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SR. NO.	ITEM	DESCRIPTION	
		(e) Hand held configurator kit for calibration of SMART Transmitter	
		(f) ½” NPT cable gland.	
		(g) ½” NPT generally 5-valve stainless steel manifold, constructed from SS316 bar stock. 3 valve manifold for DP application in flue gas and air.	
1.3	<u>DISPLACER TYPE LEVEL TRANSMITTERS</u>		
1.3.1	Type	SMART, HART Protocol.	
1.3.2	Stages of operation	Continuous.	
1.3.3	Material -		
(a)	Displacer	AISI 316 SS.	
(b)	Suspension wire	AISI 316 SS.	
(c)	Torque tube housing	Carbon steel or SS as per application.	
(d)	Torque tube	Inconel.	
(e)	Displacer chamber	CS or SS as per process application.	
(f)	Transmitter Housing	Die cast Aluminium or better.	
1.3.4	Operating Voltage	16-48 Volts D.C.	
1.3.5	Transmission	2-wire.	
1.3.6	Output Signal	4-20 mA DC.	
1.3.7	Signal processing	Solid-state electronic circuitry.	

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1.3.8	Static / overload pressure	Maximum static pressure without permanent deformation or loss of accuracy.	
1.3.9	Turn-down ratio	10 : 1 or better.	
1.3.10	Zero & Span	Easily accessible (local zero & span adjustment and non-interactive type).	
1.3.11	Enclosure Class	IP-65.	
1.3.12	Output Indicator	LCD type.	
1.3.13	Nameplate	Tag number and Service engraved in stainless steel tag plate.	
1.3.14	Ambient Temperature	0 - 50° C.	
1.3.15	Load Impedance	600 Ohms at 24 Volts (minimum).	
1.3.16	Process Connection	2" Companion flange with nuts, bolts and gaskets.	
1.3.17	Performance -		
	(a) Accuracy	±0.5 % of span or better.	
	(b) Stability	a) +/- 0.1% of calibrated span for 5 year for ranges upto and including 70 Kg/cm ² b) +/- 0.25% of calibrated span for 5 years for ranges more than 70 kg/cm ² (g)	
1.3.18	Accessories	(a) Counter Flange, nuts, bolts, gaskets etc.	

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		(b) Weights for 5 point calibration of instruments.	
		(c) Vent and drain plugs.	
		(d) Special calibration tool / configuration, if any.	
		(e) ½"NPT cable gland.	
1.3.19	Preferred Features	(a) Test plug connection and cutout terminals physically separated from other electronics.	
		(b) Electronic Damping facility (adjustable).	
1.4	<u>MASS FLOW METER</u>		
1.4.1	Sensor		
1.4.1.1	Measuring Principle	Coriolis Mass flow.	
1.4.1.2	Primary Element	Flow Tube of 316SS or better.	
1.4.1.3	Heating Arrangement	Integral.	
1.4.1.4	Temperature Control	For heavy fuel oil application.	
1.4.1.5	Process Connection	Flanged of rating as per process requirement.	
1.4.1.6	Drain	Self-draining facility.	
1.4.1.7	Enclosure	Stainless steel.	
1.4.1.8	Accessories	Counter flanges, Mounting nuts, bolts, gaskets etc.	
1.4.2	Transmitter		

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1.4.2.1	Measured quantities	Mass Flow rate, Total Mass Flow, Density, Temperature.
1.4.2.2	Input Signal Processing	Digital Processing.
1.4.2.3	Display	Digital Display LCD Type.
1.4.2.4	Output	2 off isolated 4-20mA DC output.
1.4.2.5	Load	< 750 ohms.
1.4.2.6	Power supply	240V AC, 50 Hz.
1.4.2.7	Turn Down	100:1.
1.4.2.8	Accuracy	± 0.2 % of measured value.
1.4.2.9	Housing	IP 65.
1.4.2.10	Nameplate	Tag number, service engraved in stainless steel tag plate.
1.4.2.11	Accessories	(a) Handheld configurator.
		(b) Mounting U-bolts, nuts, bolts, prefab cable etc.
		(c) ½"NPT cable gland.

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1.6	<u>MASS FLOW METER (FOR AIR)</u>		
1.6.1	Sensor	Thermal dispersion	
1.6.2	Measuring Principle	The typical thermal mass sensing element contains two thermowell-protected Resistance Temperature Detectors (platinum RTDs). When placed in the process, one RTD is heated and the other RTD senses the process temperature. The temperature difference between the two RTDs is related to the process flow rate as well as the properties of the process medium.	
1.6.3	Primary Element	316 stainless steel body with Hastelloy C thermowell sensors, 316 stainless steel compression fitting with teflon or stainless steel ferrule	
1.6.4	Pressure (Maximum Operating with Damage)		
1.6.4.1	Stainless Steel Ferrule	-18°C to 121°C	
1.6.4.2	Teflon Ferrule	-18°C to 93°C	
1.6.5	Process Connection	1/2" MNPT or 3/4" MNPT with stainless steel or Teflon ferrule	
1.6.6	Transmitter		
1.6.7	Measured quantities	Mass Flow rate, Total Mass Flow	
1.6.8	Input Signal Processing	Digital Processing.	
1.6.9	Display	LCD, ±9999 counts, user scalable to flow rate	

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		engineering units or 0-100%	
1.6.10	Output	2 off isolated 4-20mA DC output	
1.6.11	Load	< 750 ohms.	
1.6.12	Power supply	240V AC, 50 Hz.	
1.6.13	Turn Down	100:1.	
1.6.14	Accuracy	± 0.2 % of measured value.	
1.6.15	Enclosure	NEMA4X (IP67) aluminum, Epoxy coated	
1.6.16	Nameplate	Tag number, service engraved in stainless steel tag plate.	
	Notes:		
1.	The above on-line flow meter shall not create any obstruction on flow.		
2.	Users' list shall be submitted to support on proven satisfactory performance for similar process applications.		
1.7	<u>PRESSURE GAUGE AND DIFFERENTIAL PRESSURE GAUGE</u>		
1.7.1	Type	Bourdon / Bellows / Diaphragm.	
1.7.2	Sensing & Socket	AISI-316 SS.	
1.7.3	Movement Material	AISI-304 SS.	
1.7.4	Case Material	Stainless steel, IP-65.	
1.7.5	Dial Size	Generally 150 mm.	
1.7.6	Scale	Black lettering on white in 270 ° arc.	

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1.7.7	Window	Shatterproof glass.	
1.7.8	Range Selection	Normal process pressure: 50~70% of range.	
1.7.9	Over-range Protection	125% of maximum range by internal stop. External stop at zero.	
1.7.10	Adjustment	Micrometer screw for zero. Internal micrometer screw for range.	
1.7.11	Element Connection	Argon welding.	
1.7.12	Process Connection	1/2" NPT(M) Bottom for local, back for panel mounting.	
1.7.13	Performance	Accuracy of ± 1.0 % of span or better.	
1.7.14	Operating ambient	0 - 50 °C.	
1.7.15	Safety Feature	Blow out disc /diaphragm at the back.	
1.7.16	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.	

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1.7.17	Applicable standard	IS-3624 / 1996.	
1.7.18	Nameplate	Tag number, service engraved in stainless steel tag plate.	
1.8	<u>TEMPERATURE GAUGE</u>		
1.8.1	Type	Mercury or gas filled.	
1.8.2	Sensing Element Material	Bourdon - AISI-316 SS.	
1.8.3	Capillary Armoring	Stainless steel flexible.	
1.8.4	Movement Material	AISI 304 SS.	
1.8.5	Bulb / Stem Diameter	12 mm.	
1.8.6	Bulb / Stem Material	AISI 316.	
1.8.7	Capillary	Stainless Steel.	
1.8.8	Connection to well	½" NPT.	
1.8.9	Case Material	Stainless steel.	
1.8.10	Dial Size	150 mm in general.	
1.8.11	Scale	Black lettering on white in 270 ° arc.	
1.8.12	Mounting	Surface/Panel.	
1.8.13	Over range Protection	125 % of range or more.	
1.8.14	Instrument connection	Bottom for local and back for panel mounting.	
1.8.15	Range	Normal temperature – 50~70% of range.	
1.8.16	Zero adjuster	Micrometer screw adjustable from front.	



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1.8.17	Window	Shatterproof glass.
1.8.18	Accuracy	± 1 % or better.
1.8.19	Enclosure Class	IP-65.
1.8.20	Capillary	5 meters (local surface)/15.0 meters (local panel) - armoured stainless steel.
1.8.21	Compensation	Capillary and Case Compensation.
1.8.22	Accessories	(a) Forged barstock thermowell screwed as per ASME PTC code. Process connection M 33X2 (M). Material of construction of Thermowell: (i) SS 316: In general. (ii) Inconel: For flue gas application. (iii) Tungsten carbide: For coal mill application.
1.8.23	Nameplate	Tag number, service engraved in stainless steel tag plate.

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1.10.5	Protecting Tube		
(a)	O.D.	8 mm.	
(b)	Material	SS-316, Seamless.	
(c)	Filling	Magnesium oxide (Purity above 99.4%).	
1.10.6	Response time	(a) < 20 seconds for measurement.	
		(b) < 10 seconds for control.	
1.10.7	Calibration	DIN 43760.	
1.10.8	Accuracy	± 0.5%.	
1.10.9	Head:		
(a)	Type	IP-65 universal screwed type.	
(b)	Material	Die cast aluminium or better.	
(c)	Terminal blocks	Nickel plated Brass-screw type / silver plated.	
(d)	Cable connection	½" NPT gland and grommet.	
(e)	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.	
1.10.10	Accessories	(a) Adjustable nipple-union-nipple (½" Sch 80 x ½" NPT M) with Thermowell connection.	

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		(b) Compression fittings / unions.	
		(c) Flanges etc. (for flanged connections only)	
		(d) Forged / barstock Thermowell as per ASME PTC code. Process connection M33 x 2 (M). Material of construction of Thermowell: SS 316: In general. Inconel: For flue gas application. Tungsten carbide: For coal mill application.	
1.10.11	Name plate	Tag number, service engraved in stainless steel tag plate	
1.11	<u>PRESSURE SWITCH</u>		
1.11.1	Type	(a) Piston for high pressure application.	
		(b) Bellow / Diaphragm for low pressure application.	
1.11.2	Sensing element material	AISI SS-316. All other wetted part SS316.	
1.11.3	Case Material	Die-cast aluminium alloy, neoprene gasket.	
1.11.4	Setter Scale	Black graduation on white linear scale. Graduation 0-100% with red pointer for set points.	

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1.11.5	Over range	150 % of maximum pressure.	
1.11.6	Adjustments	(a) Internal Set Point.	
		(b) Differential adjustment.	
1.11.7	End Connection	½" NPT (M) bottom connected.	
1.11.8	Switch configuration	Two SPDT.	
1.11.9	Switch Rating	240V, 5A AC / 220V, 0.5A DC.	
1.11.10	Switch Type	Snap acting, hermetically sealed, shock & vibration proof.	
1.11.11	Terminal Block	Suitable for full ring lugs.	
1.11.12	Cable connection	½" NPT conduit connection.	
1.11.13	Enclosure Class	IP-65.	
1.11.14	Performance	(a) Repeat accuracy $\pm 1.0\%$.	
		(b) Accuracy of Setting Indication of $\pm 1.5\%$.	
1.11.15	Ambient temperature	0 – 50 Deg C.	
1.11.16	Nameplate	Tag number, service engraved in SS tag plate.	
1.11.17	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.	

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		(d) 1/2" NPT 2 Valve SS-316 barstock manifold.	
		(e) ½" NPT cable gland.	
1.12	<u>DIFFERENTIAL PRESSURE SWITCH</u>		
1.12.1	Type	Bellows/Diaphragm/Piston actuated.	
1.12.2	Sensing element material	AISI SS-316. For all other wetted part SS 316.	
1.12.3	Case Material	Die-cast aluminium alloy with neoprene gasket.	
1.12.4	Setter Scale	Black graduation on white scale with 0-100% graduation and provided with red pointer for set point adjustment.	
1.12.5	Over range	Static pressure on any one side, the other side being open to atmosphere.	
1.12.6	Adjustments	(a) Internal set point adjustment.	
		(b) Differential adjustment.	
1.12.7	Process Connection	1/2" NPT (M) bottom / back connected.	
1.12.8	Switch configuration	Two SPDT.	
1.12.9	Switch rating	240V, 5A AC/220V, 0.5A DC.	
1.12.10	Switch type	Snap acting type contacts, shock and vibration proof.	
1.12.11	Terminal Blocks	Suitable for full ring lugs for cable	

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		connection.	
1.12.12	Cable Connection	½" NPT conduit connection or compression gland.	
1.12.13	Performance	(a) Repeat accuracy $\pm 1.0\%$.	
		(b) Accuracy of set point Indication: $\pm 1.5\%$	
1.12.14	Operating Ambient	0 - 50 °C (Maximum Continuous).	
1.12.15	Enclosure	IP-65.	
1.12.16	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.	
1.12.17	Nameplate	Tag number, service engraved in stainless steel tag plate.	
1.12.18	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.	

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		(c) Adapter flanges with nuts, bolts and gaskets for instrument and process side.	
1.13	<u>LEVEL SWITCH</u>		
1.13.1	Type	External cage float operated. Magnetically coupled.	
1.13.2	Float Material	AISI-316 stainless steel or better.	
1.13.3	Other wetted parts	AISI-316 stainless steel or better.	
1.13.4	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.	
1.13.5	External cage mounting	Side-Side.	
1.13.6	External cage connection	25 NB socket welded.	
1.13.7	Switch housing	Epoxy coated die-cast aluminium alloy with neoprene gasket conforming to IP-65.	
1.13.8	Type of switch configuration	2 SPDT (two nos.).	
1.13.9	Contact rating	5A, 240V/AC, 0.25A, 220V DC.	
1.13.10	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	

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1.16.1	Application	Low fluid velocity flow measurement.	
1.16.2	Design Standard	BS-1042, Part-I.	
1.16.3	Number of Tapings	As required plus one additional pair of taps.	
1.16.4	Diameter Ratio	Between 0.4 to 0.7.	
1.16.5	Thickness	3 mm for main pipe diameter upto 250 mm, 6 mm for main pipe diameter above 250 mm and upto 500 mm and 10 mm for main pipe diameter of 500 mm and above.	
1.16.6	Document	Beta ratio calculation, assembly drawing and Flow vs. DP curve.	
1.16.7	Meter run pipe	Same as pipe material.	
1.16.8	Accessories	Flanges, gaskets, nuts & bolts, root valves jack screw, meter run pipe, Drain & vent hole as per application etc.	
1.17	<u>FLOW NOZZLE</u>		
1.17.1	Application	High fluid velocity flow measurement.	
1.17.2	Design Standard	ASME PTC 19.5.	
1.17.3	Number of Tapings	As required plus one additional pair of taps.	
1.17.4	Diameter Ratio	Between 0.4 and 0.7.	
1.17.5	Thickness	Suitable for the application.	
1.17.6	Document	Beta ratio calculation, assembly	

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		drawing and Flow vs. DP curve.	
1.17.7	Meter run pipe	Same as pipe material.	
1.17.8	Accessories	Meter run pipe, nipples and root valves (Inspection port assembly for nozzles used in plant performance purpose).	
1.18	<u>GAUGE GLASS</u>		
1.18.1	Type	Reflex.	
1.18.2	Glass	Toughened borosilicate Resistant to mechanical and thermal shocks.	
1.18.3	Body material	Carbon steel / stainless steel - As per process requirements (Flanged Connection).	
1.18.4	Pressure rating	Twice the maximum working pressure.	
1.18.5	Temperature rating	As required.	
1.18.6	Bolts and nuts	Rust proof alloy steel.	
1.18.7	Accessories	Suitable ball check valves of SS-304 /316 body, gaskets, companion flange etc.	
1.19	<u>POWER CYLINDERS (PNEUMATIC)</u>		
1.19.1	Mounting Type	(a) Fixed position mounting. (End mounting)	
		(b) Trunnion mounting.	
1.19.2	Control Signal	4-20 mA DC to SMART positioner with Superimposed HART protocol for	

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		modulating purposes. 24V DC operated solenoid valve operating on pneumatic line for open & closing purpose of on & off drive.	
1.19.3	Supply Air	7 Kg / cm ² .	
1.19.4	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.	
1.19.5	Casing	IP-65.	
1.19.6	Accessories	(a) Air lock relay.	
		(b) Hand wheel.	
		(c) Air filter regulator with gauge.	
		(d) Volume Booster.	
		(e) Limit Switches.	
		(f) Smart 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.	
1.19.7	Fail-safe operation	For regulating duty- stay put against	

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1.26	<u>RADAR TYPE LEVEL MEASUREMENT</u>		
1.26.1	Type	Radar based on Time Domain Reflectometry.	
1.26.2	Antenna	Co axial / single rod type guided wave or Horn type as required for the application.	
1.26.3	Communication	Two wire 4-20mA DC, HART protocol.	
1.26.4	Environmental temperature	0 – 50 °C.	
1.26.5	Enclosure	Explosion proof/IP 65 as per application.	
1.26.6	Cable Entry	½" NPT.	
1.26.7	Calibration	Self calibration with internal reference.	
		Zero & Span calibration.	
1.26.8	Programming	Handheld programmer & Local keypad.	
1.26.9	Process Connection	Flanged /screwed.	
1.26.10	Electronic Housing	Epoxy painted Die-Cast aluminium alloy.	

