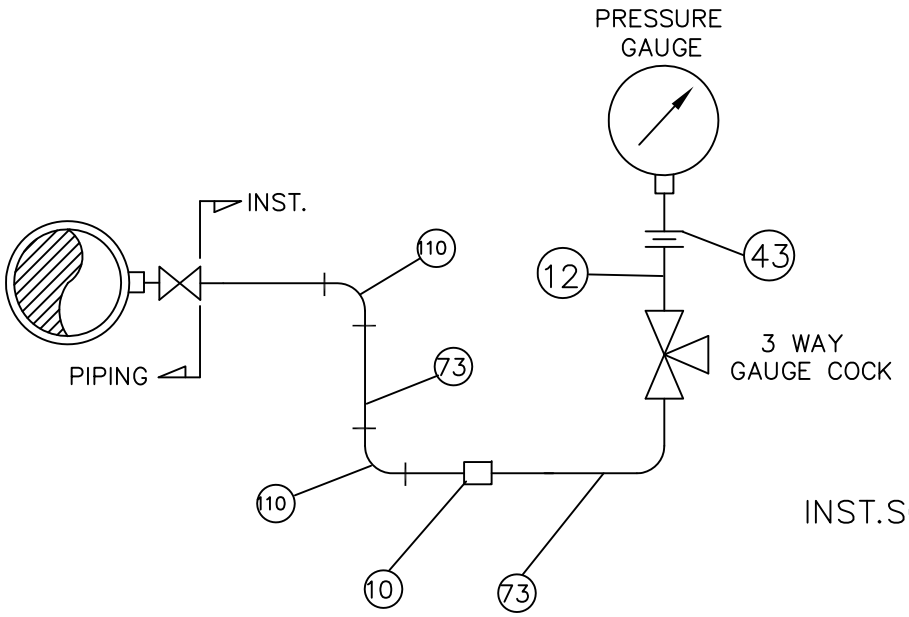
DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS
KOLKATA · MUMBAI · CHENNAI · NEW DELHI

JOB NO. DCPL–K9213R | SCALE NIL | SHT. 10 OF 20

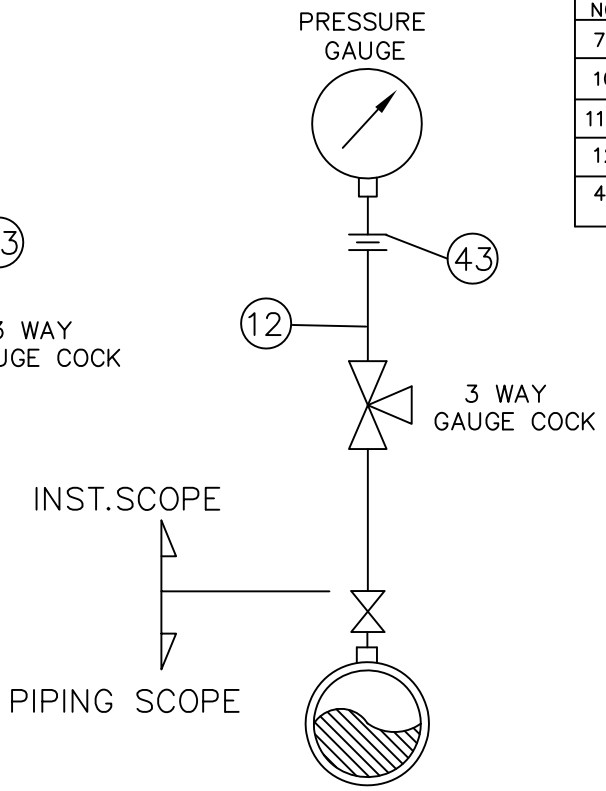
DWG. NO. K9213R–DWG–I–0060 | REV. 0

K9213-DWG-I-0060-10-20-REV-0

A4_H (08–'06) [297 x 210]



REMOTE MOUNTING



ON TAP MOUNTING

BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
73	15Mtrs	IMPULSE PIPE 15 NB SCH.80
10	1	FULL COUPLING 1/2" SW 3000lbs
110	2	90° ELBOW 1/2" SW 3000lbs
12	1	1/2" NPT(M) X 1/2" PE 4" LONG NIPPLE
43	1	NUT & TAIL FITTING WITH CU WASHER 1/2" NPT(F) X 1/2" PE

SERVICE : WATER, CONDENSATE ETC.

PRELIMINARY
TENDER PURPOSE ONLY

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

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

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

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

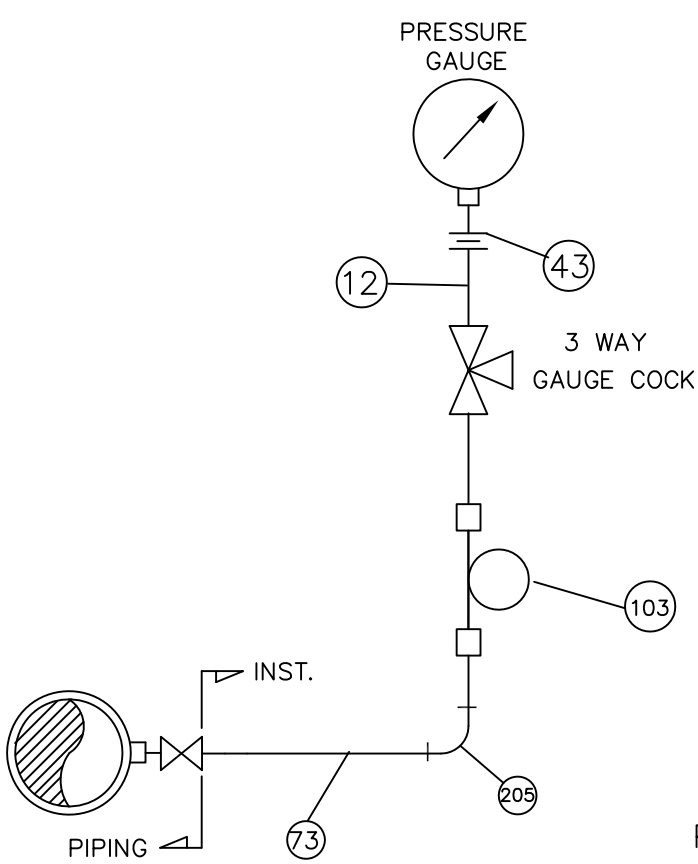
DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS
KOLKATA · MUMBAI · CHENNAI · NEW DELHI

JOB NO. DCPL–K9213R | SCALE NIL | SHT. 11 OF 20

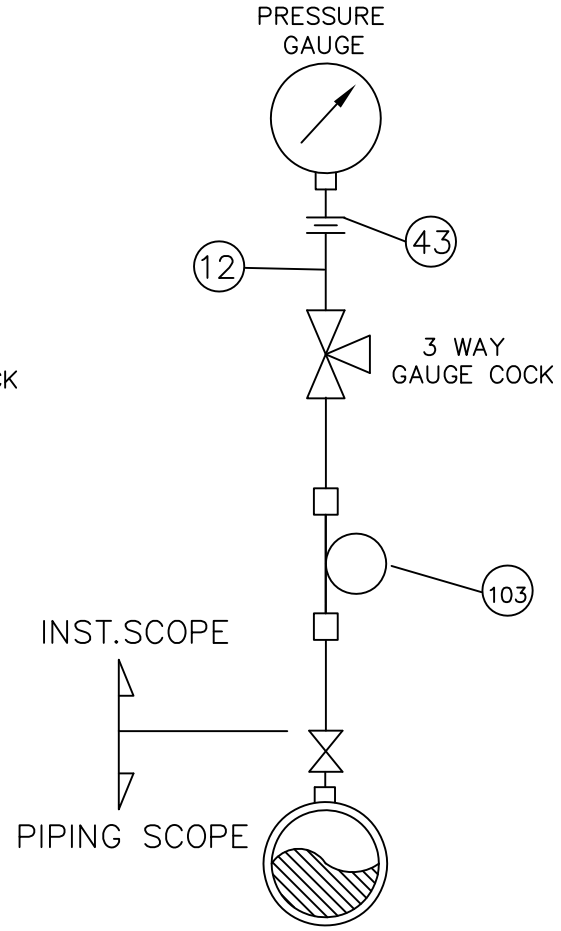
DWG. NO. K9213R–DWG–I–0060 | REV. 0

K9213-DWG-I-0060-11-20-REV-0

A4_H (08–'06) [297 x 210]



REMOTE MOUNTING



ON TAP MOUNTING

BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
73	15Mtrs	IMPULSE PIPE 15 NB SCH.80
205	2	90° ELBOW 1/2" SW 6000lbs
12	1	1/2" NPT(M) X 1/2" PE 4" LONG NIPPLE
43	1	NUT & TAIL FITTING WITH SS WASHER 1/2"NPT(F) X 1/2" PE
103	1	SYPHON 1/2" OD SCH.80