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1.26.11	Antenna / Flange assembly	316 SS or Hest alloy. (as required)	
1.26.12	Output Indicator	Digital Integral Display.	
1.26.13	Accuracy	5 mm or 0.1% of probe length.	
1.26.14	Accessories	(a) Programming tool kit.	
		(b) Gasket.	
1.27	<u>ULTRASONIC LEVEL TRANSMITTER</u>		
1.27.1	Principle of operation	Detection of reflected ultrasonic pulse, HART Protocol	
1.27.2	Measuring ranges	Up to 30 meters (typical)	
1.27.3	Signal processing	Microprocessor Controlled Signal Processing	
1.27.4	Operating frequency	10 KHz to 50 KHz (typical)	
1.27.5	Display	Large alpha-numeric back lit LCD/ LED	
1.27.6	Calibration & Configuration	Accessible from front of panel	
1.27.7	Diagnosis	On-line	
1.27.8	Status	For power, Hi/Lo/V. Hi/V. Lo - level indication, fault etc.	
1.27.9	Construction	Plug-on board	
1.27.10	Power supply	240 V AC 50 Hz / 24V DC	
1.27.11	Signal Output	4-20 mA DC - 600 Ohm load.	

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SR. NO.	ITEM	DESCRIPTION	
1.27.12	Hysteresis	Fully adjustable preferred	
1.27.13	Output contacts	2 SPDT Potential free changeover contacts @ 240V, 5A AC/220V, 0.5A DC.	
1.27.14	Accuracy & Repeatability	0.25% of span or better	
1.27.15	Resolution	0.1% of span	
1.27.16	Operating Temperature	Transmitter- 50 °C and Sensor – 80 °C	
1.27.17	MOC Sensor	Body- PVC and Face – Polyurethane	
1.27.18	Humidity	1% to 95% non condensing.	
1.27.19	Enclosure	IP-65 Epoxy painted die cast aluminium or Polycarbonate housing.	
1.27.20	Cable connection	3/4" ET	
1.27.21	Mounting	2" for sensor and Transmitter on panel.	
1.27.22	Accessories	Cable gland, prefab cable, mounting accessories.	
1.28	<u>CAPACITANCE TYPE LEVEL SWITCH</u>		
1.28.1	Type	Capacitance type	
1.28.2	Probe	(i) Rod or suspended electrode	
		(ii) Rope type probes may be used only where required probe length is greater than 3 meters.	
1.28.3	Probe Mounting	Stainless steel 1½" ANSI RF Flange / ¾" NPT (M)	

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SR. NO.	ITEM	DESCRIPTION	
1.28.4	Material of construction	316 SS	
1.28.5	Insulation	PTFE Part/ Full as per service.	
1.28.6	Enclosure	Powder/Epoxy coated Die cast aluminium with neoprene gasket conforming to IP-65. (Explosion proof for NEC Class-1, Division 1 area).	
1.28.7	Ambient temperature	0-60 °C.	
1.28.8	Mounting	On Tap	
1.28.9	Supply voltage	240V AC, 50Hz /24V DC	
1.28.10	Relay output	2 SPDT	
1.28.11	Contact rating	240V, 5A AC /220V, 0.5A DC.	
1.28.12	Response time	100 mSec or better	
1.28.13	Cable connection	¾" ET	
1.28.14	Accessories	Counter flange, Cable gland, prefab cable and stainless steel name plate engraved with alpha-numeric.	
1.29	<u>TEMPERATURE SWITCH</u>		
1.29.1	Type	Mercury filled-in.	
1.29.2	Sensing Element Material	Bellow / Bourdon AISI SS-316.	
1.29.3	Bulb Material	AISI SS-316.	
1.29.4	Capillary	Stainless steel armoured.	
1.29.5	Movement Material	AISI SS-304.	
1.29.6	Case material	Epoxy coated steel plate or die-cast aluminium alloy with neoprene gasket	

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SR. NO.	ITEM	DESCRIPTION	
		and clear glass where applicable cover conforming to IP-65. (Explosion proof for NEC Class-1, Division 1 area).	
1.29.7	Scale	Black lettering on white background.	
1.29.8	Over range Protection	120 %.	
1.29.9	Instrument connection	Bottom.	
1.29.10	Switch configuration	Two SPDT.	
1.29.11	Switch rating	240V, 5A AC/220V, 0.5A DC.	
1.29.12	Switch type	Snap acting, shock and vibration-proof.	
1.29.13	Adjustability	Internal Set point adjustable over span range.	
1.29.14	Cable connection	3/4" ET conduit connection or compression gland.	
1.29.15	Compensation	(a) Capillary compensation with invar wire throughout the capillary length.	
		(b) Case compensation.	
1.29.16	Performance :		
(a)	Scale Accuracy	±1.0 % of full scale.	
(b)	Repeatability	< 0.5 % of full range.	
(c)	Response time	Less than 40 seconds with thermowell.	
1.29.17	Capillary length	5 meters (minimum) for local mounting/15 meters for local panel mounting.	

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SR. NO.	ITEM	DESCRIPTION
1.29.18	Nameplate	Tag number, service engraved in stainless steel tag plate.
1.29.19	Accessories	Mounting accessories, 3/4"ETcable gland.
1.30	<u>ROTAMETER</u>	
1.30.1	Type	On-line up to 2". By-pass above 2".
1.30.2	Metering tube	Borosilicate glass.
1.30.3	Float	AISI 316-SS unless the process fluid demands some other material.
1.30.4	Body MOC	AISI 316-SS.
1.30.5	Scale	Graduated- Engraved black on white background.
1.30.6	Process connection	Flanged.
1.30.7	Accuracy	± 2% of full scale detection or better for on-line type and ±4% of full-scale detection or better for by-pass type.
1.30.8	Nameplate	Tag number, service engraved in stainless steel tag plate.
1.30.9	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.

CONVEYANCE REQUIREMENTS

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1.35	<u>I/P CONVERTER</u>		
1.35.1	Type	Electro-pneumatic (Outdoor Type)	
1.35.2	Input level	4-20 mA DC	
1.35.3	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)	
1.35.4	Split range	For typical application wherever required.	
1.35.5	Control Action	Selectable air to close, air to open and fail freeze application.	
1.35.6	Supply pressure	1.2 to 1.6 Kg/cm ² (1.4 typical)	
1.35.7	Max. supply pressure	7 Kg/ sq.cm.	
1.35.8	Response Time	5 Seconds for 0 to 90% output pressure.	
1.35.9	Housing	IP 55.	
1.35.10	Repeatability	±0.1% of span.	
1.35.11	Accuracy	± 0.25% of span.	
1.35.12	Supply pressure effect	Less than 1%.	
1.35.13	Span and Zero adjustments	Screw.	
1.35.14	Pneumatic connection	¼" NPT.	

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SR. NO.	ITEM	DESCRIPTION	
1.35.15	Stability	Less than 0.25% of Span / Zero for six months.	
1.35.16	Cable connection	¾” ET.	
1.35.17	Mounting	Field (pipe/wall mounting).	
1.35.18	Accessories	Air filter regulator, mounting accessories, cable gland etc.	
1.36	<u>AIR FILTER REGULATOR</u>		
1.36.1	Filter Element	Sintered Bronze.	
1.36.2	Filter Size	5 microns.	
1.36.3	Input Air	10.0 Kg/Sq. cm (maximum)	
1.36.4	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.	
1.36.5	Effect of Supply	Maximum 0.02 Kg/Sq. cm for a change pressure variation in supply pressure of 4 Kg/Sq. cm.	
1.36.6	Bowl Material	Metallic cover around high temperature area/clear transparent polycarbonate with metallic cover for ordinary applications.	
1.36.7	Accessories	2" dial size output pressure gauge.	
1.36.8	Desirable Feature	No perceptible drop of pressure on opening the drain port.	

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SR. NO.	ITEM	DESCRIPTION	
1.37	<u>SOLENOID VALVE</u>		
1.37.1	Operating Principle	Electromagnetic. (noiseless)	
1.37.2	Coil voltage rating	240 V AC/220 V DC(as required. Any other voltage, if necessary, to be arranged by Bidder)	
1.37.3	Ways	Generally 3-ways other depending on requirement	
1.37.4	Port size	1/4" NPT all ports.	
1.37.5	Body	SS bar stock.	
1.37.6	Trim	SS-316.	
1.37.7	Duty	Suitable for continuous energization.	
1.37.8	Sealing	Airtight and leak proof.	
1.37.9	Ambient Temperature	0 - 50 °C.	
1.37.10	Fluid Temperature	0-150 °C (approx.)	
1.37.11	Coil Enclosure	Stainless Steel.	
1.37.12	Insulation	Class-H.	
1.37.13	Coil Casing	IP-65 (Explosion proof for NEC Class-1, Division-1 area)	
1.37.14	Mounting	On pipe or on panel.	
1.37.15	Cable Connection	3/4" ET.	
1.37.16	Accessories	Mounting brackets, nuts and bolts.	
1.37.17	Preferred feature	(a) Solenoid valve directly integral to actuator body shall have NAMOOR interface for uniformity.	

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SR. NO.	ITEM	DESCRIPTION	
		(b) Local indication for power.	
1.38	<u>SIGHT GLASS</u>		
1.38.1	Type	Flap-type.	
1.38.2	End connection	Screwed / Flanged.	
1.38.3	Material		
(a)	Body	CS/SS as per process medium.	
(b)	Indicator	Stainless steel.	
1.38.4	Sight Glass	Toughened Borosilicate.	
1.38.5	Gasket	Neoprene.	
1.38.6	Bolts & Nuts	High tensile steel.	
1.38.7	Hydraulic Test Pressure	1.5 times maximum working pressure.	
1.38.8	Accessories	As required.	
1.39	<u>LEVEL GAUGE (FLOAT & TAPE)</u>		
1.39.1	Type	Float and Tape	
1.39.2	Float & Tape MOC	AISI 316	
1.39.3	Pulley material	Aluminium	
1.39.4	Guide wire	SS 316 Stainless steel	
1.39.5	Accuracy	± 2 mm	
1.39.6	Indication	On circular or vertical dial	
1.39.7	Rating	Twice the design pressure	

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SR. NO.	ITEM	DESCRIPTION	
1.40	<u>FLOW INDICATING SWITCH</u>		
1.40.1	Type	On line metal tube Rotameter.	
1.40.2	End connection	Flanged.	
1.40.3	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.	
(e)	Casing	Di cast Aluminium.	
1.40.4	Accuracy	+/- 2.0% of FSR.	
1.40.5	Rangeability	10:1.	
1.40.6	Electrical connection	¾" ET.	
1.40.7	Switch type	Snap acting hermitically sealed 2 nos. SPDT.	
1.40.8	Contact rating	5A, 240V AC.	
1.40.9	Protection class	IP-65.	
1.40.10	Accessories	As required.	

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SR. NO.	ITEM	DESCRIPTION	
	(q) Accessories	Special cables, electronics, cabinets etc. as required to make the system complete, with bar/chain.	
	(r) Range	Application dependent.	
	(s) Range increment	0.1% of this selected range.	
	(t) Operating temperature	0 -70 °C	
	(u) Accuracy	± 0.5% FS range	
2.0	<u>CONTROL PANELS/DESK MOUNTED INSTRUMENTS AND ELECTRICAL SYSTEM ACCESSORIES</u>		
2.1	<u>COUPLING RELAY</u>		
2.1.1	Type	Octal base plug-in type/ DIN rail Mounting.	
2.1.2	Coil voltage	24 V D.C. in general / other as required.	
2.1.3	Contact	2 NO & 2 NC (Minimum).	
2.1.4	Contact rating	250 V/5A (A.C)/220V/2A (D.C).	
2.1.5	Operating range	70 to 110% of rated voltage.	
2.1.6	Insulation	2 kV for 1 minutes between terminal & earth.	
2.1.7	Mechanical life	20 million operations.	
2.1.8	Coil protection	Diode.	
2.1.9	Indication	Coil on LED.	

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SR. NO.	ITEM	DESCRIPTION	
2.1.10	Enclosure	Transparent cover.	
2.1.11	Connection	Screw terminals.	
2.1.12	Mounting	Projection mounting inside panel / DIN rail mounting.	
2.2	<u>DISTRIBUTION BOARDS</u>		
2.2.1	Type	Fixed, Modular.	
2.2.2	Power distribution	Through MCCB.	
2.2.3	Enclosure	Sheet Steel, IP54.	
2.2.4	Mounting	Free standing (Can be attended from both front & back).	
2.3	<u>RECEIVER RECORDER</u>		
2.3.1	Type	Microprocessor Based continuous video chart type. (Paper less)	
2.3.2	Display type	320 x 240 pixels high resolution coloured LCD graphics.	
2.3.3	Number of pen	2/4 as applicable.	
2.3.4	Input	4-20mA DC/1-5 Volt/ RTD/ Thermocouple.	
2.3.5	Display span rate	1, 5, 10, 20, 30 and 60 min / div. Selectable.	
2.3.6	Digital indication	Measured values with engineering unit.	
2.3.7	Trends	Coloured display on screen.	

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SR. NO.	ITEM	DESCRIPTION	
2.3.8	Colour of trends	Selectable.	
2.3.9	Performance		
(a)	Accuracy	$\pm 0.1\%$ of span or better. (Indication & Recording)	
(b)	Updation rate	1 Sec or better.	
2.3.10	Input open circuit	Up/Down Scale. (selectable)	
2.3.11	Reference Junction Compensation	Built-in cold junction compensation for thermocouple inputs.	
2.3.12	Power Supply	240 Volt, 1 Ph, 50 Hz A.C.	
2.3.13	Operating ambient temperature range	0-50 °C. (maximum)	
2.3.14	Face Dimension	144 mm (W) x 144 mm (H).	
2.3.15	Depth	300 mm (typical).	
2.3.16	Construction	Case - drawn steel, Bezel- Polycarbonate.	
2.3.17	Readable distance	3 meters (minimum)	
2.3.18	Mounting	Flush panel.	
2.3.19	Accessories	Engraved phenolic nameplate affixed to front flange to identify each recorder by tag number and each pen by color and measured variable. Shunt resistors, Ethernet port, RS232/422a/ 485 port.	
2.3.20	Features	(i) Hi, Hi-Hi, Lo and Lo-Lo contacts each channel.	

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2.3.21		(ii) 2 MB memory for Data acquisition and 100 MB Zip disk.	
		(iii) 3 ½" Floppy disk.	
		(iv) Computation functions like linear scaling, square root, differential and engineering unit and all other mathematical functions.	
		(v) Memory status display, LCD backlight saver.	
		(vi) Event sampling typically 125, 250, 500 msec.	
2.4	<u>MULTIPOINT RECORDER</u>		
2.4.1	Type	Microprocessor Based continuous video chart type. (Paper less)	
2.4.2	Number of Points	6,12 or 24. (as required)	
2.4.3	Input	4-20 mA/1-5V/Thermocouple/RTD.	
2.4.4	Recording	Channel number or dot with different color for each channel.	
2.4.5	Point Selection	Programmable for any combination of points by selection.	
2.4.6	Readable Distance	3 meters. (minimum)	
2.4.7	Data Display	Channel number, alarm status, measured data and engineering data (or Programming Display) in green LEDs.	

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SR. NO.	ITEM	DESCRIPTION	
2.4.8	Face Dimension	(i) 144 x 144 mm (approx.) for 6 point.	
		(ii) 252 x 206 mm (approx.) for 12 point.	
		(iii) 305 x 380 mm (approx.) for 24 point.	
2.4.9	Reference Junction Compensation	Built-in.	
2.4.10	Mounting	Flush Panel.	
2.4.11	Performance		
(a)	Accuracy	$\pm 0.5\%$ of span or better.	
(b)	Ambient Temperature effect	$\pm 0.3\%$ of span for 10 °C variation or better.	
(c)	Supply voltage variation effect	$\pm 0.2\%$ of span for 10% variation in supply voltage or better.	
(d)	Frequency variation effect	$\pm 0.1\%$ of span for 2 Hz variation in frequency or better.	
(e)	Operating Position effect	$\pm 0.1\%$ of span for 0-30 Deg. inclined or better.	
2.4.12	Input Open Circuit	Up/Down Scale.	
2.4.13	Power Supply	240 Volt, 1 Phase, 50 Hz AC.	
2.4.14	Operating Conditions :-		
(a)	Temperature	0-50 °C.	
(b)	Relative Humidity	25%-90%.	

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(c)	Supply Voltage	-15% to +10%.	
2.4.15	Accessories	Engraved phenolic nameplate affixed to front flange to identify each recorder by tag number and each pen by color and measured variable. Shunt resistors, Ethernet port, RS232/422a/485 port.	
2.4.16	Preferred Features	(i) Hi, Hi-Hi, Lo and Lo-Lo contacts for each channel.	
		(ii) 2 MB memory for Data acquisition and 100 MB Zip disk.	
		(iii) 3 ½" Floppy disk.	
		(iv) Computation functions like linear scaling, square root, differential and engineering unit and all other mathematical functions.	
		(v) Memory status display, LCD backlight saver.	
		(vi) Event sampling typically 125, 250, 500msec.	
2.5	<u>BAR GRAPH INDICATOR</u>		
2.5.1	Type	Bar graph.	
2.5.2	Number of channels	One/Two (as required)	
2.5.3	Input	4-20 mA/1-5 V/Thermocouple/RTD.	
2.5.4	Indication	Green LED / LCD.	

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SR. NO.	ITEM	DESCRIPTION	
2.5.5	Scale	100 mm vertical one for each channel graduated in engineering unit. (linear scale)	
2.5.6	Readable Distance	3 meters. (minimum)	
2.5.7	Mounting	Flush panel.	
2.5.8	Face Dimension	36(W) x 144(H) mm (approx) / 72 x 144 (H) mm.	
2.5.9	Resolution	1% of scale or better.	
2.5.10	Power Supply	240V, 1 Phase, 50 Hz AC.	
2.5.11	Operating Conditions :-		
(a)	Temperature	0-50 °C.	
(b)	Relative Humidity	5%-95%.	
(c)	Supply Voltage	-15% to +10%.	
2.5.12	Connection between Indicator and Tray	Prefab Cable.	
2.5.13	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.	
2.5.14	Alarm Facility	1 HI and 1 LO for each channel independently adjustable over span. Voltage free outputs.	
2.5.15	Reference Junction Compensation	Built-in cold junction compensation for	

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SR. NO.	ITEM	DESCRIPTION	
		thermocouple inputs.	
2.5.16	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.	
2.6	<u>VALVE POSITION INDICATOR</u>		
2.6.1	Input	4-20 mA DC/1-5 Volts DC.	
2.6.2	Indication	Pointer and Scale. Moving Coil Meter.	
2.6.3	Readable Distance	3 meters (minimum)	
2.6.4	Pointer Deflection	90 Deg Sector or linear.	
2.6.5	Mounting	Flush Panel (Horizontal/vertical)	
2.6.6	Accuracy	±1% or better.	
2.6.7	Protection Class	IP-42.	
2.6.8	Operating Ambient Temp.	0-50 °C.	
2.6.9	Scale	0-100%.	
2.6.10	Bezel Size	DIN Standard.	
2.7	<u>DIGITAL INDICATOR</u>		
2.7.1	Type	Four and half digit LED seven-segment display with sign.	
2.7.2	Face Dimension	72 x 144 mm / 48 x 96 mm. (as applicable)	
2.7.3	Display Character	13.8 mm, Green. (LED)	

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2.7.4	Accuracy	0.1% of reading, ± 2 digit.	
2.7.5	Input	4-20Ma DC/1-5 V DC/ RTD/ Thermocouple.	
2.7.6	Mounting	Flush Panel.	
2.7.7	Power Supply	240V $\pm 10\%$, 50 ± 2.5 Hz.	
2.7.8	Output Contact	2 nos SPDT, contact rating 5A at 240V AC/ 0.25A at 220V DC.	
2.7.9	Power/Signal Connection	Screwed.	
	Large Display (150x300 mm) indicators shall be provided for MW, MVAR and frequency indications.		
2.8	<u>TOTALIZER / COUNTER</u>		
2.8.1	Type	Electronic.	
2.8.2	Number of digits and digit size	Six, 9 mm high.	
2.8.3	Input	4-20mA DC.	
2.8.4	Reset	Manual.	
2.8.5	Readable distance	3 meters. (minimum)	
2.8.6	Mounting	Flush.	
2.8.7	Performance		
(a)	Accuracy	$\pm 0.5\%$ of span.	
2.8.8	Operating ambient temp.	0 - 50 $^{\circ}\text{C}$.	
2.8.9	Accessories	Engraved phenolic nameplate affixed to front flange to identify tag number and measured variable.	

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SR. NO.	ITEM	DESCRIPTION	
2.8.10	Preferred Features	Power supply on/failure LED visible from front.	
2.9	<u>PUSH BUTTON</u>		
2.9.1	Type	Shrouded square format.	
2.9.2	Face Dimension	32 x 32 mm (maximum)	
2.9.3	Contact Configuration	2 NO + 2 NC.	
2.9.4	Contact Addition	Add-on block up to 4 each with 2 pairs of contacts.	
2.9.5	Contact Material	Hard Silver Alloy.	
2.9.6	Contact Rating	500V / 10 A.	
2.9.7	Utilization Category	AC11 / DC11.	
2.9.8	Insulation Voltage	2 kV for 1 minute between terminals and earth.	
2.9.9	Mechanical Life	1 million operation.	
2.9.10	Construction	Aluminium shrouding with plastic lens.	
2.9.11	Colours	Red, Green, Yellow, Black, etc.	
2.9.12	Connection	Screw terminals.	
2.9.13	Enclosure Class	IP-52.	
2.9.14	Legend	Engraving.	
2.10	<u>ILLUMINATED PUSH BUTTON</u>		
2.10.1	Type	Square format.	
2.10.2	Face Dimension	32 x 32 mm. (maximum)	

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SR. NO.	ITEM	DESCRIPTION	
2.10.3	Contact Configuration	2 NO + 2 NC. (minimum)	
2.10.4	Contact Addition	Add-on-Block up to 4 each with 2 pairs of contacts.	
2.10.5	Contact Material	Hard Silver Alloy.	
2.10.6	Contact Rating	500 V/ 10A.	
2.10.7	Utilization Category	A C11 / DC11.	
2.10.8	Insulation Voltage	2 kV for 1 minute between terminals and earth.	
2.10.9	Mechanical Life	1 Million Operation.	
2.10.10	Lamp	LED with built-in resistors as required.	
2.10.11	Lamp Rating :		
(a)	Voltage	240 V AC.	
(b)	Watt	2 Watt (approx.)	
2.10.12	Lamp and Lens Replacement	From front.	
2.10.13	Construction	Transparent Plastic Lens.	
2.10.14	Colour	Red, Green, Amber, Yellow etc.	
2.10.15	Connection	Screw terminals.	
2.10.16	Enclosure Class	IP-52.	
2.10.17	Legend	Engraving.	
2.11	<u>SELECTOR SWITCH</u>		
2.11.1	Type	2/3/4 position stay put type with rotary lever actuator.	

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SR. NO.	ITEM	DESCRIPTION	
2.11.2	Face Dimension	32 x 32 mm. (maximum)	
2.11.3	Contact Configuration	4 pair of contacts.	
2.11.4	Contact Addition	Add-on-Block up to 4 each with 2 pairs of contact.	
2.11.5	Contact Material	Hard silver Alloy.	
2.11.6	Contact Rating	500 V/10 A.	
2.11.7	Utilization Category	AC11 / DC11.	
2.11.8	Insulation Voltage	2 kV for 1 minute between terminals and earth.	
2.11.9	Mechanical Life	1 million operation.	
2.11.10	Construction	Aluminium shrouding.	
2.11.11	Connection	Screw terminals.	
2.11.12	Enclosure Class	IP-52.	
2.12	<u>INDICATING LAMP</u>		
2.12.1	Type	LED with built-in resistor.	
2.12.2	Face Dimension	32 x 32 mm. (maximum)	
2.12.3	Voltage	240 V AC.	
2.12.4	Watt	2.5 Watt (approximate).	
2.12.5	Lamp and Lens Replacement	From front.	
2.12.6	Construction	Transparent Plastic lens.	
2.12.7	Colour	Red, Green, Amber, Yellow etc.	
2.12.8	Connection	Screw terminals.	

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SR. NO.	ITEM	DESCRIPTION	
2.12.9	Legend	Engraving.	
2.13	<u>INDICATING METERS (A.C)</u>		
2.13.1	Type	Rectifier type.	
2.13.2	Face Dimension	96 x 96 mm.	
2.13.3	Scale	Radial arc of 240 Deg.	
2.13.4	Accuracy	1.5% of full scale. ± 0.5 Hz for frequency meter.	
2.13.5	Input	0-1/0-5A for current measurement, 0-240V, 50 ± 2.5 Hz for voltage/ frequency measurement.	
2.13.6	Zero Adjustment	Screw on meter face.	
2.13.7	Enclosure	Shielded Case.	
2.13.8	Mounting	Flush Panel.	
2.13.9	End Scale Suppression	6 times the measuring range only for motor ammeters.	
2.14	<u>INDICATING METERS (D.C)</u>		
2.14.1	Type	Taut band moving coil.	
2.14.2	Face Dimension	96 x 96 mm.	
2.14.3	Scale	Radial arc of 240 Deg.	
2.14.4	Accuracy	1.5% of full scale.	
2.14.5	Input	0-75 mA for current measurement. Direct reading for voltage measurement.	

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SR. NO.	ITEM	DESCRIPTION	
2.14.6	Zero Adjustment	Screw on meter face.	
2.14.7	Enclosure	Shielded case.	
2.14.8	Mounting	Flush Panel.	
2.14.9	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.		
2.15	<u>AUXILIARY RELAY</u>		
2.15.1	Type	Electromagnetic.	
2.15.2	Coil voltage	240 V A.C / 220V DC. For any other voltage bidder to make his own arrangement.	
2.15.3	Contact Configuration	2 NO & 2 NC (Minimum), additional contacts as per requirement with provision for additional contact block expansion.	
2.15.4	Contact rating	250V/5A. (A.C/D.C.)	
2.15.5	Operating range	80 to 110% of rated voltage.	
2.15.6	Insulation	2 kV for 1 minute between terminals & earth.	
2.15.7	Mechanical life	20 million operations.	
2.15.8	Coil protection	Diode/surge suppressor.	
2.15.9	Connection	Screw terminals.	
2.15.10	Mounting	Projection mounting inside panel.	

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SR. NO.	ITEM	DESCRIPTION	
2.16	<u>ELECTRICAL TRANSDUCER</u>		
		Transducers shall be provided for conversion of AC electrical quantities such as voltage, frequency, 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.	
2.17	<u>SYNCHROSCOPE</u>		
		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.	
2.18	<u>ANNUNCIATION</u>		
2.18.1		PLC based system alarm annunciation system shall be solid state/ microprocessor based and shall include all required logic sequence. Display part of the system shall have panel mounted facia LED array assemblies, sets of alarm accept, reset, mute and test push buttons and panel mounted audible devices.	
2.18.2		The system shall be immune to variations in the power supply and shall not generate spurious alarm when the system power is switched on (power-on-reset)	
2.18.3		Controller of the PLC/Microprocessor based control system shall be used for configuring the alarm	
2.18.4		10% wired spare channels & facia shall be provided in all cases	

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SR. NO.	ITEM	DESCRIPTION
2.18.5	ANNUNCIATOR LOGIC	
	(a)	The circuit components for individual windows shall be mounted on plug -in circuit cards.
	(b)	Input shall be provided with contact bounce filtering. The filter shall delay contact inputs for 15 milliseconds to protect against input device bounce and electrical noise on input lines.
	(c)	Critical alarms shall be hardwired to the input card of annunciator controller.
2.18.6	<u>OTHER TECHNICAL PARTICULARS</u>	
	(a)	Type of contact NO or NC configurable
	(b)	Contact interrogation voltage 24 V DC
	(c)	Window drivers. Electronically short circuit protected, current limiting with automatic recovery
	(d)	Facia dimension 75 mm (W) X 50 mm (H)
	(e)	LED per facia 8 nos./Window
	(f)	Flash rate Adjustable (slow, fast, intermittent)
	(g)	Inscription Type Etched on photo film (sandwiched)
	(h)	Inscription letter height 5 mm (min.)
	(i)	No. of row of inscription/ facia 4 (max.)
	(j)	No. of letters/row 14 (max.)

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SR. NO.	ITEM	DESCRIPTION	
	(k) Colour of letters	Black (for white windows)	
	(l) Facia front cover	Hi-impact polystyrene	
	(m) Facia rear plate	Translucent plastic	
	(n) Colour of background	Milk white and red for critical / trip.	
	(o) Fascia block plate	Cold rolled sheet steel epoxy painted.	
	(p) Audible alarm	Cone type speaker	
	(q) Tone generator	Electronic with adjustable tone, amplitude and frequency	
	(r) Preferred sequence	(i) Ordinary Channel : ISA-S-18.1-1979-R	
		(ii) First-up channel : ISA-S-16.1-1979- F3M3	
NOTE:			
1. Instruments which are open to atmosphere should be covered with proper canopy.			
3.0 <u>CONTROL VALVES, ACTUATORS & ACCESSORIES</u>			
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			

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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. 3.1 <u>GENERAL</u> 3.1.1 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. 3.1.2 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. 3.1.3 Bonnet joints for all control valves shall be of flanged and bolted type. 3.1.4 Flanged valve shall be rated at no less than class 300 lbs.		

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3.2	<u>VALVE BODY/END CONNECTIONS</u>																
3.2.1	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.																
3.2.2	Control valves of 40 mm. size and above with line pressure up to 50 Kg/Sq. cm may have flanged or welded end connections.																
3.2.3	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.																
3.2.4	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.																
3.2.5	The direction of flow shall be clearly engraved on the body.																
3.2.6	Valve Body Material																
	<table> <thead> <tr> <th>SR.NO.</th> <th>SERVICE</th> <th>MATERIAL</th> </tr> </thead> <tbody> <tr> <td>(a)</td> <td>Non corrosive, non-flashing and non cavitating service for fluid temperature upto 275°C</td> <td>: Cast carbon steel ASTM A216 Gr. WCB</td> </tr> <tr> <td>(b)</td> <td>Non corrosive, non-flashing and non cavitating service for fluid temperature above 275°C</td> <td>: Cast alloy steel ASTM A217 Gr. WC9</td> </tr> <tr> <td>(c)</td> <td>Severe flashing / cavitating services</td> <td>: Cast alloy steel ASTM A217 Gr. WC9</td> </tr> <tr> <td>(d)</td> <td>Low flashing / cavitating services</td> <td>: Cast alloy steel ASTM A217 Gr. WC6</td> </tr> </tbody> </table>		SR.NO.	SERVICE	MATERIAL	(a)	Non corrosive, non-flashing and non cavitating service for fluid temperature upto 275°C	: Cast carbon steel ASTM A216 Gr. WCB	(b)	Non corrosive, non-flashing and non cavitating service for fluid temperature above 275°C	: Cast alloy steel ASTM A217 Gr. WC9	(c)	Severe flashing / cavitating services	: Cast alloy steel ASTM A217 Gr. WC9	(d)	Low flashing / cavitating services	: Cast alloy steel ASTM A217 Gr. WC6
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SR.NO. SERVICE MATERIAL (e) DM water application (condenser hotwell normal, emergency make up etc.) : Cast type 316 stainless steel ASTM A351 Gr. CF8M 3.3 <u>VALVE SIZE</u> 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 characterized valves and between 70 to 80 percent opening for equal percentage characterized 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. 3.4 <u>VALVE TOP WORK</u> 3.4.1 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.		

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3.4.2	Extended bonnet/Finned bonnet and high temperature packing shall be used for high temperature application.				
3.4.3	The gland material shall be chosen to suit the operating temperature. PTFE may be chosen for lower temperature application (232°C maximum) and for high temperature application graphite asbestos glands are to be provided. For vacuum services, the glands shall be of dry seal type.				
3.5	<u>VALVE TRIM</u>				
3.5.1	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.				
3.5.2	Balanced trim valves shall be offered for high shut-off pressure or high pressure drop condition to reduce the size of the actuators.				
3.5.3	For flashing services and two stage mixtures, the trim material shall be 17-4 PH SS or equivalent.				
3.5.4	If cavitating condition is foreseen, Bidder shall offer multistage or labyrinth trim 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.				
3.5.5	Quick replacement type trim shall be considered for easy maintenance.				
3.5.6	Trim Material				
	<table> <tr> <th>SR. NO.</th><th>SERVICE</th><th>MATERIAL</th></tr> </table>		SR. NO.	SERVICE	MATERIAL
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3.7.6	Air connection size shall be ¼" NPT (F) unless otherwise dictated by process response time. Integral tubing shall be stainless steel.	
3.7.7	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.	
3.7.8	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.	
3.8	<u>VALVE POSITIONERS</u>	
3.8.1	Regulating duty valves shall be offered with SMART Electro Pneumatic Positioners to ensure accuracy and repeatability of response.	
3.8.2	Positioners shall have integral non contact type position transmitter, input and output gauges, local keypad & display.	
3.8.3	Positioners shall be capable of functioning under hot, humid and vibrating conditions.	
3.8.4	Positioner casings shall be dust tight, corrosion resistant and weatherproof.	
3.8.5	In general, positioner shall operate at signal range 4 - 20 mA DC for the full travel of the valve. Remote calibration from control room shall be possible through HART management station for main plant positioners. However the calibration of positioner of off-site plants shall be carried out from hand held station.	
3.9	<u>VALVE ACCESSORIES</u>	
	Accessories shall include side mounted hand wheels, limit switches, junction boxes, airlock relays etc.. Solenoid valve wherever required shall be furnished.	