SERVICE : STEAM, FEED WATER

PRELIMINARY
TENDER PURPOSE ONLY

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

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

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

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

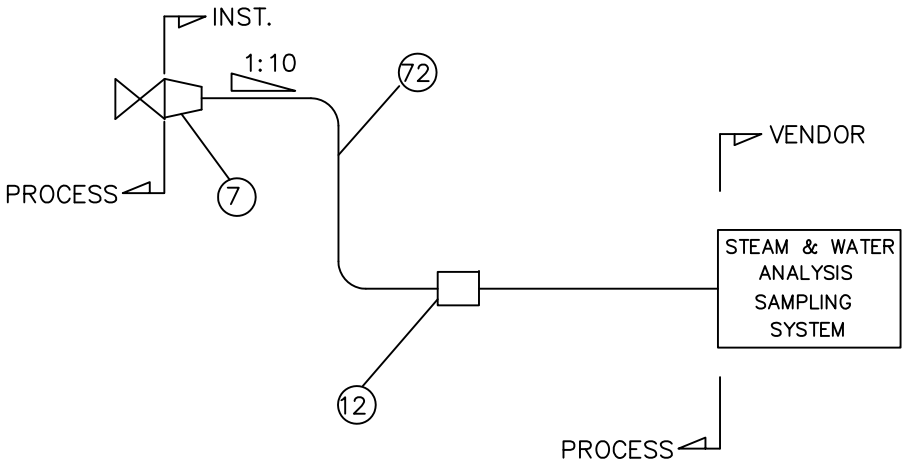
DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS
KOLKATA · MUMBAI · CHENNAI · NEW DELHI

JOB NO. DCPL–K9213R | SCALE NIL | SHT. 12 OF 20

DWG. NO. K9213R–DWG–I–0060 | REV. 0

K9213-DWG-I-0060-12-20-REV-0

A4_H (08–'06) [297 x 210]



BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
12	1	FULL COUPLING 1/2" SW 6000 lbs
7	1	REDUCER 1" SW X 1/2" SW 6000 lbs
72	A/R	IMPULSE PIPE 15 NB SCH 80

PRELIMINARY
TENDER PURPOSE ONLY

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

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

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

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

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

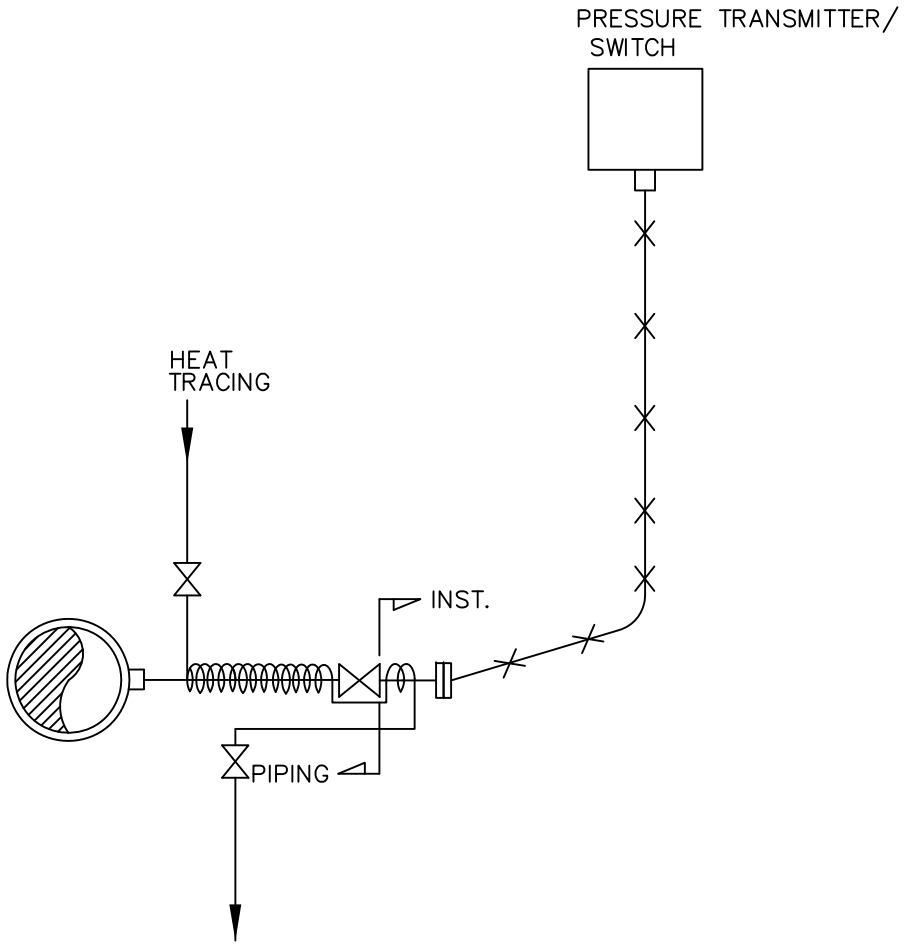
JOB NO. DCPL–K9213R | SCALE NIL | SHT. 13 OF 20

DWG. NO. K9213R–DWG–I–0060 | REV. 0

K9213-DWG-I-0060-13-20-REV-0

A4_H (08–'06) [297 x 210]

PRESSURE TRANSMITTER/PRESSURE SWITCH
IN HFO SERVICE



PRELIMINARY
TENDER PURPOSE ONLY

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

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

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

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

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

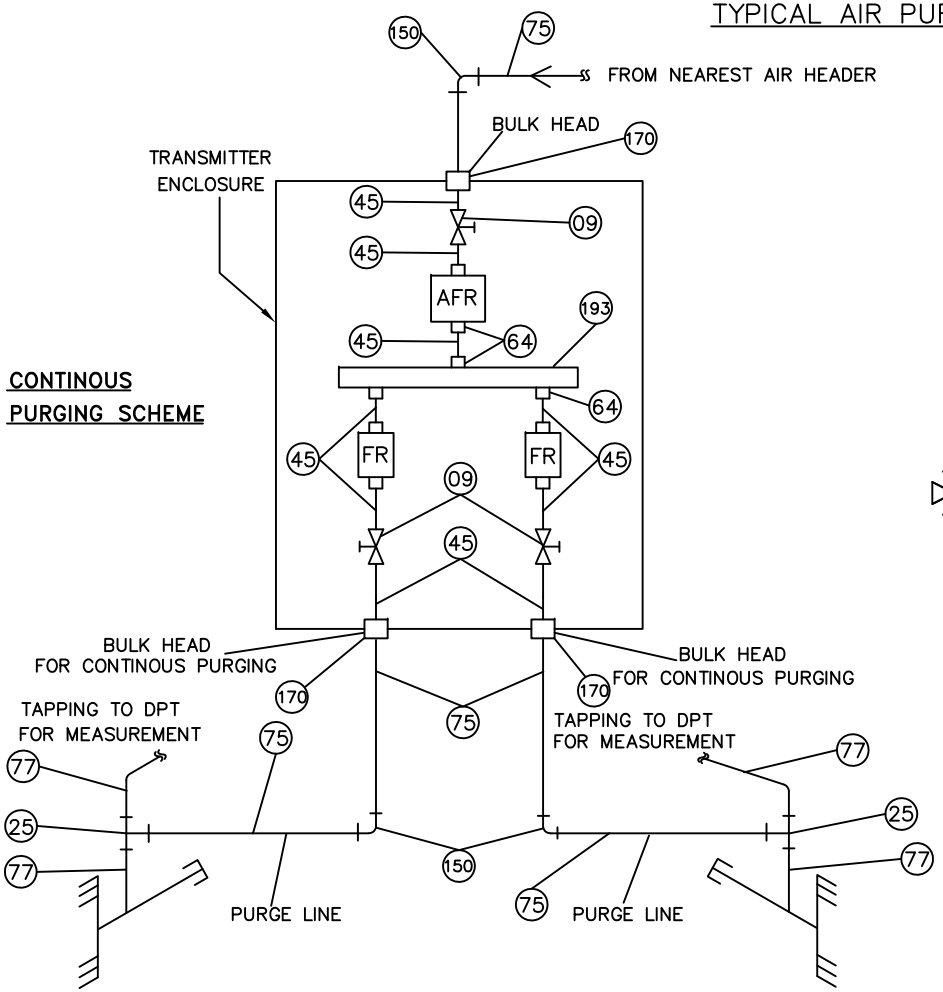
JOB NO. DCPL–K9213R | SCALE NIL | SHT. 14 OF 20

DWG. NO. K9213R–DWG–I–0060 | REV. 0

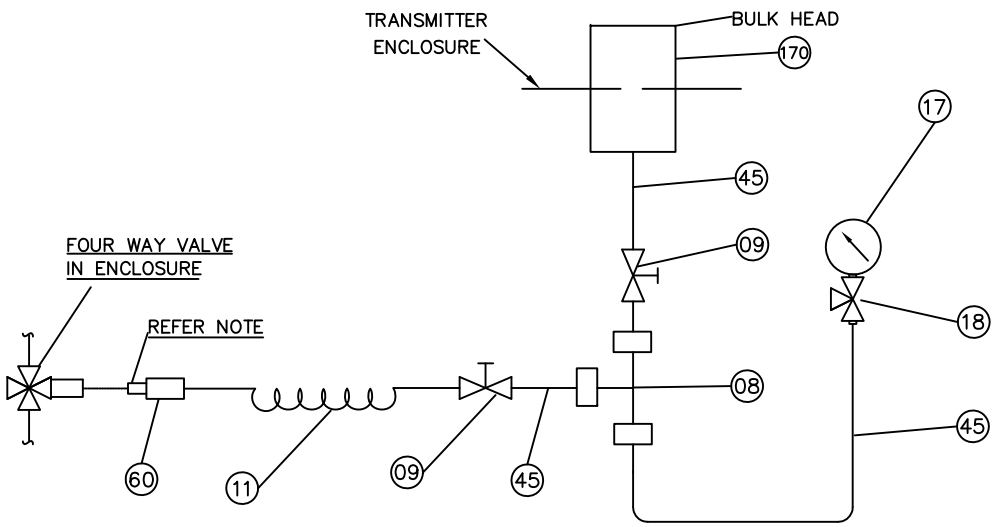
K9213-DWG-I-0060-14-20-REV-0

A4_H (08–'06) [297 x 210]

TYPICAL AIR PURGING SCHEMES



CONTINOUS PURGING SCHEME



INTERMITTENT PURGING SCHEME

NOTE:

QUICK DISCONNECTING FITTING IS CONNECTED TO FOUR WAY VALVE WHERE INTERMITTENT PURGING IS CALLED IN SCHEME.