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4.0	<u>CONTROL DESK / PANELS / RACKS</u> (a) Convenient and logical approach to operational interfaces and aesthetics in the overall view of the panel /desk shall be considered. (b) For items susceptible to vibration, suitable anti-vibration padding shall be provided to prevent damage or malfunction. (c) All items inside the panels/cabinets shall be neatly arranged with easy access/maintenance approach. (d) Incoming power supply feeders shall be duplicated . Alarm shall be provided for failure of a power supply feed. (e) Desk/panel shall be provided with interior illumination, utility receptacles with plug and cooling fan. (f) Panel/Desk shall have gland plate at cable entry to panel. Thickness of gland plate shall not be less than 3 mm. (g) Wire shall be routed/laid through covered trough. (h) 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. (i) Nameplate (i) Nameplate shall be provided for instrument or device mounted on the panel. (ii) Nameplates for panels shall be provided both in front and rear. (j) All local control panels shall be housed in air condition environment.
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4.1 <u>CONTROL DESK</u> 4.1.1 Devices mounted on the desk shall be flush type. Devices shall be so mounted that their removal and replacement can be accomplished without interruption of services to others. 4.1.2 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. 4.1.3 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. Thickness of sheet shall not be less than 3 mm. 4.1.4 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. 4.1.5 Desk shall be of modular, scalable and industrially ruggedized design and shall have Telephones and Intercom connections. 4.1.6 Desk shall have concealed cable trays for wire dressing. 4.1.7 Design shall include Earthing bolts. 4.1.8 Back installed items shall be suitably concealed from front view. 4.2 <u>BACK UP PANEL</u> 4.2.1 Construction shall be from sheet steel of thickness not less than 3 mm. 4.2.2 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.		

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4.2.3	Cabinets/Enclosure/Panels		
(a)	Material of construction	:	Cold rolled steel sheet.
(b)	Thickness of Sheet	:	(i) 2.0 mm for faces supporting instruments / terminals.
(c)	Construction	:	Welded throughout as per approved National Standards.
(d)	Panel height	:	2300 mm. (approx)
(e)	(i) Corners	:	7 mm inner radius.
	(ii) Dimensional	:	a. In height & length - 3 mm.
	(iii) Tolerances	:	b. In height between adjacent sections - 2 mm.
(f)		:	c. Total for a group - 6 mm.
	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.
(g)	Color of interior	:	Brilliant white.
(h)	Colour external	:	RAL 7032.

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<table border="0"> <tr> <td>(i)</td> <td>Painting</td> <td>: Epoxy powder coated or better.</td> </tr> <tr> <td>(j)</td> <td>Gland plates</td> <td>: Removable 3 mm thick. (bottom)</td> </tr> <tr> <td>(k)</td> <td>Cable entry</td> <td>: Bottom.</td> </tr> <tr> <td>(l)</td> <td>Hardware</td> <td> : (i) Anti vibration pad- 15 mm. : (ii) Predrilled base channel ISMC - 10 or equivalent for all sides. : (iii) Stainless steel buff- finished 2 mm thick kick plate for all sides. : (iv) Stainless steel scratch strips along desk edges fixed with pan-head recessed screws. : (v) Rubber strips to ensure air tightness between kick plate and finished floor. : (vi) Lifting hook / Eye bolt. : (vii) Drawing pocket. : (viii) Door switch, lamps, thermostat, heaters and fans. </td> </tr> <tr> <td>(m)</td> <td>Enclosure Protection</td> <td>: As per environment condition of the area of installation. Refer section-1 of this vol.</td> </tr> </table>			(i)	Painting	: Epoxy powder coated or better.	(j)	Gland plates	: Removable 3 mm thick. (bottom)	(k)	Cable entry	: Bottom.	(l)	Hardware	: (i) Anti vibration pad- 15 mm. : (ii) Predrilled base channel ISMC - 10 or equivalent for all sides. : (iii) Stainless steel buff- finished 2 mm thick kick plate for all sides. : (iv) Stainless steel scratch strips along desk edges fixed with pan-head recessed screws. : (v) Rubber strips to ensure air tightness between kick plate and finished floor. : (vi) Lifting hook / Eye bolt. : (vii) Drawing pocket. : (viii) Door switch, lamps, thermostat, heaters and fans.	(m)	Enclosure Protection	: As per environment condition of the area of installation. Refer section-1 of this vol.
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4.3	<u>LOCAL INSTRUMENT RACKS & ENCLOSURE</u>																
4.3.1	General Requirements																
(a)	Devices located in the field shall be grouped and installed in the enclosure (Closed Rack) in outdoor areas such as Boiler area etc. and in Open Type Rack in covered areas such as TG Building.																

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(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 which 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.		

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(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 No. PE-189-IN-SK-8004/P0 (Sheets 10) shall be referred for typical arrangement of Local instrument enclosure and rack. 4.3.2 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 color 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.		

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(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. 4.3.3 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		

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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. 4.3.4 Junction Box Junction boxes of metallic construction. (a) Junction box shall be provided at a dry compartment at one side of the enclosure/rack with front opening type door. Junction box shall be of sheet steel construction with thickness not less than 2 mm. Earth stud shall be furnished at rack for safety grounding. (b) Terminals shall be screwless cageclamp type of reputed make and 20% spare terminals shall be furnished in the junction box.		

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10.0	<u>CONTROL & INSTRUMENTATION CABLE</u>	
10.1	Cables shall be flame retardant low smoke (FRLS) type. In hazardous areas cables of suitable R/L ratio shall be provided for intrinsic safety.	
10.2	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. Sequential length marking shall also be provided at every meter interval on outer sheath of cable.	
10.3	Standard seasoned wooden drum containing minimum 500 /1000 M $\pm$ 5% length. Drum shall be anti rodent, anti termite and smooth finish. Both end of cable shall be capped by means of non hygroscopic sealing material.	
10.4	<u>THERMOCOUPLE EXTENSION & COMPENSATING CABLE</u>	
	(a) Conductor	: Solid conductor.
	(b) Conductor size	: 16 AWG (1.31 Sq. mm)
	(c) Type	: KX (Extension) (Chromel Alumel) RX (Compensating) (Copper-Copper alloy) JX (Extension) (Iron Constantan).
	(d) Conductor Insulation	: HR PVC Type-C (IS-5831,1984) 0.6 mm thick.
	(e) Operating Voltage	: 300V /500V RMS (Core to earth / core to core).
	(f) Twisting	: Pair twisted with lay of 60 mm (max)
	(g) Twisting Direction	: All pairs in the same direction. Lapped to form bunch with mylar tape.

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(h)	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.
(i)	Drain wire	:	Annealed tinned copper wire, stranded. Size 0.5 Sq. mm. (No. of strands/size:- 7/0.3mm)
(j)	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.
(k)	Rip Cord	:	Non metallic under sheath.
(l)	Armouring	:	GI wire/strip as per IS 3975.
(m)	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.
(n)	Filler	:	Non hygroscopic with FRLS property.
(o)	Temperature Range	:	Up to 85 $^{\circ}\text{C}$.
(p)	Insulation at 20 $^{\circ}\text{C}$	:	100 MOhms/Km [Min].
(q)	Capacitance at 800 Hz	:	120 nf/km.

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- (v) 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

- (w) Durable printed or embossed numbering at regular interval of 50mm shall be provided for identification of pairs.

10.5 INSTRUMENTATION MULTI PAIRED SIGNAL CABLE

- (a) Conductor type : Stranded (7) annealed tinned copper.
- (b) Conductor size : 0.5/1.0/1.5 Sq.mm. (as required)
- (c) Conductor resistance : 39 Ω /Km/18 Ω /Km/12 Ω /Km.
- (d) Conductor Insulation : HR PVC Type-C (IS-5831,1984) 0.6 mm thick.
- (e) Operating Voltage : 300/500V RMS. (Core to earth/core to core)
- (f) Twisting : Twin twisted with lay of 60 mm.

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(g) Twisting Direction : All pairs in the same direction. Lapped to form bunch with mylar tape. (h) 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. (i) Analog signals- Individual pair & overall shield to be considered. (ii) Binary signals- overall shield to be considered. (i) Drain wire : Annealed tinned copper wire, stranded. Size 0.5 Sq. mm. (No. of strands / size:- 7 / 0.3mm) (j) 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 (k) Rip Cord : Non metallic under sheath. (l) Armouring : GI wire/strip as per IS 3975 (m) Outer Sheath : Extruded FRLS PVC (anti rodent, anti termite & moisture resistant properties).			

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HR PVC Type ST2 of IS-5831,1984. Thickness as per IS-1554, Part-I 1976. (n) Filler : Non hygroscopic with FRLS property. (o) Temperature Range : 85 °C. (p) Insulation at 20 : 100 MOhms/Km [Min] Deg.C (q) Capacitance at 800 : 120 nf/km Hz (r) Cross talk : 60 dB. (s) Attenuation : 1.2 dB/Km. (t) Codes & Standards : (i) IPCEA-S-61-402. (ii) BS 5308. (iii) IEC 332-1. (iv) ASTM-B-33. (v) IS-8130-1984. (vi) IS 1554 Part-1. (vii) IS 10810. (u) Sheath color : Inner- Black and Outer- Gray. (v) Tests (i) Oxygen Index: Min.29 at room temp. (ASTM-D-2863). (ii) Acid Gas Gen.: Max.20% by weight as per IEC 754 Part-I. (iii) Temp Index: Min 250 ° C at 21Oxy. Ind. (ASTM-D-2863).		

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(iv) Smoke Density Rating: Max.60% (ASTM-D-2843). (v) Flammability Test : as per IEC 332 Part-I. (vi) Swedish Chimney Test-SS-424-1475 F3. (vii) Insulation Resistance 100 M Ohm / Km Min. (viii) High voltage test Core to core- 1.5 kV for 1 min. Core to screen- 1.0 kV for 1 min. (ix) Rodent & Termite repulsion test (Presence of lead shall be confirmed). (w) Colour of core for Instrumentation Cable (As per IS-9938) <table border="1"> <thead> <tr> <th>PAIR</th><th>CORE</th><th>COLOR</th></tr> </thead> <tbody> <tr> <td>1st</td><td>1st</td><td>Blue</td></tr> <tr> <td>1st</td><td>2nd</td><td>Red</td></tr> <tr> <td>2nd</td><td>1st</td><td>Gray</td></tr> <tr> <td>2nd</td><td>2nd</td><td>Yellow</td></tr> <tr> <td>3rd</td><td>1st</td><td>Green</td></tr> <tr> <td>3rd</td><td>2nd</td><td>Brown</td></tr> <tr> <td>4th</td><td>1st</td><td>White</td></tr> <tr> <td>4th</td><td>2nd</td><td>Black</td></tr> </tbody> </table>			PAIR	CORE	COLOR	1 st	1 st	Blue	1 st	2 nd	Red	2 nd	1 st	Gray	2 nd	2 nd	Yellow	3 rd	1 st	Green	3 rd	2 nd	Brown	4 th	1 st	White	4 th	2 nd	Black
PAIR	CORE	COLOR																											
1 st	1 st	Blue																											
1 st	2 nd	Red																											
2 nd	1 st	Gray																											
2 nd	2 nd	Yellow																											
3 rd	1 st	Green																											
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(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.		

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11.1.1 Electrical Junction Box (a) Type of Enclosure : Dust tight & weatherproof conforming to IP 65. (b) Material : 3 mm sheet steel (c) Type of Cover : Solid unhinged with retention chain. (d) Paint : External - RAL 7032, Internal – Brilliant White. (e) Mounting : Surface (f) Cable Entry : 3 mm (min) Gland plate (g) Gasket : Neoprene (h) Grounding : Brass earth lug with green screw head External-2 nos , Internal-1no.M6. (i) Number of Drain Holes : Two at bottom capped. (j) Identification : Label for JB and Tags for cable. (k) Accessories : (i) Rail mounted cage clamp type screwless terminals with markers. : (ii) Cable gland : (iii) Ferrules : (iv) Canopy at top 11.1.2 Cable Gland (a) Type : Double compression (b) Entry Thread : NPT		

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(c) Material : Brass (d) Finish : Cadmium Plated (e) Protection : IP 54 or better (f) Accessories : Neoprene gasket, locknuts, reducers etc. 11.1.3 Cable Tray (a) Material : Mild steel, slotted (b) Thickness : not less than 2.0 mm (c) Finish : Hot dip galvanized (d) Perforation : As per MFR standard (e) Cover : Suitable for tray		
11.2	<u>PROCESS HOOK UP ACCESSORIES & SPECIFICATION</u>	
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.		
11.2.1	Seamless Stainless Steel Pipe	
(a) Reference : ASTM A-312 TP 316 (b) Material Grade : TP 316 (c) Type : Seamless /Plain end (d) Size : ½” NB (e) Schedule : 40 (f) Standard Length : 5 meter		

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11.2.2 Stainless Steel Pipe Fittings (a) Reference : ASTM A-182 F 316 / ANSI B16.11 (b) Type : Forged (c) Rating : 3000 lbs / 6000 lbs / 9000 lbs (d) Size : ½" NB (e) End connection : Generally socket weld (f) Type of Fittings : Reducing coupling, male-female reducer, straight coupling, equal tee, three piece union, elbow, cap etc. 11.2.3 Seamless Stainless Steel Tube (a) Reference : ASTM A-213 TP 316 (b) Material Grade : TP 316 (c) Size : ½" OD X 2.1 MM Thick (d) Type : Cold drawn annealed, pickled, passivated, de-scaled, hydraulically cleaned seamless tube. (e) 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. (f) Test Pressure : 400 Kg/Sq. cm (minimum) (g) Tolerance : ± 0.13 mm for outside diameter		

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± 15 % for wall thickness. (h) Standard Length : 5 meter (i) Test : Flare, Hardness, Ball and Bubble Test. 11.2.4 Stainless Steel Tube Fittings (a) Reference : ASTM-A-182 (b) Type : Double ferrule double compression. (c) Material : 316 Stainless steel forged. (d) Ferrule : 316 Stainless Steel. (e) Type of Fittings : Male/female connector, elbow, cross /equal tee, straight connector, bulkhead union, ferrule etc. as required to suit installation. (f) Size : To suit SS tubing and NPT end connection. 11.2.5 C.S. Pipe (a) C.S. Pipe : ASTM-A 106 Gr. C (b) Material : Cold drawn seamless black C.S (c) Type : Seamless/Plain ends. (d) Size : ½" NB (e) Schedule : 80, 160, XXS as required. (f) Standard Length : 6 meter		

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11.2.6 C.S. Pipe Fittings (a) Reference : ASTM-A 105/ANSI B16.11 (b) Type : Forged (c) Rating : 3000 lbs/6000 lbs/9000 lbs (d) Size : ½" NB (e) End connection : Generally socket weld. (f) Type of Fittings : Reducing coupling, male-female reducer, straight coupling, equal tee, three piece union, elbow, cap etc. 11.2.7 A.S. Pipe (a) Reference : ASTM-A 335 P22 AS PER ANSI B 36.10 (b) Material : Cold drawn seamless A.S (c) Type : Seamless / Plain ends (d) Size : ½" NB (e) Schedule : XXS (f) Standard Length : 5 meter 11.2.8 A.S. Pipe Fittings (a) Reference : ASTM-A 182 F22 AS PER ANSI B 16.11 (b) Type : Forged (c) Rating : 9000 lbs (d) Size : ½" NB		

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11.2.9 Carbon Steel Globe Valve		
(e) End connection	:	Generally socket weld
(f) Type of Fittings	:	Reducing coupling, male-female reducer, straight coupling, equal tee, three piece union, elbow, cap etc.
(a) Reference	:	ASTM A-105
(b) Type	:	Globe
(c) Construction	:	Forged Body Cadmium Plated.
(d) End Connection	:	½" Socket Weld
(e) Rating	:	CL. 800 / CL. 2500
(f) Material	:	Body - Carbon steel Stem - Hardened Steel Plug - AISI 316 SS Seat- Stainless steel stellited
(g) Packing	:	Teflon / Grafoil as required
(h) Yoke	:	ASTM A105
(i) Handwheel	:	Carbon steel
(j) Design standard	:	As per ANSI B 16.34
11.2.10 Stainless Steel Globe Valve		
(a) Reference	:	ASTM A-182 F316
(b) Type	:	Globe
(c) Construction	:	Forged Body
(d) End Connection	:	Socket Weld
(e) Proof Pressure	:	400 Kg/Cm ²
(f) Material	:	Body - Stainless steel

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11.2.10 Alloy Steel Gate Valve (g) Packing : Teflon as required (h) Yoke : ASTM A182 F316 (i) Handwheel : Carbon steel (j) Design standard : As per ANSI B 16.34 Stem - Hardened Steel Plug - AISI 316 SS Seat- Stainless steel stellited 11.2.11 Alloy Steel Globe Valve (a) Reference : ASTM A-182 F22 (b) Type : Globe (c) Construction : Forged Body (d) End Connection : ½" Socket Weld (e) Rating : CL. 2500 (f) Material : Body - Alloy steel Stem - Hardened Steel Plug - AISI 316 SS Seat- Stainless steel stellited (g) Packing : Grafoil as required (h) Yoke : ASTM A182 F22 (i) Handwheel : Carbon steel (j) Design standard : As per ANSI B 16.34 11.2.12 Condensate Pot (a) Reference : ASTM A182 F22 /ASTM A105 (b) Material : Alloy steel/carbon steel as per applicatio		

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(c) Construction : Drilled from bar stock (d) End connection : 3 nos. ½" socket weld end (e) Accessories : Vent valves 11.2.13 Instrument Valve Manifold (f) Type : (i) Two valve manifold : (ii) Five valve manifold (g) Mounting : Remote 2" Pipe Mounting (h) Construction : Single block (bar stock) (i) Material : Forged body and bonnet AISI 316 stainless steel. (j) Ports : 1/2 " NPT (F) (k) Rating : 420 Kg/Sq. cm at ambient (l) Operating Temperature : (-) 30 to (+) 170 Deg C (m) Packing : PTFE Wafer (n) Seat & Stem : AISI 316 SS (o) Plug : AISI 316 SS free to turn on stem/17-4 PH. (p) Handle Bar : AISI 316 SS (q) Connection : Straight (r) Accessories : (i) Plugs for all ports. : (ii) Mounting Bracket , bolts , nuts.		

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11.3	<u>PNEUMATIC HOOK UP ACCESSORIES</u>		
11.3.1	Air Header :		
	(a) Technical Particulars	:	For Panel For Field
	(b) Material of Construction	:	Stainless steel Stainless steel
	(c) Inlet Connection	:	2" NPT (M) 1" NPT (M)
	(d) Header Take-off	:	Stainless steel Stainless steel
	(e) Take off connection	:	1 / 2" NPT (M) 1 / 2" NPT (M)
	(f) Tube Take-off	:	Tube adapter on valve Tube adapter on valve
	(g) Drain	:	SS drain valve at lowest point SS drain valves at lowest poin
11.3.2	Seamless Stainless Steel Tube		
	(a) Reference	ASTM A-269 TP 316	
	(b) Material Grade	TP 316	
	(c) Size	¼" OD X 0.049" wall thickness.	
	(d) Type	Cold drawn annealed, pickled, passivated, de-scaled, ,hydraulically cleaned seamless tube.	
	(e) 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.	
	(f) Test Pressure	400 Kg/Sq. cm	

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(g) Tolerance ± 0.13 mm for outside diameter ± 15 % for wall thickness (h) Standard Length 5 meter (i) Test Flare, Hardness, Ball and Bubble Test		
12.0	<u>SPECIAL TOOLS & TACKLE AND TEST EQUIPMENT FOR DCS/PLC AND OTHER SYSTEMS</u>	
12.1	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.	
12.2	The tools & tackle and Test Equipment shall be shipped in separate container, clearly marked with names of the equipment for which they are intended.	
12.3	Bidder shall furnish list of tools & tackle and test equipment proposed to be supplied along with the bid.	

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9.0 PROCESS CONNECTION & INSTRUMENT HOOK UP

9.1 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. 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.

9.2 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.

9.3 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 425°C 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.

9.4 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.

SR. NO.	INSTRUMENTS	EQUIPMENT/PIPE SIDE	INSTRUMENT SIDE
(a)	Level Instruments		
	(i) Internal Displacer	4” – Flanged.	4” – Flanged.
	(ii) External Displacer	2” – Flanged.	2” – Flanged.
	(iii) Level gauge	¾” – Flanged.	¾” – Flanged.

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SR. NO.	INSTRUMENTS	EQUIPMENT/PIPE SIDE	INSTRUMENT SIDE
	(iv) DP Type	½" (min.) - welded 1" – welded for vessel like HP heaters, LP heaters, De-aerator etc. application.	½"- NPT.
	(v) External cage Level switch	1"- welded.	1"- welded.
(b)	Flow Instruments		
	(i) DP Type	½" - welded in general. 1" – welded for high pressure/ temperature main steam, feed water, PRDS etc. application.	½" – NPT.
(c)	Pressure Instruments		
	(i) Conventional	½" (min.)-welded 1"- welded for high pressure/ temperature main steam, feed water, PRDS etc. application.	½" – NPT.
	(ii) Diaphragm type-HFO application	3"- Flanged.	3"- Flanged.

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<table><tr><th>SR. NO.</th><th>INSTRUMENTS</th><th>EQUIPMENT/PIPE SIDE</th><th>INSTRUMENT SIDE</th></tr><tr><td>(d)</td><td>Temperature Instruments</td><td></td><td></td></tr><tr><td></td><td>(i) Thermowell</td><td>Generally - M 33 X2 (M). 1½" Flanged- For air /FG path application.</td><td>½" NPT.</td></tr><tr><td>(e)</td><td>Analyzer</td><td></td><td></td></tr><tr><td></td><td>(i) Liquid analyzer</td><td>½" - 1" – welded.</td><td>½".</td></tr></table>				SR. NO.	INSTRUMENTS	EQUIPMENT/PIPE SIDE	INSTRUMENT SIDE	(d)	Temperature Instruments				(i) Thermowell	Generally - M 33 X2 (M). 1½" Flanged- For air /FG path application.	½" NPT.	(e)	Analyzer				(i) Liquid analyzer	½" - 1" – welded.	½".
SR. NO.	INSTRUMENTS	EQUIPMENT/PIPE SIDE	INSTRUMENT SIDE																				
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	(i) Liquid analyzer	½" - 1" – welded.	½".																				
9.5	Size of impulse pipe for pressure measurement in air and flue gas duct path of boiler shall not be less than ½" NPT.																						
9.6	Separate stubs and take-off points with thermo well/root valves shall be provided for performance guarantee test.																						
9.7	Impulse pipes shall be clamped at suitable interval not exceeding 1.5 meter. Process pipe shall not be used for supporting the impulse pipe.																						
9.8	Fittings shall conform to ANSI B 16.11. Threads of piping component shall be of tapered construction.																						
9.9	Instrument blow down header shall in no case be lower than the material grade ASTM A 106 Gr. C.																						
9.10	Impulse pipe shall be laid at least with slope of gradient 1:10 to avoid any air pocket or water accumulation.																						
9.11	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.																						

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9.12	Siphon shall be provided in the impulse pipe or tube to protect the instruments where fluid temperature is 100 °C or more.	
9.13	Orientation of tappings shall be as follows : (a) For liquid service within 45° at lower half of the pipe horizontal plane. (b) For gas service within 90° at upper half of the pipe horizontal plane. (c) For steam service within 45° at upper half of the pipe horizontal plane. As a rule tap orientation of high and low pressure side should be parallel and symmetrical.	
9.14	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.	
9.15	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.	
9.16	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.	
9.17	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. 316H 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.	

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10.0	<u>POWER SUPPLY SYSTEMS</u> 10.1 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. 10.2 Type of power supply systems envisaged are as follows: (a) 240V AC UPS. (b) 24V DC battery system. The battery system shall be dual floating with each stream having its own float cum boost charger. Care shall be taken so that the control system is not damaged during boost charging and also that the cables are properly sized so that the voltage drop does not cause the terminal voltage at the consumer end to fall below the minimum recommended value.	
11.0	<u>ENVIRONMENTAL CONSIDERATIONS</u> 11.1 I&C components should operate properly with no degradation in expected lifetime or in operation parameter in the normal power plant environment. C&I system shall be designed considering all the operating conditions which may be encountered during installation and operation. 11.2 <u>TEMPERATURE</u> 11.2.1 Where the environmental extreme exceeds the capabilities of the selected system, Bidder should take appropriate steps to control the environment. 11.3 <u>HUMIDITY</u> 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.	

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7.9.1

Elevated Temperature Test

(a)

During the first 48 hours the ambient temperature shall be maintained at 50^o C and the equipment shall be made to repeatedly perform operations it will be expected to perform in service with loads on various components being equal to those which will be experienced in actual service.

(b)

The 48 hours test period shall be continuous but shall be divided into four 12-hour segments. The power supply voltage during each 12 hours segment shall be nominal voltage for 11 hours; followed by 110 percent of nominal voltage for 30 minutes; followed by 90 percent of nominal voltage for 30 minutes.

(c)

During the elevated temperature test the cubicle doors shall be kept closed and inside temperature in the zone of highest heat dissipating component/ module shall be monitored. Temperature rise inside the cubicle should not exceed 10 Deg.C above the ambient temperature of 50 Deg.C.

(d)

Solid-state logic systems shall be subject to the elevated temperature test and burn-in test as complete assemblies. Testing of individual components or modules shall not be acceptable.

7.9.2

Burn in Test

The 48 hours elevated temperature test shall be followed by 120 hours of burn in test at normal operating temperature. This test shall also be conducted as per above procedure.

7.10

PANELS, CUBICLES AND ENCLOSURES

7.10.1

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.

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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. (b) 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. (c) Panel/cabinet shall have eyebolt on top for lifting. 7.10.2 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 surface shall be applied to all exterior and interior surfaces, each coat of primer surface shall be of dry film thickness of 1.5 mil. A minimum of two spray coats of final finish colour (Catalyzed epoxy or polyurethane) shall be applied to all surface of dry film thickness 2.0 Mil. The finish colours for exterior and interior surfaces shall conform to the following shades: (i) Exterior – RAL 7032. (ii) Interior - Brilliant White.		

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(c) Paint films, which show sags, cheeks, blisters, teardrops, fat edges or other painting imperfections shall not be acceptable. 7.10.3 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.		

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(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 colour-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: (i) Control wiring : 1.5 Sq.mm (switches, pushbuttons etc.) (ii) Power supply/receptacle : 2.5 sq. mm or higher as /illumination wiring per load/ (iii) 4-20mA DC current : 0.5 Sq. mm and low voltage signal upto 24V DC		

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(p) Identification of conductors shall be done by insulation color-coding identified on drawings or by printed wiring lists. 7.10.4 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 6 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.		

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(f) Electrical meters, relays, transmitters and switching devices, operating at a voltage less than 50V may be grounded through the steel structure. 7.10.5 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: <table border="1"> <thead> <tr> <th>SR. NO.</th><th>LOCATION</th><th>ENCLOSURE TYPE</th></tr> </thead> <tbody> <tr> <td>(i)</td><td>Indoor type non- ventilated enclosure in non-hazardous area</td><td>IP-54.</td></tr> <tr> <td>(ii)</td><td>Indoor type ventilated enclosure in non-hazardous area</td><td>IP -42.</td></tr> <tr> <td>(iii)</td><td>Enclosure in Air conditioned area</td><td>IP-22 with suitable canopy at top to prevent ingress of dripping water.</td></tr> <tr> <td>(iv)</td><td>Outdoor type in non-hazardous areas</td><td>IP-55.</td></tr> <tr> <td>(v)</td><td>Outdoor in hazardous areas</td><td>As per requirements of the NEC Code for the location.</td></tr> </tbody> </table> 7.10.6 Terminal Blocks (a) Terminals shall be chromated galvanized DIN rail mounted screw less cage clamp type. Terminals shall have screwed connection for conductor cross-section above 2.5 mm². Terminal blocks shall conform to IEC 947-7-1.			SR. NO.	LOCATION	ENCLOSURE TYPE	(i)	Indoor type non- ventilated enclosure in non-hazardous area	IP-54.	(ii)	Indoor type ventilated enclosure in non-hazardous area	IP -42.	(iii)	Enclosure in Air conditioned area	IP-22 with suitable canopy at top to prevent ingress of dripping water.	(iv)	Outdoor type in non-hazardous areas	IP-55.	(v)	Outdoor in hazardous areas	As per requirements of the NEC Code for the location.
SR. NO.	LOCATION	ENCLOSURE TYPE																		
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(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 20 percent spare unwired terminals shall be provided for all panels/cabinets /desks /junction box etc. This shall be in addition to 20% 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 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:		

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(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 colours depending on voltage levels. 7.10.7 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 colour 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.		

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(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. exemption

8.0 METERING BASES AND CHART UNITS

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

(a)	Pressure	: Kg/cm ² .
(b)	Differential Pressure	: mm of H ₂ O column/Kg/cm ² .
(c)	Draught	: mm of H ₂ O column.
(d)	Vacuum	: Kg/cm ² (abs)/mm of Hg column.
(e)	Temperature	: Degree Celsius (°C).
(f)	Flow (Steam, Water)	: Tonnes/hr, M ³ /Hr.
(g)	Flow (Oil)	: M ³ /Hr, Litter/Hr.
(h)	Flow Air	: Tonnes/hr/M ³ /Hr.
(i)	Density	: gms/c.c.
(j)	Level	: mm/%.
(k)	Conductivity	: Siemens/cm.
(l)	Gas Analyzer	: Percentage by weight or as specified in respective case.
(m)	Dissolved Oxygen/Silica /Sodium	: ppm /ppb.



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1.0 SCOPE

This specification covers the Design, Manufacture, Inspection and Testing at the manufacturer's works, proper packing for transportation and delivery to site, supervision, erection, and commissioning at site of Local Panels required for control and monitoring of the Auxiliary Plant & Equipment.

2.0 CODES AND STANDARDS

2.1 All the equipments specified herein shall comply with the requirements of the latest issue of the relevant National and International standards.

2.2 As a minimum requirement, the following standards shall be complied with:

- | | | |
|----|--------------------------|---|
| a) | IS-6005 : 1998 | : Code of practice for phosphating of iron and steel. |
| b) | IS-5 : 2007 | : Colors for ready mixed paints and enamels. |
| c) | IS-1248:2003 | : Direct Acting Indicating Analog Elec Measuring Instruments. |
| d) | IS/IEC 60947:Part 1:2004 | : Low Voltage switchgear & control gear: Part-I (General Rules) |
| e) | IS-8828:1996 | : Circuit breaker for household and similar installations. |
| f) | IS-13947 (Part-I):1993 | : Low Voltage switchgear & control gear : Part-I (General Rules) |
| g) | ISA-18.1:1979 | : Annunciator Sequences and Specification |
| h) | NFPA-496:2003 | : Purged & Pressurised Enclosure for Electrical Equipment in Hazardous Locations. |

3.0 TECHNICAL REQUIREMENTS

3.1 Panel Construction

3.1.1 The local panels shall house the secondary instruments, annunciation system, Single loop controller, Control switches / push buttons, indicating lamps/LED cluster, relays, timers and other devices required for operation and monitoring of the equipment locally.

3.1.2 The panels shall be of free standing type either welded construction on angle iron (minimum section of 50 x 50 x 4 mm) structure or folded construction by sheet metal formation depending upon the equipments to be mounted on it. The panels shall be robustly built and stiffeners as necessary shall be provided.

3.1.3 The panel shall be suitably reinforced to ensure adequate support for all instruments mounted thereon. All welds on exposed panel surfaces shall be ground smooth.

3.1.4 The salient features of construction shall be:

Sheet material: Cold rolled sheet steel

Frame thickness: Not less than 3.0mm

Enclosure thickness: Not less than 3.0 mm for load bearing sections (Mounted with instruments)
2.0 mm for doors and Not less than 2.0 mm for others

Panel Height: Not less than 2365 mm (Refer data sheet-A (No. PES-145A-DS1-0)

Gland plate thickness: 3.0mm

Base channel: ISMC 100 with anti-vibration mounting & foundation bolts.

3.1.5 The panel shall be provided with rear doors with integral lockable handle. The door when locked shall be held at minimum three places. The door width shall not be more than 550mm. The doors shall be provided with suitable stiffeners to prevent buckling. The handle shall be on the right side of the door. The door shall be removable type with concealed hinges to facilitate maintenance work. Suitable pocket inside the door shall be provided for keeping the drawings / documents. Double door shall be provided with suitable glass windows, as per the requirement.

3.1.6 Suitable neoprene gasket shall be provided on all doors and removable covers. Suitable ventilation system along with louvers shall be provided at bottom and top of the doors covered with removable wire mesh.