FR–FLOW REGULATOR

CONTINUE TO SHT. NO. 16/20

PRELIMINARY
TENDER PURPOSE ONLY

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

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

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

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

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

JOB NO. DCPL–K9213R | SCALE NIL | SHT. 15 OF 20

DWG. NO. K9213R–DWG–I–0060 | REV. 0

K9213-DWG-I-0060-15-20-REV-0

A4_H (08–'06) [297 x 210]

BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
77	15Mtrs	IMPULSE PIPE 3/4" NB
75	A/R	GI PIPE/1/2" NB
25	2	FORGED UNEQUAL TEE/AS PER ANSI B16.11 SIZE: 2 X 3/4" NB SW X 1/2"NPTF/CL 3000
150	3	GALVANISED ELBOW CL 3000 SIZE: 1/2" NPTF
60	1	QUICK DISCONNECTING FITTING MALE/END CONN. TO SUIT 1/2" OD CONN.
11	A/R	NYLON NOSE TO SUIT 1/2" END CONN./Pr. TESTING 10 Kg/cm^2
45	A/R	SEAMLESS TUBE 1/2" OD TUBE X 2.1 MM THK.
170	3	BULK HEAD COUPLING TO SUIT 1/2" OD TUBE & 1/2" NB PIPE
09	5	BALL VALVETO SUIT 1/2" OD TUBE
64	9	MALE CONNECTOR 1/2" NPT(M) X 1/2" OD 3000lbs
193	1	INSTRUMENT AIR HEADER 1" NB PIPE
08	1	EQUAL TEE/SS 316/TO SUIT 1/2" OD TUBE.
17	1	Pr. GAUGE/4" DIAL SIZE/RANGE 0–10 Kg/cm^2 CONNECTION 1/2" NPTM
18	1	3 WAY GAUGE 1/2"NPTF X TO SUIT 1/2" TUBE.

PRELIMINARY
TENDER PURPOSE ONLY

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

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

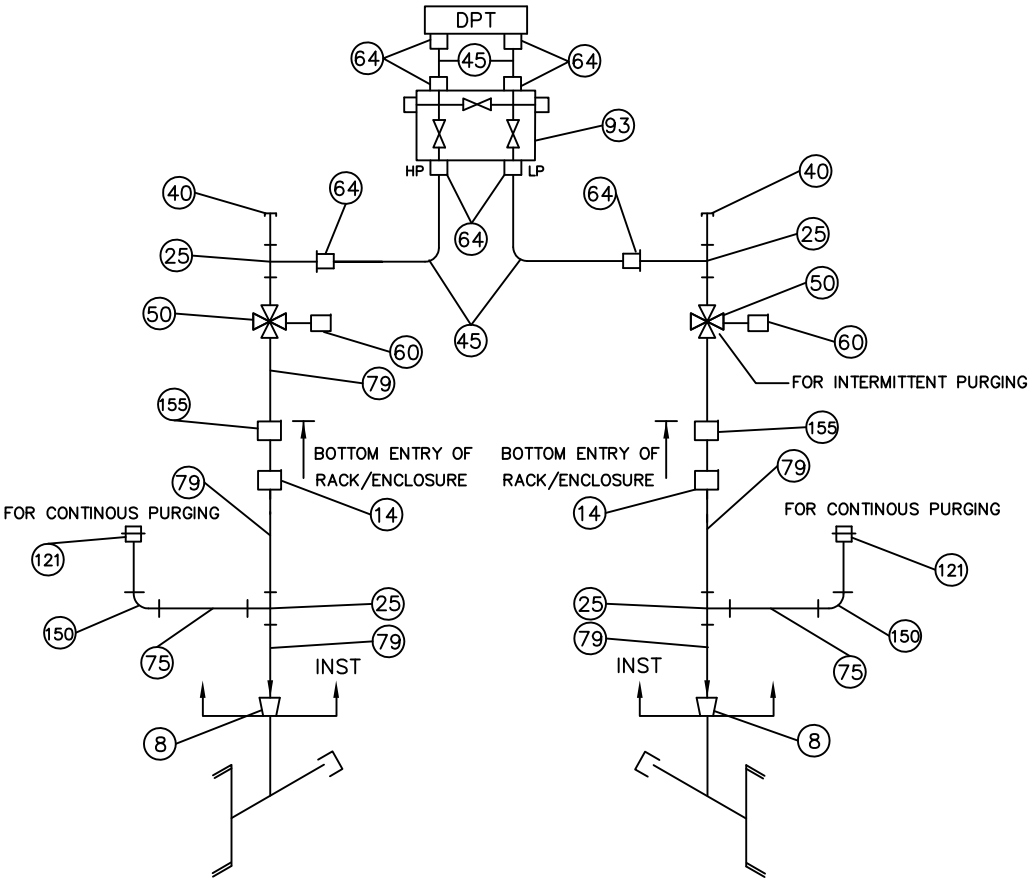
1x800MW SUPER CRITICAL THERMAL POWER PROJECT
(UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

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

JOB NO. DCPL–K9213R | SCALE NIL | SHT. 16 OF 20

DWG. NO. K9213R–DWG–I–0060 | REV. 0



BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
8	2	REDUCER 1" BSPF X 3/4" NB–SW CL 3000
14	2	FORGED COUPLING 3/4" SW CL 3000/AS PER ANSI B16.11
25	4	FORGED UNEQUAL TEE AS PER ANSI B16.11 SIZE : 2 X 3/4" NB–SW X 1/2" NPTF/CL3000
40	2	NIPPLE & CAP 3/4" NB–SCH 80/CAP–3/4" NPTF
45	6 Mtrs.	SEAMLESS TUBE 1/2" OD X 2.1 MM THK.
50	2	FOUR WAY VALVE SIZE :(2 X 3/4" NB–SW)X(2 X 1/2"NPTF) CL:800
60	2	QUICK DISCONNECTING FITTING SIZE:1/2"NPTM
64	8	MALE CONNECTOR 1/2" NPT(M) X TO SUIT 1/2" OD TUBE
79	30Mtrs	SEAMLESS PIPE/3/4" NB SCH 80
75	A/R	PIPE AS PER IS–1239 SIZE :1/2" NB–HEAVY GRADE
93	1	3 VALVE MANIFOLD 1/2" NPT(F)
150	2	GALVANISED ELBOW CL 3000 SIZE :1/2" NPTF
155	2	BULK HEAD COUPLING CL 3000 SIZE :3/4" NB SW /CL 3000/AS PER ANSI B16.11
121	2	BULK HEAD COUPLING CL 3000 SIZE :1/2" NPTF /AS PER ANSI B16.11

SERVICE : FLUE GAS, FURNACE ETC.

PRELIMINARY
TENDER PURPOSE ONLY

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

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

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

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

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

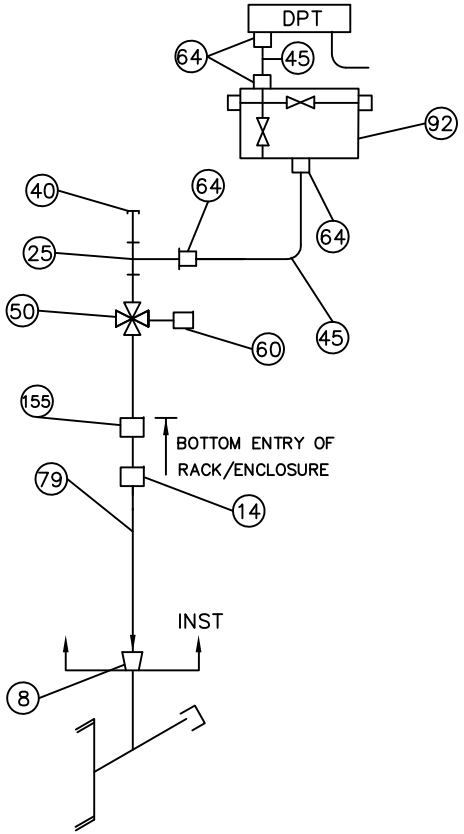
JOB NO. DCPL–K9213R | SCALE NIL | SHT. 17 OF 20

DWG. NO. K9213R–DWG–I–0060 | REV. 0

K9213-DWG-I-0060-17-20-REV-0

A4_H (08–'06) [297 x 210]

DIFF. PRESSURE TRANSMITTER
MOUNTED ABOVE SOURCE POINT



BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
8	1	REDUCER 1" BSPF X 3/4" NB–SW CL 3000
14	1	FORGED COUPLING 3/4" SW CL 3000/AS PER ANSI B16.11
25	1	FORGED UNEQUAL TEE AS PER ANSI B16.11 SIZE : 2 X 3/4" NB–SW X 1/2" NPTF/CL3000
40	1	NIPPLE & CAP 3/4" NB–SCH 80/CAP–3/4" NPTF
45	6 Mtrs.	SEAMLESS TUBE 1/2" OD X 2.1 MM THK.
50	1	FOUR WAY VALVE SIZE :(2 X 3/4" NB–SW)X(2 X 1/2"NPTF) CL:800
60	1	QUICK DISCONNECTING FITTING SIZE:1/2"NPTM
64	3	MALE CONNECTOR /SS 316 1/2" NPT(M) X TO SUIT 1/2" OD TUBE
79	30Mtrs	SEAMLESS PIPE/3/4" NB SCH 80
92	1	2 VALVE MANIFOLD 1/2" NPT(F)
155	1	BULK HEAD COUPLING CL 3000 SIZE :3/4" SW /CL 3000/AS PER ANSI B16.11

SERVICE : FLUE GAS, PRIMARY AIR, SECONDARY AIR ETC.