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- 3.1.7 The class of protection shall be in accordance with IP-55 unless otherwise specified in the data sheet – A (No. PES-145-54A-DS1-0).
- 3.1.8 All steel surfaces shall be cleaned by sand / pellet blasting, treated for pickling, degreasing and phosphating etc. by seven tank method. The panel shall have a high quality finish and appearance. The panel shall be painted with two coats of primer followed by two coats of epoxy / synthetic enamel based final paint of color shade and finish as given in data sheet-A (No. PES-145A-DS1-0). Minimum thickness of the paint shall be 85 microns for external paint and 70 microns for internal paint.
- 3.1.9 The cable glands of the required size and type as given in data sheet-A (No. PES-145A-DS1-0) shall be supplied alongwith the Panel.
- 3.1.10 All operable and indicating devices shall be mounted on the front of the panel while aux. Relays / timers MCBs etc. required for realization of control logics shall be mounted on a mounting plate inside the panel. Auxiliary relays and timers etc. shall be grouped according to the control function.
No operable or indicating devices shall be mounted below 750 mm and above 1800 mm (w.r.t. finished ground level). The devices shall be located in such a way so as to ensure easy access for operation / maintenance.
- 3.1.11 Single / dual control power supply feeders of voltage class as specified in data sheet-A (No. PES-145A-DS1-0) shall be provided by the purchaser. In case redundant power supply feeders are provided then auto changeover unit shall be mounted on the panel are in the panel supplier's scope. Where DC control power supply is specified an additional 240V, 50 Hz AC supply feeder for powering of space heater and lighting shall be provided by the purchaser. Suitable arrangement shall be provided inside the panel to receive and terminate the power supply feeder(s). For this purpose MCBs of suitable current rating shall be provided by the vendor. A supervisory relay along with a pilot lamp to indicate control supply 'ON' shall be provided on the panel. Any other power supply required for the operation of the devices mounted in the panel shall be arranged by the vendor.
- 3.1.12 The internal wiring shall be carried out with 1100 volt grade PVC insulated copper multi strand wire / flexible of 1.5mm² size. AC & DC wires shall be kept separate from each other. Separate coloured wires to be used for AC and DC circuits. All wires shall be properly numbered and identified with ferrules as per the Control scheme / wiring diagram. Wires shall be routed and run through PVC troughs.
- 3.1.13 Terminal blocks shall be clip on type, 1100 volts grade. Separate terminal blocks shall be used for AC & DC circuits. The terminals shall be suitable for terminating 0.5 mm² to 2.5mm² external cables. The TB points in terminal block shall be cage clamp type / screw type. The terminal for ammeters shall be provided with removable links for shorting CTs. Each terminal strip shall be provided with identification strip. The terminal shall not be mounted below 250 mm height from finished floor. The panel shall have ten (20) percent spare terminal.
- 3.1.14 The interior of each panel shall be suitably illuminated through fluorescent lamps / tube lights with shrouded cover of minimum 15W operable on 240V 50 Hz AC power supply through panel door switch. A 15 Amp. 3-pin Power receptacle shall be provided.
- 3.1.15 Suitable space heaters operable on 240 Volts 50 Hz AC power system shall be provided at the panel bottom. These shall be designed to maintain the panel temperature five (5) deg. C above the ambient temperature during maintenance shutdown. Suitable isolating and control devices comprising of MCB, thermostat etc. shall be provided for the space heater.
- 3.1.16 The panel shall be provided with a copper earth bus of 25 x 6 mm size running throughout the width of the panel. It shall be terminated internally with 10 mm bolts at extreme ends for connection to; main station earth. The panel mounted equipments / devices shall be connected to earth bus through green coloured PVC insulated stranded copper conductor of 2.5 mm² size.
- 3.1.17 Local Panel shall be provided with main name plate of 150 mm x 40 mm size having inscription of 20 mm height. The individual devices on the panels shall be as provided with separate name plate with inscription of 3 mm height. The instrument / devices shall be provided with stick on label plates inside the panel. The material of the main and individual labels shall be three (3) ply 3 mm thick Traffolyte



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Sheet / 2 mm Anodised Aluminium Plate. The inscription shall be with white letters on black background on traffolyte sheet. The labels shall be fixed by self tapping non-rusting screws.

- 3.1.18 Vendor shall furnish electric load and heat load list (in case panel is to be placed in ac environment) of each panel.
- 3.2 Hazardous Area Panel Requirement
- 3.2.1 The Local Panel located in hazardous area shall be pressurized as per NFPA-496 requirements to render it non-hazardous. Alarms shall be provided for local and remote annunciation when pressurisation falls below 2.5 mm of water column. Protection shall be of type Z of NFPA-496. It shall not be possible to switch ON the power of purged section unless it is purged as per the recommendation of NFPA-496. Vendor must provide a protective device on the panel to protect the panel from over pressurisation.
- 3.2.2 Vendor shall supply pressurisation kit consisting of valves, restriction orifices, dual filter regulation, pressure gauges, pressure switches, rotameter etc. Pressurisation kit shall be surface mounting on a metal board and located outside the local panel. Pressurisation kit shall further consist of solenoid valve flow switch, timer blow off safety device etc., so as to make purging fully automatic. However final start shall be manual. Panel protection against over pressure to be provided as per NFPA-496.
- 3.2.3 Pressurised local control panel pressurization kit assembly design shall provide minimum leakage flow through the Local Control Panel. Panel venting shall be as per NFPA-496.
- 3.2.4 All components in the local panel like indicating instruments, push buttons switches, lamps etc., which are required to be energized without panel pressurization or before completion of purge cycle shall be explosion proof as per NEMA-7 & suitable for area classification.
- 3.2.5 All push buttons etc. requiring frequent operation during machine running shall have good positive sealing. Weatherproof housing or cover to be provided wherever necessary. Vendor shall provide pressurisation bypass switch outside explosion proof enclosure of pressurized panel with lamp indication. This shall be used only during maintenance. All hinges, screws, other non-painted metallic parts shall be of stainless steel material.
- 3.2.6 Provision to switch off manually all types of power shall be provided in the panel. In addition, it shall also be possible to switch off power circuits / components which are powered from motor control centre or control room manually in case of pressurization failure. All such cables from MCC and main control room shall be terminated in explosion proof boxes (NEMA-7).
- 3.3 Control & Monitoring devices
- 3.3.1 Instruments like Indicators, recorders, single loop controllers etc. as applicable and specified elsewhere for the plant / equipment shall be supplied and mounted on the panel.
- 3.3.2 Alarm Annunciator System
It shall be solid state discrete facia type having a sequence of ISA-S18.1A or as specified, opaque facia windows of 70 mm x 50 mm size, having two (2) lamps per window, and hooter of 10W, and provision for repeat group alarm at remote. The annunciator shall be provided with ten (10) percent spare windows or minimum two (2) windows along with electronics.
- 3.3.3 Relays
The relays shall be electromagnetic type suitable for specified control supply. Its contact configuration and rating shall be suitable for the specified control function. However minimum contact rating shall be 5 Amp AC & 2 Amp DC as applicable. There shall be ten (10) percent spare contacts.
- 3.3.4 Timers
The timers shall be electronic type suitable for specified control supply. Its contact configuration and rating shall be suitable for the specified control function. However, minimum contact rating shall be 5 Amp AC & 2 Amp DC as applicable.



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3.3.5 Control / Selector Switches

Switches shall be Rotary Cam type with minimum of 5 Amps AC & 2 Amp DC continuous current rating. Selector switches shall be stay put type while control switches shall be spring-return-to-neutral type. Contact configuration and rating shall be as per the control function requirement. The switches shall be lockable type wherever specified. Each switch shall be provided with engraved plates indicating the switch position / functions.

3.3.6 Push Buttons / Indicating Lights

The push buttons shall be momentary action self-resetting type, however stop P.B. for unidirectional drives shall be provided with manual reset facility. Its contact configuration & rating shall be as required for the control function but minimum 2 NO + 2 NC of 5 Amp. AC rating. It shall have round coloured projecting tab and engraved escutcheon plate / inscription plate. Colour coding of push buttons shall be as under:

RED	Motor OFF / Valve CLOSE	YELLOW	Alarm acknowledge	Left Hand Side
GREEN	Motor ON / Valve OPEN	BLACK	Lamp test	Right Hand Side

Indicating lights shall be suitable for direct connections across specified power supplies. It shall be fitted with built in resistance to prevent circuit tripping on shorting of lamp filament. It shall be fitted with LED cluster type lamp replaceable from front.

GREEN	Motor OFF / Valve CLOSED condition	AMBER	Motor tripped	Left Hand Side
RED	Motor ON / Valve OPEN condition	WHITE	Normal / healthy	Right Hand Side

3.3.7 Ammeters

Ammeter shall be 96 x 96 mm size, 90 deg. deflection, 1.5% accuracy, 1 Amp. CT operated or with 4-20mA input and Flush mounting type as called for in the data sheet-A (No. PES-145-54A-DS1-0). Ammeters for motors shall have six (6) times folded scale at upper end to enable motor starting current indication

3.3.8 Miniature Circuit Breaker (MCB)

These shall be instantaneous magnetic trip type for short circuit in addition to current time inverse delayed thermal trip feature for over current protection. The housing of MCB shall be made of non-ignitable, high impact material. It shall have minimum short circuit rating of 9 KA for AC Voltages and 4 KA for DC Voltages.

3.3.9 Makes of various instruments / devices shall be as given below

1.	Alarm Annunciators	:	Procon / IIC
2.	Ammeters	:	AEP / IMP
3.	Control / Selector Switches	:	Alsthom / Kaycee / Siemens / L&T
4.	Push Buttons / Indicating Lamps	:	Siemens / L&T / Teknic / Alsthom
5.	Auxiliary Relays	:	Jyoti / Siemens / L&T / OEN
6.	Timers	:	L&T / Alsthom / Bhartiya Cutler Hammer
7.	MCBs	:	S&S Power Engg. / Indo Asian / MDS
8.	Terminal Blocks	:	Jyoti / Elmex

4.0 TESTING AND INSPECTION

4.1 The bidder shall adopt suitable quality assurance program to ensure that the equipments offered will meet the specification requirements in full.

4.2 BHEL's standard Quality Plan for LCP is enclosed with the specification. The bidder shall furnish his acceptance to BHEL's QP and submit the signed and stamped copy of QP along with the offer.



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4.3 The vendor shall conduct the following tests as a minimum requirement:

4.3.1 Routine Tests

1. High Voltage (H.V.)
2. Insulation Resistance (I.R.)
3. Functional

4.3.2 Type Tests

1. Enclosure Class Test

5.0 SPARES AND CONSUMABLES

5.1 Commissioning Spares and consumables

The bidder shall supply all commissioning spares and consumables 'as required' during Start-up, as part of the main equipment supply.

5.2. Mandatory Spares

The bidder shall offer alongwith main offer, the Mandatory Spares as specified elsewhere in the specification. The Mandatory Spares offered shall be of the same make and type as the main equipment.

5.3. Recommended Spares

The bidder shall furnish a list of Recommended Spares indicating the normal service expectancy period and frequency of replacement; quantities recommended for 3 years operation alongwith unit rate against each item to enable BHEL/BHEL's Customer to place a separate order later, if required.

6.0 DRAWINGS AND DOCUMENTS

6.1 The bidder shall furnish the following documents in required number of copies along with the bid :

1. Data Sheet no. PES-145A-DS1-0
2. General Arrangement Drawing.
3. Catalogue and technical information for instruments and devices.
4. Quality Plan.

6.2 The vendor shall furnish the following documents in required number as agreed after the award of contract:

1. Data Shee No. PES-145A-DS2-0
2. GA Drawing indicating layout of instruments, construction details, foundation details, cable gland plate alongwith cable glands and all details mentioned in this specification.
3. Control Schematic Diagram along with grouping of different terminals for various functions.
4. Catalogue and technical information for instruments and devices with selected options clearly marked.
5. O&M Manuals.
6. "As Built" Drawing.
7. CDs.

7.0 MARKING AND PACKING

7.1 Panel with all instruments / devices mounted on it shall be suitably packed & protected for the entire period of despatch, storage and erection against impact, abrasion, corrosion, incidental damage due



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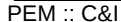
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to vermin, sunlight, high temperature, rain moisture, humidity, dust, sea-water spray (where applicable) as well as rough handling and delays in Transit and storage in open.

8.0 APPLICABLE DATA SHEET FORMS

This document shall be read with one or more of the following data sheet forms :

- Data sheet A&B for Local Panels : Data sheet no. PES-145A-DS1-0
- Data sheet C for Local Panels : Data sheet no. PES-145A-DS2-0



STD QUALITY PLAN NO.: PE-QP-999-145-I056

IIB

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DATE: 22-02-2008

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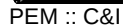
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^s			Remarks
									P	W	V	
1.0	INCOMING Sheet Steel (CRCA & HR)	1. Chemical Composition	MA	Chemical analysis	Sample	IS:1079 IS:513	IS:1079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

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- 1 - BHEL
- 2 - Vendor
- 3 - Sub-vendor

 PEM :: C&I		STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL						STD QUALITY PLAN NO.: PE-QP-999-145-I056				
								VOLUME IIB				
								SECTION D				
								REV. NO. 01 DATE: 22-02-2008				
								SHEET 2 OF 7				
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^s			Remarks
									P	W	V	
		3. Conductor a) Resistance b) Size c) Sheet colour	MA MA MA	Electrical Measurement Visual	100% 100% 100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	2	---	---	
		4. Type / Routine Test Certificates	MA	Verification	100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	3	---	2	
4.0	Electrical Components like Annunciator Transformers Lamps Switches PBs Contactors Relays Timers Space Heaters Thermostat Indicating meters etc.	1. Verification at make and Type 2. Verification of Test Certificates 3. Operation / Functional check 4. I.R. 5. H.V. 6. Calibration 7. Pick up / Drop off Voltage	CR CR CR MA MA MA MA	Visual Scrutiny of Type / Routine T.Cs. Electrical Electrical Electrical Electrical	Sample 100% Sample+ 100% 100% 100% 100% 100%	BHEL Spec. and BOM Relevant IS Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue	BHEL Spec. and BOM Relevant IS Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue	Log Book Log Book Log Book Log Book Log Book Log Book Log Book	2 2 2 2 2 2 2	--- --- --- --- --- --- ---	--- --- --- --- --- 1 ---	+ for relay & contactors only @ for all components except relays & contactors.
LEGEND: * CR - Critical characteristics MA - Major characteristics MI - Minor characteristics ^s P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test. 1 - BHEL 2 - Vendor 3 - Sub-vendor												

 PEM :: C&I		STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL						STD QUALITY PLAN NO.: PE-QP-999-145-I056				
								VOLUME IIB				
								SECTION D				
								REV. NO. 01 DATE: 22-02-2008				
								SHEET 3 OF 7				
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^s			Remarks
									P	W	V	
5.0	Misc. Components like Gaskets, Terminal Blocks etc.	1. Verification of Type / Make 2. Surface defects 3. IR / HV on Terminal Blocks	MA MA MA	Visual Visual Electrical	Sample Sample Sample	BHEL Spec. & Mfrs. Catalogue BHEL Spec. & Mfrs. Catalogue BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue BHEL Spec. & Mfrs. Catalogue BHEL Spec. & Mfrs. Catalogue	Log Book Log Book Log Book	2 2 2	--- --- ---	--- --- ---	
6.0	IN PROCESS Blanking / Bending / Forming	1. Dimensions 2. Surface defects after bending	MI MA	Measurement Visual	100% 100%	Approved Mfr. drgs. Factory Standard	Approved Mfr. drgs. Factory Standard	Log Book Log Book	2 2	--- ---	--- ---	
7.0	Nibbling / Punching	1. Cutout Sizes 2. Deburring	MI MA	Measurement Visual	100% 100%	Approved Mfr. drgs. Approved Mfr. drgs.	Approved Mfr. drgs. Approved Mfr. drgs.	Log Book Log Book	2 2	--- ---	--- ---	
8.0	ASSEMBLY Frame Assembly & Sheet fixing	1. Dimensions 2. Alignment 3. Welding Quality 4. Surface defects	MA MA MA MA	Measurement Measurement Visual Visual	100% 100% 100% 100%	Approved drg. / Mfr. Standards Approved drg. / Mfr. Standards Approved drg. / Mfr. Standards Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards Approved drg. / Mfr. Standards Approved drg. / Mfr. Standards Approved drg. / Mfr. Standards	Log Book Log Book Log Book Log Book	2 2 2 2	--- --- --- ---	2 2 2 2	
LEGEND: * CR - Critical characteristics MA - Major characteristics MI - Minor characteristics ^s P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test. 1 - BHEL 2 - Vendor 3 - Sub-vendor												



STD QUALITY PLAN NO.: PE-OP-999-145-I056

IIB

D

01

DATE: 22-02-2008

4

OF

7

7

7

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

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 PEM :: C&I		STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL						STD QUALITY PLAN NO.: PE-QP-999-145-I056				
								VOLUME IIB				
								SECTION D				
								REV. NO. 01 DATE: 22-02-2008				
								SHEET 5 OF 7				
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^s			Remarks
									P	W	V	
10.	Panel Wiring	1. Wiring Layout	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	
		2. Wiring Termination (Crimped Lugs)	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	
		3. Ferrule numbers	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	
		4. Colour of wiring	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	1	
		5. Size of Conductor	MA	Measurement	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	1	
11.	Component Mounting	1. Correct components	MA	Visual	100%	Approved drgs., Specs. & BOM	Approved drgs., Specs. & BOM	Log Book	2	---	---	
		2. Fixing	MA	Visual	100%	Approved drgs., Specs. & BOM	Approved drgs., Specs. & BOM	Log Book	2	---	---	
12.	FINAL Final Inspection	1. Workmanship	MA	Visual	100%	Factory Standard	Factory Standard	Inspection Report	2	1	1	At Random by BHEL, based on 100 % internal test reports by Mfr.
		2. Component layout (neatness, accessibility & safety) Mounting / Proper fixing of all components	MA	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	
		3. Components identification Marking / Name plates	MA	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	

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बी एच ई एल BHEL PEM :: C&I		STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL						STD QUALITY PLAN NO.: PE-QP-999-145-I056					
								VOLUME		IIB			
								SECTION		D			
								REV. NO.		01		DATE: 22-02-2008	
								SHEET		6		OF 7	
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^s			Remarks	
									P	W	V		
		5. Dimensions	MA	Measurement	100%	BHEL approved drg. / Spec., BOM	BHEL approved drg. / Spec., BOM	Inspection Report	2	1	1	At Random by BHEL, based on 100 % internal test reports by Mfr.	
		6. Door functioning	MA	Functional	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1		
		7. Paint Shade	CR	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1		
		8. Paint Thickness	CR	Measurement	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1		
		9. Workmanship of Gaskets	MA	Visual	100%	Factory Standard	Factory Standard	Inspection Report	2	1	1		
		10. Wiring Layout	MA	Visual	100%	BHEL approved drg.	BHEL approved drg.	Inspection Report	2	1	1		
		11. Wire Termination	MA	Pulling manually	Sample	-----	Firm termination	Inspection Report	2	1	1		
		12. Continuity	MA	Electrical	100%	-----	Continuity OK	Inspection Report	2	1	1		

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बीएचएल भारतीय वैद्युत समिति PEM :: C&I		STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL						STD QUALITY PLAN NO.: PE-QP-999-145-I056					
								VOLUME		IIB			
								SECTION		D			
								REV. NO.		01		DATE: 22-02-2008	
								SHEET		7		OF 7	
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^s			Remarks	
									P	W	V		
13.	TYPE TEST	Degree of Protection	CR	Mech. Protection	Sample	BHEL approved spec., drg relevant IS-13947 Part-1, IS-2148.	BHEL approved spec., drg relevant IS-13947 Part-1, IS-2148.	Type Test Certificate	3	---	1		
14	ROUTINE TEST	IR before & after HV Test	CR	Electrical	100%	BHEL approved spec., drg., BOM & relevant IS.	BHEL approved spec., drg., BOM & relevant IS.	Test Report	2	1	1		
15	FUCTIONAL TEST	1. Control Logic Operation	CR	Electrical	100%	BHEL approved spec. / drg.	BHEL approved spec. / drg.	Inspection Report	2	1	1		
		2. Instrument Calibratio	CR	Electrical	10%	BHEL approved spec. / drg.	BHEL approved spec. / drg.	Inspection Report	2	1	1		
		3. Temperature rise	CR	Electrical	100%	BHEL approved spec/drg. & relevant IS.	BHEL approved spec/drg & relevant IS.	Inspection Report	2	1	1		

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DATA SHEET FOR LOCAL PANELS

SPECIFICATION NO.: PES-145-054A

VOLUME

SECTION

REV. NO. 01

DATE: 24.01.2019

SHEET 1 OF 2

TAG No. Qty.....

Data Sheet No.: PES-145A-DS1-0

Data Sheet A & B

DATA SHEET-A FOR LOCAL PANEL
(TO BE FILLED BY PURCHASER)

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

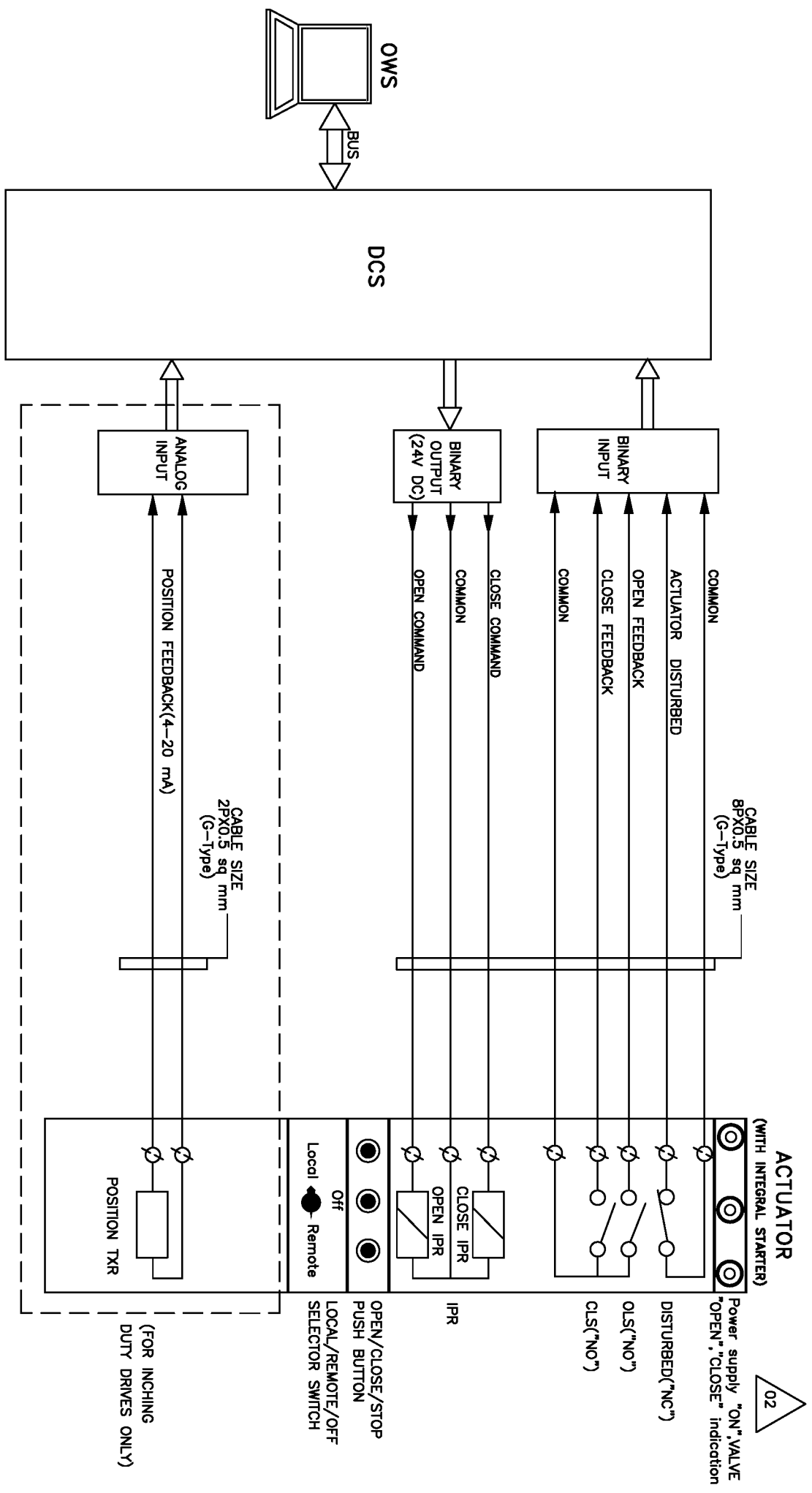
GENERAL	MANUFACTURER		
	CONSTRUCTION		☐ FOLDED ☐ WELDED (As per requirement EDN)
	ENCLOSURE SHEET THICKNESS	FRONT	☒ 3.0 mm (FOR FACES SUPPORTING INSTRUMENTS/TERMINALS)
		OTHER	☒ 2.0 mm (FOR OTHER SIDES AND TOP)
		DOOR	☒ 2.0 mm
		HEIGHT	☐ 2365 mm for stand alone panels. (THIS SHALL BE DECIDED BY BHEL DURING DETAILED ENGG.)
	OTHER	☐	
TECHNICAL	INPUT POWER SUPPLY *		☐ 240V 50 Hz AC ☐ 220V DC ☐ 415V 3 PHASE 3W ☐ 415V 3 PHASE 4W
	NO. OF FEEDERS		☐ ONE ☒ TWO
	CONTROL SUPPLY		☐ 110V AC ☐ 220V AC ☐ 220V DC ☐ Other. (As per requirement)
	ALARM ANNUNCIATOR WINDOW (EXCLUDING SPARES)		_____ NOS. (AS REQUIRED)
	PAINT TYPE		☐ EPOXY ENAMEL ☒ EPOXY POWDER COATED OR BETTER (THIS SHALL BE DECIDED BY BHEL DURING DETAILED ENGG.)
	PANEL COLOUR (EXTERNAL)		☐ LIGHT GREY (Shade 631 IS-5) ☐ OPALINE GREEN (Shade 275) . ☒ RAL 7032 (THIS SHALL BE DECIDED BY BHEL DURING DETAILED ENGG.)
	FINISH (EXTERNAL)		☐ MATT ☐ GLOSSY ☐ SEMI GLOSSY
	PANEL COLOUR (INTERNAL)		☐ WHITE ☐ CREAM ☐ OFF WHITE ☒ BRILLIANT WHITE
	FINISH (INTERNAL)		☐ MATT ☐ GLOSSY ☐ SEMI GLOSSY
	CLASS OF PROTECTION		☐ IP-42 (FOR INDOOR SERVICE) ☒ IP-55 (FOR OUTDOOR SERVICE) ☐ ANY OTHER
	CONTROL HARDWARE		☒ RELAY BASED
	FOUNDATION ARRANGEMENT		☐ FOUNDATION BOLTS ☐ ANCHOR FASTENERS
	WEIGHT OF PANEL (Kg.)		
	PANEL TYPE		☐ PRESSURISED ☐ UNPRESSURISED As per Requirement
	CABLE GLAND		☐ DOUBLE COMPRESSION
	AMMETER (TYPE OF INPUT) *		☐ 1 Amp CT ☐ 4-20 mA

	DATA SHEET FOR LOCAL PANELS			SPECIFICATION NO.: PES-145-054A	
				VOLUME	
				SECTION	
				REV. NO. 01	DATE: 24.01.2019
				SHEET 2	OF 2
TAG No. Qty.....			Data Sheet No.: PES-145A-DS1-0		
Data Sheet A & B					
DATA SHEET-A FOR LOCAL PANEL (TO BE FILLED BY PURCHASER)				DATA SHEET-B (TO BE FILLED-UP BY BIDDER)	
* TO BE CO-ORDINATED WITH PEM ELECTRICAL					
NAME SIGNATURE DATE	PREPARED BY	CHECKED BY	APPROVED BY	COMPANY SEAL NAME: SIGNATURE: DATE:	

	1X660 MW Bhusawal STPP	SECTION: C SUB SECTION : C&I
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	
DRIVE CONTROL PHILOSOPHY		

DRIVE CONTROL PHILOSOPHY

DCS INTERFACE FOR BIDIRECTIONAL DRIVE(WITH INTEGRAL STARTER)

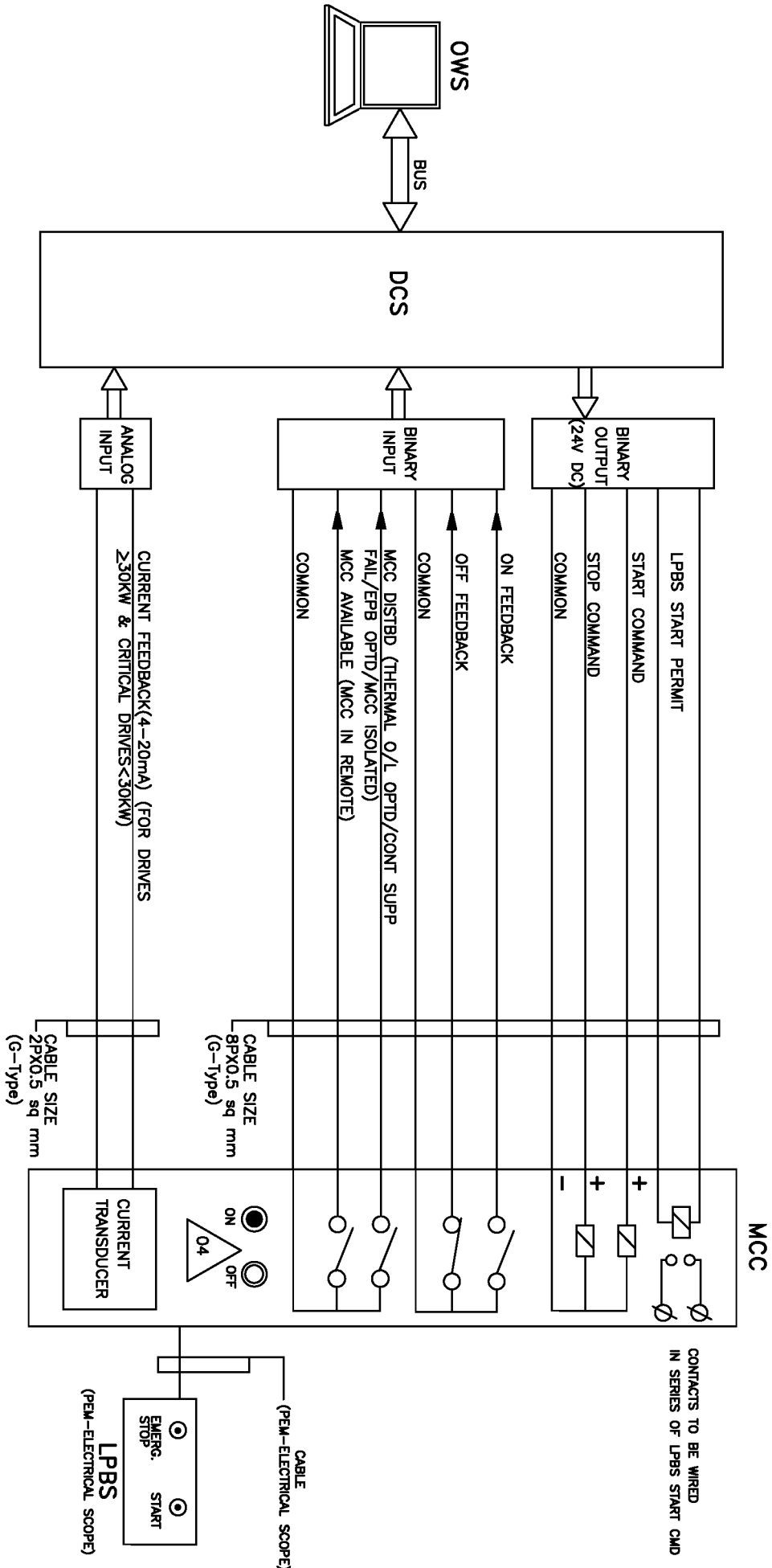


NOTE:

- 1. DISTURBED= Loss of Power supply (1 Phase/3 Phase), Loss of control supply, Motor thermostat trip, Thermal over load relay trip, Valve jammed, Torque open/close cut off, Local/Off/Remote Sel. switch in local or off mode etc.

PROJECT:	1x660 MW BHUSAWAL STPP
TITLE	DDCMS INTERFACE FOR BIDIRECTIONAL DRIVE
DRG.NO.	PE-DM-415-145-1002
DATE	01.10.2018
REV.NO.	04
SHT	8 OF 12

DCS INTERFACE FOR UNIDIRECTIONAL LT DRIVE(CONTACTOR OPERATED)



NOTE: INTERPOSING RELAYS(IPRS) TO BE SUPPLIED ALONG WITH MCC.



PROJECT:

1x660 MW BHUSAWAL STPP

TITLE

DDCMIS INTERFACE FOR
UNIDIRECTIONAL LT DRIVE

DRG.NO.

PE-DM-415-145-1002

DATE

01.10.2018

REV.NO.