NOTE : AIR PURGING ARRANGEMENT SHALL BE INCLUDED.

PRELIMINARY
TENDER PURPOSE ONLY

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

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

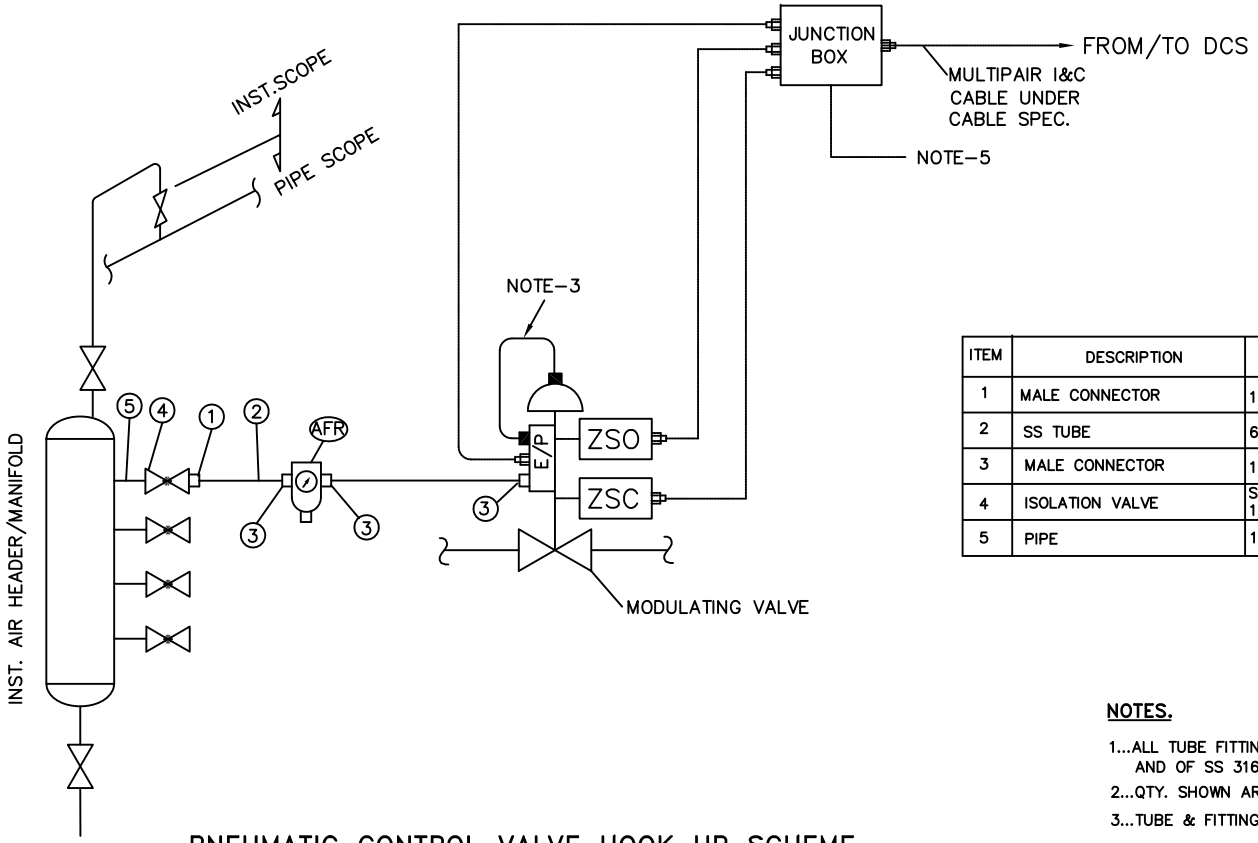
1x800MW SUPER CRITICAL THERMAL POWER PROJECT
(UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

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

JOB NO. DCPL–K9213R | SCALE NIL | SHT. 18 OF 20

DWG. NO. K9213R–DWG–I–0060 | REV. 0



ITEM	DESCRIPTION	SPECIFICATION	QTY.	REMARKS
1	MALE CONNECTOR	1/2"NPT(M) X 6 mm OD COMPRN.	1	
2	SS TUBE	6 mm OD X 1 mm THK.	10 MTRS.	
3	MALE CONNECTOR	1/4"NPT(M) X 6 mm OD COMPRN.	3	
4	ISOLATION VALVE	SS BALL TYPE 600LBS 1/2" SW X 1/2" NPT(F)		
5	PIPE	1/2" NB SCH 40S	A/R	

PNEUMATIC CONTROL VALVE HOOK UP SCHEME

NOTES.

1...ALL TUBE FITTINGS ARE OF DOUBLE COMPRESSION TYPE AND OF SS 316 MATERIAL.

2...QTY. SHOWN ARE TYPICAL FOR ONE INSTALLATION ONLY.

3...TUBE & FITTINGS MARKED ■ ARE INTEGRAL TO THE VALVE.

4...LIMIT SWITCHES WILL BE CONNECTED WHEREVER APPLICABLE.

5...JUNCTION BOX WILL BE INTEGRAL TO ACTUATOR.

6...ISOLATION VALVE SHALL BE INSTALLED CLOSE TO THE VALVE ASSEMBLY.

PRELIMINARY
TENDER PURPOSE ONLY

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

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

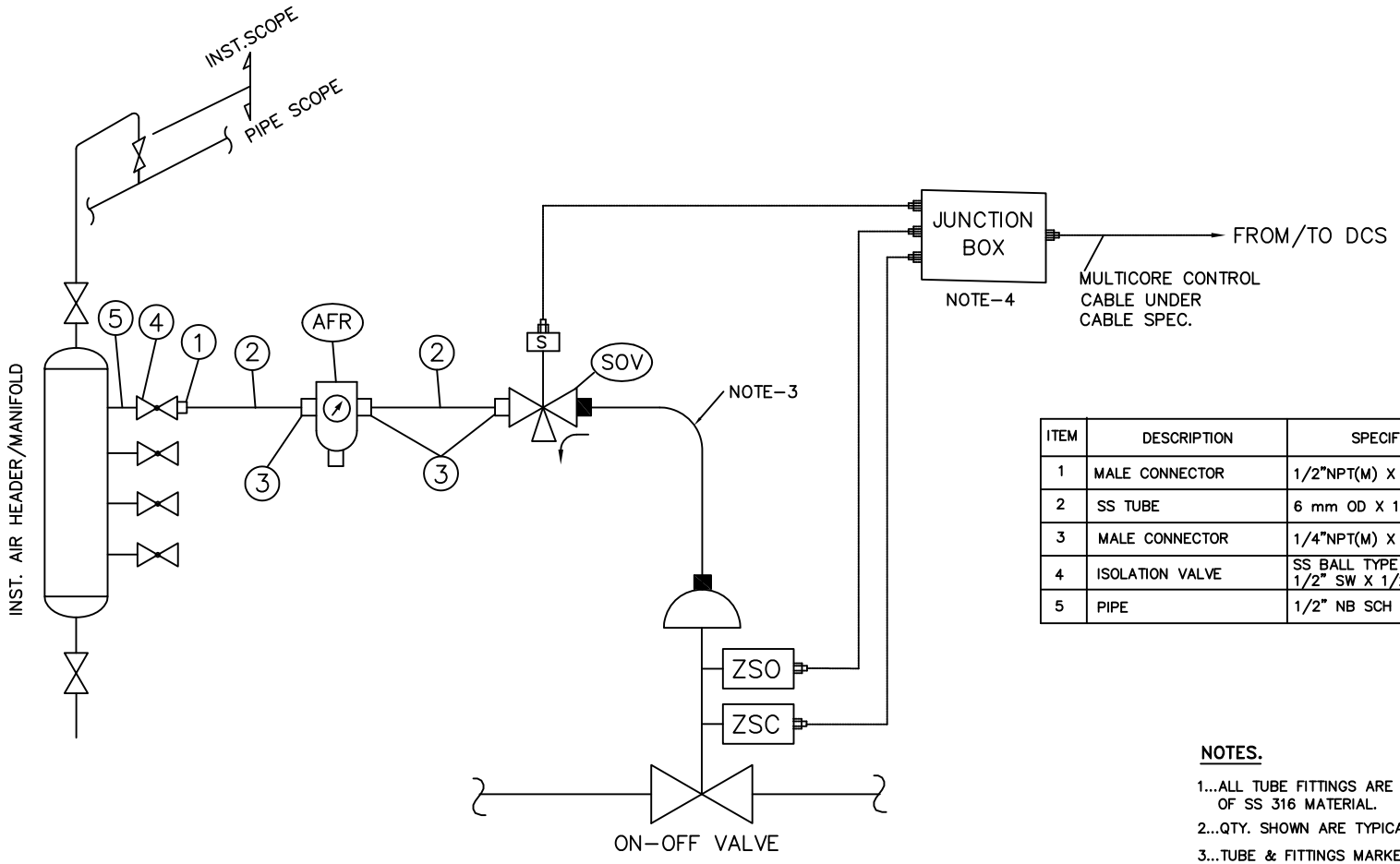
1x800MW SUPER CRITICAL THERMAL POWER PROJECT
(UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

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

JOB NO. DCPL-K9213R | SCALE NIL | SHT. 19 OF 20

DWG. NO. K9213R-DWG-I-0060 | REV. 0



ITEM	DESCRIPTION	SPECIFICATION	QTY.	REMARKS
1	MALE CONNECTOR	1/2"NPT(M) X 6 mm OD COMPRN.	1	
2	SS TUBE	6 mm OD X 1.0 mm THK.	10 MTRS.	
3	MALE CONNECTOR	1/4"NPT(M) X 6 mm OD COMPRN.	3	
4	ISOLATION VALVE	SS BALL TYPE 600LBS 1/2" SW X 1/2" NPT(F)		
5	PIPE	1/2" NB SCH 40S	A/R	

PNEUMATIC SOV HOOK UP SCHEME

NOTES.

1...ALL TUBE FITTINGS ARE OF DOUBLE COMPRESSION TYPE AND OF SS 316 MATERIAL.

2...QTY. SHOWN ARE TYPICAL FOR ONE INSTALLATION ONLY.

3...TUBE & FITTINGS MARKED ■ ARE INTEGRAL TO THE VALVE.

4...JUNCTION BOX WILL BE INTEGRAL TO ACTUATOR.

5...ISOLATION VALVE SHALL BE INSTALLED CLOSE TO THE VALVE ASSEMBLY.

PRELIMINARY
TENDER PURPOSE ONLY

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

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

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

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

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

JOB NO. DCPL–K9213R | SCALE NIL | SHT. 20 OF 20

DWG. NO. K9213R–DWG–I–0060 | REV. 0

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

A4_H (08–'06) [297 x 210]

ANNEXURE-I

LIST OF MAKES OF SUB-VENDOR ITEMS

LIST OF SUB VENDORS (ANNEXURE-I)

SR No.	Items	Approved Vendor	Place / Location	Remarks
1.0	Horziontal/Vertical Centrifugal Pump	KBL	Kirolskarwadi	
		M&P	Pune	
		Flowmore	Ghaziabad	
		Sulzer pumps india ltd.	Navi mumbai	
		Worthington	Ghaziabad	
		Bharat pumps & compressors ltd	Allahabad	
		Flowserve India Controls Pvt. Ltd.	Coimbatore	
		Jyoti ltd.	Vadodara	
2.0	Vertical Centrifugal Pump	Kishore Pump	Pune	
		Sam Turbo	Coimbatore	
		KSB	Pune	
		Best and Crompton	Chennai	
		Voltas	Mumbai	
		V-Flo Pumps & Systems Co. Ltd.,	Beijing, China	
		Kishore Pump	Pune	
3.0	Strainers (Y & Basket Type)	Multitetex Filtration Engg Ltd.	Noida	
		Sarojini Enterprises	Kolkata	
		Otoklin Filters	Mumbai	
		BHATIA ENGINEERING CO.	Delhi	
		JAYPEE INDUSTRIES PVT. LTD.	Delhi	
		FILTERATION ENGINEERS (I) PVT. LTD.	MUMBAI	
		OTOKLIN GLOBAL BUSINESS LIMITED	Mumbai	
		SUNGOV Engg. PVT. LTD.	Delhi	
		Grand Prix	Faridabad	
4.0	Fittings (metallic)	M.S. Fittings	Kolkata	
		Metal lloyds	Mumbai	
		True Forge	Faridabad	
		Tube Products	Baroda	
		NL Hazra	Kolkata	
		Gujrat Infra Pipes	Baroda	
		Edwards	USA	
		Pipefit Engineers	Baroda	
		Siddarth & Gautam	Faridabad	
		EBY	Mumbai	
		Reliance Forge	Mumbai	
5.0	MS/GI ERW Pipes	SAIL	Rourkela	
		Jindal	Ghazibad/ Hissar	Upto 300 NB ERW Pipes as per IS 1239/3589
		Surya Roshni	Bahadur Garh	Upto 400 NB ERW Pipes as per IS 1239/3589 and SAW as per IS 3589
		TATA Tube	Jamshedpur	Upto 150 NB ERW Pipes as per IS 1239
		PSL	Chennai/Vizag/Kutch /Daman	Spiral Weld SAW as per IS 3589
		Lalit Profile	Thane	Spiral Weld SAW as per IS 3589
		Samshi Pipes Industries	Vadodara	Spiral Weld SAW as per IS 3589
		Mukut Pipes	Rajpura	Longitudinal SAW (Single side weld) as per IS 3589
		Indus Tubes	G B Nagar	Upto 300 NB ERW Pipes as per IS 1239/3589
		Mann Ind	Indore	Spiral Weld SAW as per IS 3589
		Surendra Engg	Rajpura	Spiral Weld SAW as per IS 3589
		Pratibha Pipes & Structure Pvt Ltd	Thane	Spiral Weld SAW as per IS 3589
		JCO Gas Pipe	Chindwara	Spiral Weld SAW as per IS 3589
		Nukat Tanks and Vessels	Tarapur	Longitudinal SAW (Single side weld) as per IS 3589
		DADU Pipes	Sikrandrabad	Upto 300 NB ERW Pipes as per IS 1239/3589
		Good Luck Tubes	Sikandrabad	
		Advance Steel Tubes	Sahibabad	
		Bihar Tubes	Sikandrabad	
		Hi Tech Pipes	Sikandrabad	
		Ratnamani	Kutch/Ahmedabad/C hhatral	Upto 400 NB ERW Pipes as per IS 3589 and SAW as per IS 3589
		Maharashtra Seamless	Raigad	200-500 NB ERW Pipes as per IS 3589
		Welspun	Anjar/Bharuch	Upto 400 NB ERW Pipes as per IS 1239/ 3589 and SAW as per IS 3589
6.0	Seamless Pipes	ISMT	Ahmednagar/Baramati	
		Maharashtra Seamless	Raigad	
7.0	S.S. Pipes (For small Quantity 500 m)	REMI	Mumbai	
		Ratmani	Ahmedabad	
		Apex Tubes	Behror	
		Choksi	Ahmedabad	

8.0	CI Gate/ Globe/NRV/ SRV (Manual and motorized)	H.Sarkar	Howrah	SIZE UPTO 300NB
		A.V. VALVES LTD	Agra	
		Leader	Jalandhar	
		SURYA VALVES AND INSTRUMENTS MFG CO.	Chennai	FOR GV UPTO 450NB,GLV UPTO 300NB AND CHECK VALVES UPTO 350NB.
		ATAM VALVES PVT. LTD.	JALANDHAR	(1) CARBON IRON GATE VALVES: 65 NB TO 450 NB (UPTO PN-16.0) (2) CARBON IRON GLOBE VALVES & NON RETURN VALVES: 65 NB TO 150 NB (UPTO PN-16.0)
		FLUIDLINE VALVES COMPANY PVT.LTD.	Mumbai	1. CI Gate- CL125 & up to 900 NB, 2. CI Globe- CL125 & up to 450 NB, 3. CI SCNRV- CL125 & up to 600 NB.
		G.M. DALUI AND SONS PVT.LTD.	Howrah	
		KBL	Kondhapuri	Additionally approved for FM approved Gate valve 50-250 NB
		Bankim	Kolkata	
		VENUS PUMPS AND ENGG. WORKS	Kolkata	1) CI GATE VALVE SIZES 65NB-800NB ,2) CI GLOBE VALVE FOR SIZES 65NB-400 NB AND 3) CI SCNRV FOR SIZES 65 NB -600 NB.
9.0	GM valve	A.V. VALVES LTD	Agra	
		ATAM VALVES PVT. LTD.	Mumbai	GUN METAL GATE/GLOBE/NRV: 15 NB TO 50 NB (UPTO PN-16.0) & 15 NB TO 50 NB (UPTO #150)
		Leader	Jalandhar	
		VALTECH INDUSTRIES		GUN METAL SCREWED END TYPE , SCREWED IN BONNET , OUT SIDE SCREW & YOKE TPE , PN 16 , SIZES UPTO 50.
		SANT VALVES PVT. LTD.	Jalandhar	UP TO SIZE 100-NB ONLY.
10.0	Solenoid Valve	Rotex	Baroda	
		Avcon	Mumbai	
		Asco	Chennai	
		SMC	Noida	
		Nucon	Hyderabad	
		Rotex	Baroda	
		Avcon	Mumbai	
11.0	PLC Based Panels	SIEMENS	Nasik	
		SCHNEIDER	Nasik	
		ROCKWELL	Sahibabad	
		GE Intelligent Platform	BANGALORE	
		Honeywell Automation India Limited	Pune	
		ABB	Bangalore	
		SIEME	Nasik	
		SCHNEIDER	Nasik	
12.0	Battery (Ni Cd for PLC)	Amco saft	Bangalore	
		HBL Power System	Hyderabad	
		SAFT	France/Sweden	
13.0	Motor	Marathon,	kolkata	For HT and LT motor
		Crompton Greaves	Ahmednagar	For HT and LT motor
		NGEF	Bangalore	Upto 15 KW
		ABB	Bangalore/Faridabad	Upto 200 KW
		Siemens	Mumbai	For HT and LT motor
		Jyoti	Baroda	For LT motor only
		LHP	Solapur	Upto 120 KW
		BHEL	Bhopal	For HT motor only
		Bharat Electric (BHEL)		For LT motor only
		Bharat Bijlee	Mumbai	Upto 160 KW(For LT motor only)
		KEC	Bangalore/Hubli	Upto 90 KW
14.0	Battery (maintenance free for PLC/ Fire Alarm Panel)	EXIDE	Kolkata	
		HBL Power System	Hyderabad	
		AMAR RAJA	Tirupati	
15.0	Steel Plate, Structural Steel	SAIL		
		Essar Steel		
		TISCO		
		RINL		
		Jindal		

		Lloyd		
		Ispat		
		Indian Iron & Steel Co. Ltd		
16.0	Pressure Gauge/DP Gauge	Gluck (I) Manufacturing Co	Mumbai,	
		H Guru	Rishra/Muzaffarpur/ Bangalore	
		AN Instruments	Kolkata	
		ASHCROFT INDIA PVT LTD.	GIDC Chhatral Kalol	
		FORBES MARSHALL (HYD) LTD.	HYDERABAD	
		GAUGE BOURDON INDIA PVT. LTD.	Mumbai,	
		H.GURU INSTRUMENTS (SOUTH INDIA) P. LTD	BANGALORE	
		WIKA	Pune	
		Manometer India	Mumbai,	
		Baumer Technologies India Pvt. Ltd.	VAPI	
		GIC(Gauges Bourdon)	Panvel	
17.0	Pressure/DP/Vacuum Switch	Indfoss	Ghaziabad	
		SOR	USA	
		Dressor	USA	
		Delta control	UK	
		Trafag	Ranipet	
		GIC(Gauges Bourdon)	Panvel	
		ASHCROFT INDIA PVT LTD.	USA/GERMANY	
		Switzer	Chennai	
18.0	Level Switch (Float/Displacer)	DK Instruments	Kolkata	
		Levcon	Kolkata	
		Sigma	Mumbai	
		V-Automat	New Delhi	
		SBEM	Pune	
		Flow Star	Faridabad	
19.0	Level Indicator	Flow Star	Faridabad	
		Scientific Devices	Mumbai	
		Gauges Bourden	Panvel	
		SBEM	Pune	
		Pune Techtrol	Pune	
		Levcon	Kolkata	
		Sigma	Mumbai	
		V-Automat	New Delhi	
		DK Instruments	Kolkata	
20.0	OWS/PC	HP/Compaq /Dell/HCL/IBM/Lenovo		
21.0	Printer	HP/Cannon/Epson/Xeror/IBM/Lexmark		
22.0	UPS	HITACHI-HIREL	Gandhinagar	
		APC	Bangalore	
		Delta	Gurgaon	
		Emerson	Mumbai	
		DB Power	Pune	
		Aplab	Mumbai	
23.0	Control / Power Cable	Cords Cable	Bhiwadi	
		Radiant Cables	Hyderabad	
		PolyCab	Daman	
		KEI	Bhiwadi	
		Nicco	Kolkata	
		Ravin Cables	Pune	
		Incab	Pune	
		HVPL	Faridabad	
		Torrent cable	Nadiad	
		Havells	Alwar	
		Paramount	Khushkhera	
		SRI Ram Cables	Bhiwadi	
		Thermocables	Hyderabad	
		Torrent cable	Nadiad	
		Universal Cables	SATNA	
		Gemscab	Bhiwadi	
		Delton	Faridabad	
24.0	Battery Charger for PLC/Diesel Engine	Chloride Power	Kolkata	
		Chabbi	Jalgaon	
		AMAR RAJA	Tirupati	
		Statcon	Noida	
		HBL Power System	Hyderabad	
		Dubas	Bangalore	
		Caldyne	Kolkata	
25.0	Fibre Optic Cable	Birla Ericsson	Rewa	
		Finolex	Pune/Goa	
		Aksh Fibre	Bhiwadi	
26.0	Pressure Transmitter and Diff. pressure Transmitter	Emerson	USA/Pawane	
		Laxons Automation	Daman	

		YIL	Bangalore	
		Siemens	Thane	
		Fuji	China	
		Yokogawa	Japan	
		Honeywell	USA/Pune	
27.0	Level Transmitter	ABB LIMITED		
		Endress + Hauser (India) Pvt. Ltd.,		
		Moore Industries International Inc.		
		NIVO CONTROLS PVT. LTD.		
		Pune Techtrol Pvt. Ltd.		
		EMERSON PROCESS MANAGEMENT (INDIA)		
		SIEMENS LIMITED		
		SMART INSTRUMENTS LTD, BRAZIL		
		SBEM PVT. LTD.		
		Honeywell Automation India Limited		
		TOSHNIWAL INDUSTRIES PVT. LTD.,		
		V. AUTOMAT & INTRUMENTS (P) LTD.		
		YOKOGAWA INDIA LIMITED,		
28.0	AGITATOR	REMI	MUMBAI	
		FIBRE & FIBRE PRODUTS		
		STANDARD ENGINEERS	MUMBAI	
		CROMPTON GREAVES	AHAMADNAGAR	
29.0	ORIFICE PLATE	MICRO PRECISION	FARIDABAD	
		INSTRUMENTAION LTD	PALGHAT	
		CARLO DYNAMICS	HYDRABAD	
30.0	BUTTERFLY VALVE	ADVANCE VALVES PVT. LTD.	NOIDA	
		FLUIDLINE VALVES COMPANY PVT.LTD.	GHAZIABAD	
		INSTRUMENTATION LTD.	PALAKKAD-KERALA	
		INTERVALVE (INDIA) LTD.	PUNE	
		R AND D MULTIPLES (METAL CAST) PVT LTD	MUMBAI	
		SURYA VALVES AND INSTRUMENTS MFG CO.	CHENNAI	
		PENTAIR VALVES AND CONTROLS INDIA PRIVATE LIMITED	NAVI MUMBAI	
		UPADHAYA VALVES MANUFACTURERS PRIVATE LIMITED,	KOLKATA	
		VENUS PUMPS AND ENGG. WORKS	KOLKATA	
		WEIR BDK VALVES- A UNIT OF WEIR INDIA PVT. LTD.	NEW DELHI	
31.0	DUAL PLATE CHECK VALVE	ADVANCE VALVES PVT. LTD.	NOIDA	
		ASIAN INDUSTRIAL VALVES & INSTRUMENTS.	CHENAI	
		FLUIDLINE VALVES COMPANY PVT.LTD.	GHAZIABAD	
		R AND D MULTIPLES (METAL CAST) PVT LTD	MUMBAI	
		VENUS PUMPS AND ENGG. WORKS	KOLKATA	
32.0	ELECTRICAL HOIST	ARMSEL MHE PVT. LTD	BANGALORE	
		ALPHA SERVICES	NEW DELHI	
		CONSOLIDATED HOISTS PVT LTD	PUNE	
		CENTURY CRANE ENGINEERS PVT. LTD.	FARIDABAD	
		EDDY CRANES PVT. LTD.	MUMBAI	
		GRIP ENGINEERS PVT. LTD.,	FARIDABAD	
		GLOBAL TECHNOLOGIES	HYDERABAD	
		HERCULES HOISTS LTD.	RAIGAD	
		LIFTING EQUIPMENTS AND ACCESSORIES	NEW DELHI	
		MANGLA HOISTS PVT LTD	NEW DELHI	
		REVA INDUSTRIES LTD.	FARIDABAD	
		ROCKWELL HOISTO CRANES PVT. LTD.	JHAJJAR-HARYANA	
		SAFEX ENERGY PVT. LTD.	AHMEDABAD	
		TUOBRO FURGUSON (INDIA) PVT LTD	KOLKATA-	
33.0	INSTRUMENT FITTING	AURA INCORPORATED	NEW DELHI	
		ASTEC VALVES & FITTINGS PVT. LTD.,	MUMBAI	
		ARYA CRAFTS & ENGINEERING PVT. LTD.	MUMBAI	
		COMFIT & VALVE PVT. LTD.	AHMEDABAD	
		FLUIDFIT ENGINEERS PVT. LTD.	MUMBAI	
		FLUID CONTROLS PVT. LTD.	MUMBAI	
		HP VALVES & FITTINGS INDIA PVT. LTD.	CHENNAI	
		PRECISION ENGINEERING INDUSTRIES	MUMBAI	
		PANAM ENGINEERS,	MUMBAI	
		PERFECT INSTRUMENTATION CONTROL (INDIA)	MUMBAI	
		VIKAS INDUSTRIAL PRODUCTS	NOIDA	
34.0	JUNCTION BOX	AJMERA INDUSTRIAL & ENGINEERING WORKS	MUMBAI	
		FLEXPRO ELECTRICALS PVT. LTD.	GUJARAT	
		K.S.INSTRUMENTS PVT.LTD.	BANGLORE	
		SUCHITRA INDUSTRIES	BANGLORE	
		SHRENIK & COMPANY,	GUJARAT	
35.0	ROTAMETER	EUREKA INDUSTRIAL EQUIPMENTS PVT.LTD.	PUNE	
		FLOW STAR ENGINEERING PVT. LTD.,	FARIDABAD	
		FLOWTECH INSTRUMENTS SERVICRS	GUJARAT	
		INSTRUMENTATION ENGINEERS PVT LTD	HYDERABAD	
		SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	NAVI MUMBAI	
36.0	SIGHT FLOW INDICATORS	B.K.EQUIPMENTS PVT.LTD.	CHENNAI	
		BLISS ANAND PVT. LTD.	GURGAON	
		FLOWTECH INSTRUMENTS SERVICRS	GUJARAT	

		INSTRUMENTATION ENGINEERS PVT LTD	HYDERABAD	
		SIGMA INSTRUMENTS CO.	MUMBAI	
		SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	NAVI MUMBAI	
		TELACE EQUIPMENT PVT.LTD.	CHENNAI	
37.0	TEMPERATURE ELEMENT	GOA INSTRUMENTS INDUSTRIES PVT.LTD.,	GOA	
		DETRIVE INSTRUMENTATION & ELECTRONICS LTD.	MUMBAI	
		PYRO ELECTRIC INSTRUMENTS GOA PVT.LTD.	GOA	
		TECHNO INSTRUMENTS	GUJARAT	
		TEMPSENS INSTRUMENT (I) PVT LTD	UDAIPUR	
		TM TECNOMATIC SPA	ITALY	
		TOSHNIWAL INDUSTRIES PVT. LTD.,	AJMER	
		THERMAL INSTRUMENT INDIA PVT. LTD.	MUMBAI	
		BAUMER TECHNOLOGIES INDIA PVT. LTD.	MUMBAI	
38.0	**TEMPERATURE GAUGE**	A.N. INSTRUMENTS PVT. LTD.	KOLKATA	
		ASHCROFT INDIA PVT LTD.	GUJARAT	
		BUDENBERG GUAGE CO.LTD.	UK	
		FORBES MARSHALL (HYD) LTD.	HYDERABAD	
		GOA INSTRUMENTS INDUSTRIES PVT.LTD.,	GOA	
		GOA THERMOSTATIC INSTRUMENTS PVT.LTD.	GOA	
		GAUGE BOURDON INDIA PVT. LTD.	MUMBAI	
		H.GURU INDUSTRIES	KOLKATA	
		H.GURU INSTRUMENTS (SOUTH INDIA) P. LTD	BANGLORE	
		BAUMER TECHNOLOGIES INDIA PVT. LTD.	MUMBAI	
39.0	**BALL VALVE**	BDK	HUBLI	
		LEADER	JALANDHAR	
		BANKIM	KOLKATA	
		H SARKAR	KOLKATA	
		AV VALVES	AGRA	
		HAWA VALVES	MUMBAI	
		FLOW CHEM	AHMEDABAD	
		STEEL STRON VALVES	MUMBAI	
		AKAY VALVES LTD.	MUMBAI	
		AQUA VALVES PVT.LTD.	KARNATAKA	
		CRESCENT VALVES	MUMBAI	
		FISHER SANMAR LIMITED	CHENNAI	
		HABONIM VAAS AUTOMATION PVT LTD.,CHENNAI	CHENNAI	
		KIRLOSKAR BROTHERS LTD.	PUNE	
		KSB PUMPS LTD.	MUMBAI	
		MICROFINISH VALVES PVT LTD.	HUBLI	
		MICON VALVES (INDIA) PVT.LTD	MUMBAI	
		PEC VALVES	MUMBAI	
40.0	SLUICE GATE	H SARKAR	KOLKATA	
		JASH ENGINEERING	INDORE	
		YASHWANT	MIRAJ	
		GLOBETECH	HOWRAH	
41.0	DIAPHRAGM VALVE	PROCON ENGINEERES	MUMBAI	
		HAWA VALVES	MUMBAI	
		BDK VALVES	HUBLI	
		FOURESS	BANALORE	
		INERVALVE	GUJRAT	
42.0	3 WAY VALVE	HI TECH	AHMEDABAD	
		ADVANCE VALVES PVT.LTD	NOIDA	
		BDK	HUBLI	
		FOURESS ENGG.INDIA LTD.	MUMBAI	
		FLUIDLINEVALVES COMPANY PRIVATE LTD.,	MUMBAI	
		INSTRUMENTATION LTD.	PALAKAD	
		KIRLOSKAR BROTHERS LTD.	PUNE	
		VENUS PUMP & ENGG. WORKS	KOLKATA	
		SURYA VALVES AND INSTRUMENTS MANUFACTURING COMPANY	CHENNAI	
		STAFFORD CONTROLS LIMITED	PUNE	
		MICON VALVES (INDIA) PVT.LTD	MUMBAI	
43.0	PLUG VALVE	FISHER SANMAR LIMITED	CHENNAI	
		BDK	HUBLI	
		LARSEN & TOUBRO LTD.	MUMBAI	
		LEADER	JALANDHAR	
		MICON VALVES (INDIA) PVT.LTD	MUMBAI	
44.0	FLANGES (SS/CS)	BHARAT FORGE	PUNE	
		RELIANCE FORGE	MUMBAI	
		MS FITTINGS	KOLKATA	
45.0	POSITIVE DISPLACEMETN PUMP	MILTON ROY INIDA	CHENNAI	
		SWELLORE	AHMEDABAD	
		VK PUMP	NASIK	
		DENCIL PUMP	MUMBAI	
46.0	VALVES (GATE/GLOBE/NRV/ BALL)-CPVC/PVC/PP/ HDPE/PVDF	GEROGE FISHCHER IPING SYSTEMS PVT LTD	DELHI	
		ASTROL PLYTECHINC LTD	AHMEDABAD	

47.0	PIPE/FITTINGS/ FLANGES CPVC/PVC/ PP/HDPE/PFDF	GEROGE FISHCHER IPING SYSTEMS PVT LTD	DELHI	
		ASTROL PLYTECHINC LTD	AHMEDABAD	
48.0	RUBBER LINING FOR PIPES/TANKS	RISHI INDUTRIES	SONEPET	
		INDUSTRIAL LINING LTD	BARODA	
		MIL	CHENNAI	
49.0	NON METALIC PUMP (CENTRIFUGAL)	Anticorrosive Pumps	Mumbai	
		Rajedia Pumps	Gujrat	
		Price Pumps	Mumbai	
50.0	Blower	Everest	Delhi	
		Kay International	Haryana	
		Swam Pneumatics	Delhi	
		Kulkarni brothers	Mumbai	
51.0	TEMPERATURE SWITCH	INDFOSS (INDIA) LTD.	GAZIABAD	
		DRESSER INDUSTRIES INC.	USA	
		SWITZER INSTRUMENT LTD.	CHENNAI	
		SOR INC.	USA	
		TOSHNIWAL BROTHERS (P) LTD.	DELHI	
		VASU TECH LIMITED	DELHI	
52.0	HDPE TANK	SINTEX		
53.0	PRP TANK	TIANODE	CHENNAI	
		BHAVI PLAST	MUMBAI	
54.0	HYDROGEN DETECTOR	Detection Instruments	INDIA	
		HACH	USA	
		HONEYWELL	UK	
		ORBIT	INDIA	
55.0	RESIDUAL CHLORINE ANALYZER	EMERSON		
		HACH		
56.0	LOCAL CONTROL PANEL	INDSUSTRIAL SWITCHGEAR & CONTROL	MUMBAI	
		POSITRONICS	BARODA	
		ECS	NOIDA	
		SWITCHING CIRCUIT	KOLKATA	
		CONTROL & SCHEMATICS	HYDRABAD	
		GE POWER	BANGLORE	
		SIEMENS	KOLKATA	
		C&S	NOIDA	
		PYROTECH	UDAIPUR	
		DELTA CONTROL	MUMBAI	
		L&T	MUMBAI	
57.0	PAINT	BERGER		
		ASIAN PAINTS		
		SHALIMAR		
		J&N		
58.0	CHLORINE TONNER	ISGEC	YAMUNA NAGAR	
		ANUP ENGG	AHMEDABAD	
59.0	Chain pulley block	INDEF		
		BRADY		
		Lifting Equipment		
		GRIP ENGG		
		Tractel tirfor		
		REVA		
		TECHNO INDUSTRIES		
60.0	HAND PUMP (MOTOR OPERATED BARREL PUMP)	JYOTI		
		SOLVACID		
		SLEEK		
		FLUDIYNE		
		Mach Powerpoint		
61.0	SELF CONTAINED AIR BREATHING APPARATTUS	USHA FIRE SAFETY(P) LTD		
		MEDICAL ENGINEERING		
		JOSEPH LESLIE DRAGER		
		GANDHI UDYOG		
62.0	GAS MASK WITH CANNISTER	VOLTEC(INDIA)		
		JK		
		JOSEPH LESLIE DRAGER		
		MEDICAL ENGINEERING		

Notes:-

a) All the finally selected sub vendors shall be subject to customer approval during detailed engineering without any delivery/ commercial implications to BHEL/ CUSTOMER.

b) This vendor list applicable for Mechanical, electrical and C&I items.

ANNEXURE-II

MANDATORY SPARE LIST

ANNEXURE-II

LIST OF MANDATORY SPARES FOR CW CHLORINAITON PLANT

S.No	Equipment/Package name	Quantity
1.	**Spares for Horizontal Centrifugal Pumps (For Each Service)**	
1.1	Shaft	1No.
1.2	Shaft Sleeve	2 Nos.
1.3	Impeller	1 No.
1.4	Impeller locking nut and bolt	4 Nos.
1.5	Impeller wear ring	4 Nos.
1.6	Casing wear ring	4 Nos.
1.7	Oil Seal	4 Nos.
1.8	Oil Deflector	3 Nos.
1.9	Oil Ring	3 Nos.
1.10	Gland Packing	400%
1.11	Lantern Ring	3 Nos.
1.12	Mech Seal Assembly	1 No.
1.13	Stationary/Carbon Packing and O" Ring for Mechanical Seal "	3 Sets
1.14	Oil Level Gauge	3 Nos.
1.15	Coupling	2 Nos.
1.16	Rubber Bush for Coupling	2 Nos.
1.17	O" Rings "	2 Sets
1.18	Suction Strainers Element	3 Nos.
1.19	Bearing for Pump Motor	2 Sets
2.	**Spares for Agitators (For Each Service)**	
2.1	Gear Box Unit Complete	1 No.
2.2	Bearing for Gear Box Unit	1 Set
2.3	Coupling complete (Motor/Gear box and gear box/agitator)	1 Set
2.4	Coupling Bolts	1 Set
2.5	Coupling shim pack (if applicable)	4 Sets
2.6	Oil seals	4 Sets
3.	**Spares for Valves**	
3.1	I. Manual Diaphragm valves	10% of total quantity used for each type and size with minimum no. two (2) for each type and size.
	II. Auto Diaphragm valves	10% of total quantity used for each type and size with minimum no. two (2) for each type and size.

	III. Spare Diaphragm for above	10% of total quantity used for each type and size with minimum no. two (2) for each type and size.
	IV. Diaphragm	10% of total quantity used for each type and size with minimum no. one (1) for each type and size.
3.2	I. Non return valves (NRV)	2 nos. of each size & type
	II. Flaps for above NRV	2 nos. of each size & type
3.3	Gate/Globe/Ball valves/plug valve/needle valve	
	I. Up to 4”	10% of total quantity used for each type and size with minimum no. two (2) for each type and size.
	II. Above 4”	1 no. each type and size.
3.4	Butter fly valve	
	I. Up to 4”	10% of total quantity used for each type and size with minimum no two (2) for each type size
	II. Above 4””	1 no. each type and size
4.	**Spares for Air Blowers (For Each Service)**	
4.1	Impeller with shaft	1 Set
4.2	Bearings	1 Set
4.3	Oil seals	5 Sets
4.4	Filter	1 Set
5.	**Pneumatic Control Valve**	
5.1	Pneumatic Diaphragm for Diaphragm actuated valve	2 Nos. for each type of Actuator
5.2	Gland Packing	1 set for each type of Control Valve
5.3	Plug, Seat, Cage, Stem etc.	1 set for each type of Control Valve
5.4	Retainer Ring, Seal Ring etc.	1 set for each type of Control Valve
5.5	Gasket	2 Sets. for each type of Control Valve
5.6	Position Transmitter complete set	10% of total quantity used in the system for each type and model.
5.7	Control Valve E/P Positioner complete Set	10% of total quantity used in the system for each type and model.
5.8	Complete Set of Solenoid Valve for Pneumatic type On/Off Valve	2 Nos. for each type & ratings
5.9	Solenoid Coil for Pneumatic type On/Off Valve	5 Nos. for each type & ratings
5.10	Position Limit Switch for Pneumatic type On/Off Valve	10 Nos. for each type & ratings
6.	**Control Panel/Desk Mounted Items**	
6.1	Push Button	
	I. Complete assembly	5 Nos. for each colour
	II. Contact Element (1NO + 1NC) Block	20 Nos.
6.2	Selector Switch	10Nos. for each type and rating
6.3	Meter (Analog or Digital)	

	I. Ammeter	10% for each type and range or minimum one (1) no. whichever is more
	II. Voltmeter	10% for each type and range or minimum one (1) no. whichever is more
	III. Frequency	10% for each type and range or minimum one (1) no. whichever is more
	IV. MW	10% for each type and range or minimum one (1) no. whichever is more
	V. MVAR	10% for each type and range or minimum one (1) no. whichever is more
	VI. Power Factor	10% for each type and range or minimum one (1) no. whichever is more
	VII. Synchroscope	10% for each type and range or minimum one (1) no. whichever is more
6.4	Indicating Lamps complete assembly	10Nos. for each Colour and type
6.5	Mimic Lamps	10Nos. for each Colour and type
6.6	MCB	2Nos. for each type and rating
6.7	Door Limit Switch	2Nos.
6.8	Annunciation system	
	I. Lamp Box with Facia & Lamps (LED type)	25Nos.
	II. Hooter	1No.
	III. Each type of PCB (for non-PLC driven system)	1(one) no.
7.	**Actuator**	
7.1	Complete set of Actuator	1No. for each type and rating
7.2	Limit Switch	2 Nos each type and rating
7.3	Torque Switch	2 Nos each type and rating
7.4	Auxiliary Contact	1 no each type and rating
7.5	Motor	1 no each type and rating
7.6	Complete Seal kit	1Set for each type and rating
7.7	Complete O-Ring Set	1Set
8.	**UPS (For BOP systems)**	
8.1	Fuse	3 (Three) times of total quantity of each type of fuses used in the system (for all BOP systems).
8.2	SCR	10% of total quantity of each type used in the system or minimum 2(two) nos. whichever is more.
8.3	Diode	10% of total quantity of each type used in the system or minimum 2 two) nos. whichever is more.
8.4	IGBT	2 (two) nos.
8.5	Electronic Module/ PCB	
	I. Static Switch	1 (one) no. each type of Electronic Card/ PCB/ modules used in the system
	II. Inverter	1 (one) no. each type of Electronic Card/ PCB/ modules used in the system

	III. Static voltage Regulator	1 (one) no. each type of Electronic Card/ PCB/ modules used in the system used in the system
	IV. Charger	1 (one) no. each type of Electronic Card/ PCB/ modules used in the system
	V. UPS of 2 KVA rating or below.	One Complete set.
	VI. Selector Switch	1 (one) no. each type
	VII. Digital Voltage/ Current Indicator (LCD type)	1 (one) no. each type
	VIII. Indication Lamp- Complete assembly (Red/ Green colour)	1 (one) no. each type
	IX. Cooling Fan - 240 VAC supply	1 (one) no. each type
8.6	UPS Battery	
	I. Battery Cell (Uncharged, Dry)	10% of total quantity of each BOP UPS.
	II. Inter connecting cell strips	10 nos.
	III. Rubber gloves	1 pair
	IV. Voltmeter for measuring cell voltage (Centre zero type)	1 no.
	V. Appron & Goggles	1 set
	VI. Cell lifting puller	1 no.
	VII. Insulated socket spanner with handle	1 no.
	VIII. Terminal screw with bellaville washer	10% of total quantity used
	IX. Thermometer	1 no.
9.	**415 Volt Motor (above 30KW Rating upto 160KW)**	
9.1	End Shield Cover Driving & Non-Driving End	1Set for each type and rating of Motor
9.2	Driving End & Non-Driving End Bearing	1Set for each type and rating of Motor
9.3	Cooling Fan	1No. for each type and rating of Motor
9.4	Motor Space Heater	1No. for each type and rating of Motor
9.5	Motor Terminal Block	1No. for each type and rating of Motor
9.6	Complete Set of Coupling	1Set for each Application
10.	415 Volt Motor (Up to 30KW Rating)	
10.1	Driving End & Non-Driving End Bearing	3Set for each type and rating of Motor
10.2	Cooling Fan	2No. for each type and rating of Motor
10.3	Motor Terminal Block	5No. for each type and rating of Motor
10.4	Complete Set of Coupling	1Set for each Application
11.	Field Instruments (Transmitters/temperature elements (TC / RTD) / Gauges / Switches etc. along with relevant accessories)	10 (ten) percent of total of each type or at least one (whichever is higher) of each type along with accessories.
12.	Control System (DCS, PLC etc.)	

12.1	2 (two) numbers each of keyboard and cursor control devices.	
12.2	2 (two) numbers of LCD TFT (24") Monitors.	
12.3	10 (ten) sets of spare interface cables with connecting plugs for each type of peripherals & I / O hardware.	
12.4	10 (ten) percent of power supply modules of the total qty. offered for each type or 4 (four) numbers, whichever is Higher.	
12.5	10 (ten) percent of the total qty. offered for each type of electronic modules (I / O) or 5 (five) numbers of each Electronic type of module, whichever is higher.	
12.6	10 (ten) percent of total bus couplers and communication interface cards of each type or 2 (two) numbers of bus Couplers and communication interface cards whichever is higher.	
12.7	Controllers for DCS, Control panel ST, Boiler control system, Balance of plant system, PLC system/Sub-systems 10%of each type (at least 1 no. of each type) whichever is higher.	For applicable
13.	Control Valves	
12.8	2 (two) sets of spare control valve stem packing for each of the control valves, as offered.	
12.9	1 (one) set of spare valve trim (including cage, plug, stem, seat rings, guide bushings etc.) for both the units for Each of the control valves, as offered.	
14.	Control valve Actuators	
14.1	1 (one) set of spare actuators with drive of each type and rating.	
14.2	10 (ten) percent of valve positioners of each type.	
14.3	10 (ten) percent of position transmitters of each type.	
14.4	10 (ten) percent of limit switches/torque switches of each type.	

Note: **Only applicable items shall be considered. Applicable items are those which are installed in the system.**

LIST OF MANDATORY SPARES FOR RW CHLORINAITON PLANT

S.No	Equipment/Package name	Quantity
1.	**Spares for Horizontal Centrifugal Pumps (For Each Service)**	
1.20	Shaft	1No.
1.21	Shaft Sleeve	2 Nos.
1.22	Impeller	1 No.
1.23	Impeller locking nut and bolt	4 Nos.
1.24	Impeller wear ring	4 Nos.
1.25	Casing wear ring	4 Nos.
1.26	Oil Seal	4 Nos.
1.27	Oil Deflector	3 Nos.
1.28	Oil Ring	3 Nos.
1.29	Gland Packing	400%
1.30	Lantern Ring	3 Nos.
1.31	Mech Seal Assembly	1 No.
1.32	Stationary/Carbon Packing and O" Ring for Mechanical Seal "	3 Sets
1.33	Oil Level Gauge	3 Nos.
1.34	Coupling	2 Nos.
1.35	Rubber Bush for Coupling	2 Nos.
1.36	O" Rings "	2 Sets
1.37	Suction Strainers Element	3 Nos.
1.38	Bearing for Pump Motor	2 Sets
2.	**Spares for Agitators (For Each Service)**	
2.7	Gear Box Unit Complete	1 No.
2.8	Bearing for Gear Box Unit	1 Set
2.9	Coupling complete (Motor/Gear box and gear box/agitator)	1 Set
2.10	Coupling Bolts	1 Set
2.11	Coupling shim pack (if applicable)	4 Sets
2.12	Oil seals	4 Sets
3.	**Spares for Valves**	
3.5	V. Manual Diaphragm valves	10% of total quantity used for each type and size with minimum no. two (2) for each type and size.
	VI. Auto Diaphragm valves	10% of total quantity used for each type and size with minimum no. two (2) for each type and size.
	VII. Spare Diaphragm for above	10% of total quantity used for each type and size with minimum no. two (2) for each type and size.