04

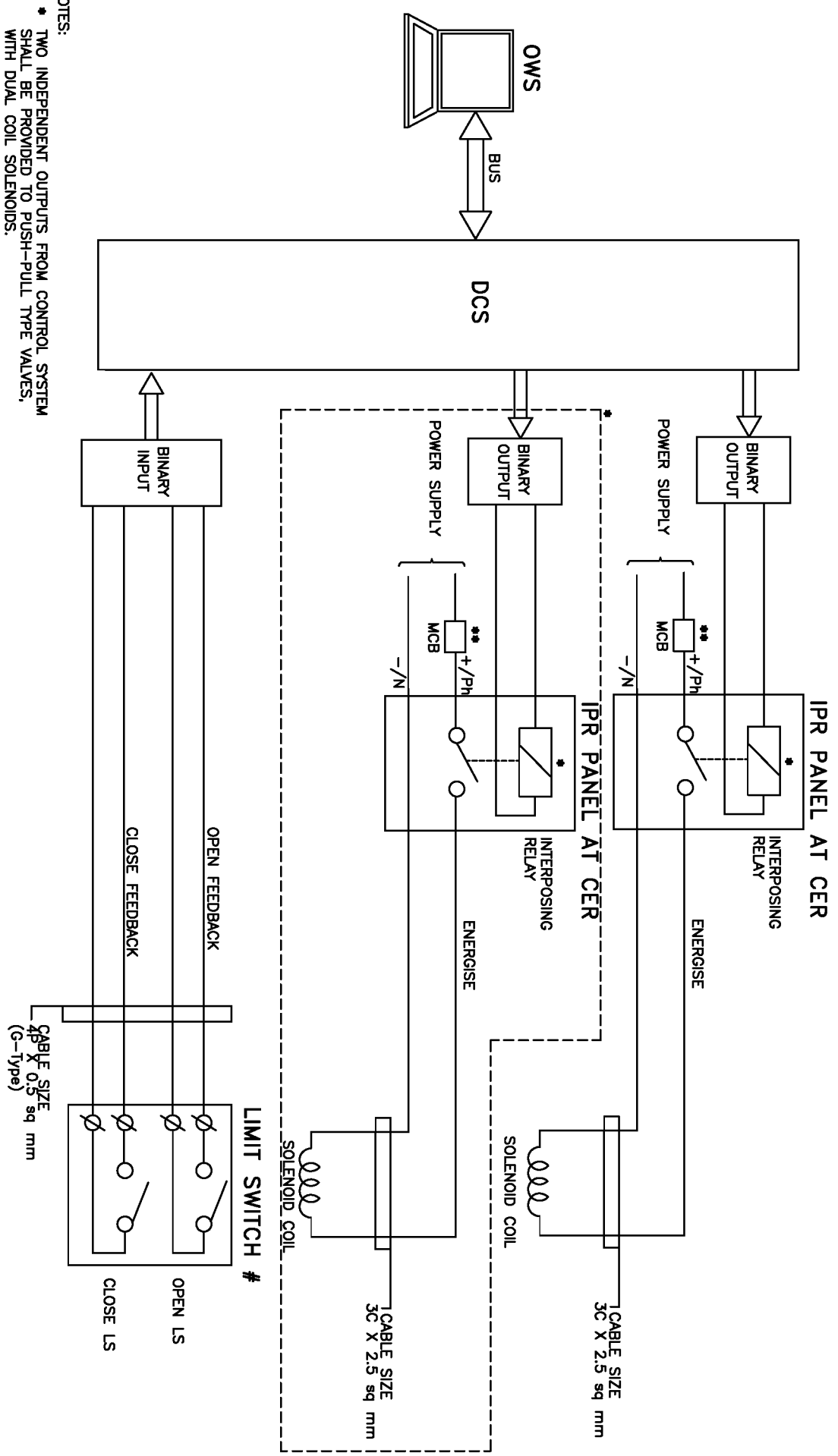
SHT

9

OF

12

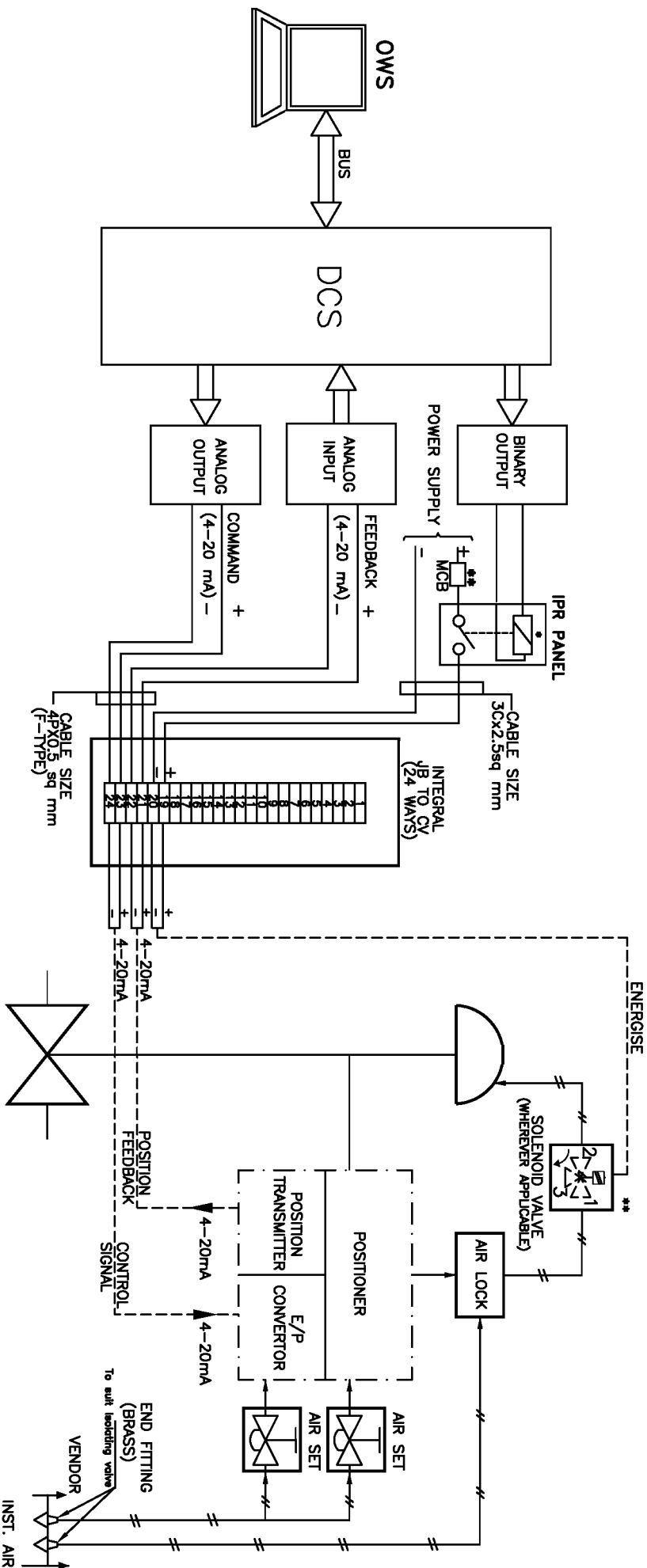
DCS INTERFACE FOR SOLENOID DRIVE (24V DC / 240V AC UPS)



- NOTES:
- * TWO INDEPENDENT OUTPUTS 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.

	PROJECT:		1x660 MW BHUSAWAL STPP	
	TITLE		DDCMIS INTERFACE FOR SOLENOID DRIVE	
	DRG.NO.	PE-DM-415-145-1002		
	DATE	01.10.2018		
	REV.NO.	04		
	SHT	10	OF	12

DCS INTERFACE FOR ANALOG DRIVE



NOTES:

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

PROJECT:	1x660 MW BHUSAWAL STPP		DRG.NO.	PE-DM-415-145-1002
	TYPICAL HOOK-UP DIAGRAM		DATE	01.10.2018
TITLE		ANALOG DRIVE	REV.NO.	04
			SHT	12 OF 12



	1X660 MW Bhusawal STPP	SECTION: C SUB SECTION : C&I
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	
APPLICABLE CODES AND STANDARDS		

	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – I
REV: R0	CONTROL & INSTRUMENTATION	Page 37 of 718
The required quantities of cable accessories shall be similarly estimated on the basis of number of terminations and proposed routing of the cables and shall be included in the offer allowing a positive allowance of at least 30% for each accessory. The exact quantity of different accessories shall be specified in the offer. Any shortfall in the quantity of accessories observed during actual laying shall be compensated at no extra cost. 5.0 <u>PROVEN PRODUCT</u> 5.1 The offered model of DCS, Microprocessor based control system must have been successfully supplied, erected, tested and commissioned as complete station Control & Instrumentation system for at least two units of capacity not less than 600 MW supercritical Thermal Power Station(s) with reheat type pulverized coal fired boiler. Further, these units should be in successful operation for a minimum period of two (2) years. 5.2 Similarly, all other C&I equipment/PLC/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 500 MW. 5.3 Bidder shall furnish required information to fully satisfy Owner regarding successful operation and high reliability of products/systems furnished. 6.0 <u>CODES AND STANDARDS</u> 6.1 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 Boiler for the design and design calculations, manufacturing and erection procedure as called for under the IBR Act for all items requiring such certification. 6.2 Generally, the following latest edition of codes and standards prevailing at the time of award of contract shall be applicable.		

	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 1
REV: R0	CONTROL & INSTRUMENTATION	Page 38 of 718
6.2.1 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. 6.2.2 Pressure Measurement (a) Instrument and apparatus for pressure measurement - ASME PTC 19.2 (1964). (b) Bourdon tube pressure and vacuum gauges - IS: 3624/1996. 6.2.3 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. 6.2.4 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).		

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 1
REV: R0	CONTROL & INSTRUMENTATION	Page 39 of 718
(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. 6.2.5 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. 6.2.6 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). 6.2.7 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.		

	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – I
REV: R0	CONTROL & INSTRUMENTATION	Page 40 of 718
(d) Purged and pressurized enclosure for electrical equipment in hazardous location - NFPA Article 496 Volume-4, 1978.		
6.2.8	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.		
6.2.9	Annunciator	
(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.		
6.2.10	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.		
6.2.11	UPS System	
(a) Practice and requirements for semi-conductor power rectifiers - ANSI C34.2.		



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(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. (e) Battery: IEEE Std. 1106/IS, 10918, BS 6920-II: 1984, IS 1652, IEC 896-1987. (f) For Lead acid plante type battery selection & sizing : IEEE Std. 485:1997 6.2.12 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. 6.2.13 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.		

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(g) Seamless Alloy Steel Pipe ASTM A 335 P22. (h) Seamless Stainless Steel Pipe ASTM A-312 TP 316. 6.2.14 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. 6.2.15 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		

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	(iii) Radiated Electromagnetic Field : IEC-801.3 (iv) Electrostatic Discharge : IEC-801.2 (v) Electromagnetic Emissions : VDE 0871, Class-B	
6.2.16 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.		
7.0	<u>DESIGN CRITERIA</u> This section lays down the general design criteria to be adapted in designing the instrumentation and control system of the plant.	
7.1	<u>GENERAL REQUIREMENTS</u>	
7.1.1	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. (g) Able to withstand high vibration.	

	1X660 MW Bhusawal STPP	SECTION: C SUB SECTION : C&I
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	
MANDATORY SPARES		

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<u>SR. NO.</u>	<u>EQUIPMENT/PACKAGE NAME</u>	<u>QUANTITY</u>
	measurement used.	
3.0	<u>MEASURING INSTRUMENTS</u>	
3.1	<u>ELECTRONIC TRANSMITTERS</u>	
3.1.1	Transmitters of all types, ranges and model no. (for the measurement of Pressure, differential pressure flow, level etc.)	10% or 2 no. of each type and model, whichever is more
3.1.2	Electronic cards / PCB's for each type and model and model of transmitters	10% or 5 nos. of each type, whichever is more
3.2	<u>TEMPERATURE ELEMENTS</u>	
3.2.1	RTDs of each type & length	10% or 2 nos. whichever is more
3.2.2	Thermocouples of each type like K-type, R-type, metal etc and length	10% or 2 nos. whichever is more
3.2.3	Thermowell for T/C & RTDs	10% or 1 no. of each type, rating, length used in the system whichever is more
3.2.4	Process actuated switch devices Including all types of pressure, differential pressure, flow, temperature, differential temperature, level switch devices	10% or 1 no. of each type and model whichever is more
3.3	<u>INDICATORS/RECORDERS</u>	
3.3.1	Digital Indicators of each model, type & range (including relevant digital indicators of electrical system)	10% or 2 nos. min. whichever is more

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3.3.2	Vertical Indicators of each type & model	5% or 1 no. of each model whichever is more
3.3.3	Recorders for each type and model	5% or 1 no. whichever is more.
3.3.4	Consumables for continuous recorders Charts Ink capsules	25 rolls per recorder/ 25 nos per recorder/ 20 nos. per recorder / Ink Pads /Pens.
3.3.5	Consumables for multi point recorders	
(a)	Charts	5 nos. per recorder
(b)	Ink pads	5 nos. per recorder
(c)	Print mechanism/ print head assembly	10% or 5 nos. of each type whichever is more
3.3.6	Level transmitters (displacer type)	
(a)	Electronic cards / PCB's of level transmitters	10% of total quantity used or 1 for each type/rating whichever is more
(b)	Level transmitters	10% of total quantity used or 1 for each type/rating whichever is more
(c)	Electronic water level indicator	10% or 2 nos. min. whichever is more
3.3.7	PD type flow transmitters	10% of total quantity used or 1 for each type/rating whichever is more
3.4	<u>SWITCHES</u>	
3.4.1	Switches (Pressure, DP, Level, Flow, Temperature etc)	10% of each type of total nos. used in the system or minimum 1 no. of each type, model & range whichever is more

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3.5	Rotameter	10% of each type of total nos. used in the system or minimum 2 no. of each type, model & range whichever is more	
3.6	<u>SOLENOID VALVE</u>	10% of each type of total nos. used in the system or minimum 2 no. of each type, model & range whichever is more	
3.6.1	Assembly	10% of total quantity used or minimum 2 no. of each type whichever is more	
3.6.2	Coil	10% of total quantity used or 5 no. whichever is more	
3.7	E/P Converter	10% of each type of total nos. used in the system or minimum 2 no. of each type, model & range whichever is more	
3.8	<u>SPECIAL INSTRUMENTS</u>		
3.8.1	Nucleonic /non-nucleonic density meter, solid flow meter etc.	1 no. and spare parts as per manufacturer	
3.9	Electrical Transducers	10% of total quantity used or minimum 1 no. of each type and range whichever is more	
4.0	<u>POWER SUPPLY SYSTEM</u> <u>(24 V DC POWER SUPPLY SYSTEM)</u>		
4.1	Silicon controlled thyristors, diodes power transistors	100%	

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5.0	<u>PROCESS CONNECTION PIPING</u> (for impulse piping /tubing, sampling piping/ tubing and air supply piping as applicable)		
5.1	Valves of all types and models	10% or 2 no. of each type, class, size and model whichever is more.	
5.2	2 way, 3way, 5way valve manifolds	10% or 2 no. of each type, class size and model whichever is more.	
5.3	Fittings	10 nos. of each type	
5.4	Purge meters	10 % of each model or 2 Nos. whichever is more	
5.5	Filter regulators	10% of each model or 2 Nos. whichever is more	
5.6	Impulse pipe & tubing of all type	20 mtrs each type & size	
5.7	Impulse line root valve	10% of total quantity used or 4 no. whichever is more for each type and rating of each size	
5.8	SS tube	40 mtrs of each type/size	
5.9	Fitting for SS tube	40 nos. of each type/size	

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<u>SR. NO.</u>	<u>EQUIPMENT/PACKAGE NAME</u>	<u>QUANTITY</u>
6.0	<u>INSTRUMENTATION CABLE, INTERNAL WIRING AND ELECTRICAL FIELD</u>	
6.1	Pre fabricated cable of each type	10% of installed quantity
6.2	Pre fabricated cable connector	10% or 1 no. of each type and model, whichever is more.
6.3	Other cables	10% of each type, pair and size of actual installed quantity
7.0	<u>ELECTRICAL ACTUATORS</u>	
7.1	Actuators	10% or 1 no. of each type, model and rating, whichever is more.
7.2	Power unit for modulating actuator	10% or 2 nos. of each type, whichever is more.
7.3	DC-DC unit/power pack units	10% or 2 nos. of each type, whichever is more.
7.4	Electronic cards	10% or 5 nos. of each type, whichever is more
7.5	Brake assembly	10% or 2 nos. of each type, whichever is more..
7.6	Brake coils	10% or 2 nos. of each type whichever is more.
7.7	Position feed back transmitters	10% or 2 nos. of each type whichever is more.
7.8	Control unit	10% or 2 nos. of each type whichever is more
7.9	Torque and limit switch assembly of each unit	10% or 2 nos. of each type, whichever is more.
7.10	O-ring	1 set of each size

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<u>SR. NO.</u>	<u>EQUIPMENT/PACKAGE NAME</u>	<u>QUANTITY</u>	
7.11	Motor	1 no. of each type & rating	
7.12	Auxiliary contact	10% of total quantity used or 2 nos. whichever is more for each type and rating of each size	
7.13	Seal kit	1 set of each type & size	

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<u>SR. NO.</u>	<u>EQUIPMENT/PACKAGE NAME</u>	<u>QUANTITY</u>
11.0	<u>RADAR TYPE LEVEL</u> <u>TRANSMITTER</u>	
11.1	Transmitter/Receiver	10% or 1 no. of each type transmitter/ receiver
11.2	Electronic card	10% or 1 no. of each type electronic card

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<u>SR. NO.</u>	<u>EQUIPMENT/PACKAGE NAME</u>	<u>QUANTITY</u>
12.0	<u>CONTROL VALVE</u>	
12.1	<u>NON-CRITICAL CONTROL VALVE</u>	(a) One set of spare control valve stem packing for each control valve.
		(b) Two moulded rubber diaphragms for each control valve.
		(c) 2 no. of gasket for each type/size.
		(d) 100% quantity of lubricants for gaskets for each control valve on one year consumption basis.
		(e) 2 set of limit switches for each control valve.
		(f) One (1) set of valve trims (such as plug, stem, seat ring/cage, guide bushing, stem lock pin, packing retaining ring etc) for each control valve.
		(g) One complete actuator of each type or min. 10% for each type and size whichever is more.
12.2	<u>CRITICAL CONTROL VALVE</u> (BFP RECIRCULATION VALVE, SUPERHEATER SPRAY VALVE, REHEATER SPRAY VALVE, SOOT BLOWER VALVE, PRDS STEAM PRESSURE REDUCING VALVE, FEED CONTROL VALVE)	Spares for BFP minimum recirculation valve & feed control valve are to be included in C & I package, the spares for remaining critical control valve are covered in volume II, section VIII, Annexure –A
12.2.1	Soft goods kit valve	1 set

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<u>SR. NO.</u>	<u>EQUIPMENT/PACKAGE NAME</u>	<u>QUANTITY</u>
12.2.2	Metal seat	1
12.2.3	Seat ring	1
12.2.4	Spindle	1
12.2.5	Actuator soft goods kit	1 set
12.3	<u>COMMON SPARES AND ACCESSORIES FOR ABOVE VALVE</u>	
12.3.1	Feed back transmitter unit	10% of total quantity used or 2 nos. whichever is more for each type/rating
12.3.2	Electronic positioner	10% of total quantity used or 2 nos. whichever is more for each type/rating
12.3.3	Solenoid valve	10% of total quantity used or 2 nos. whichever is more for each type/rating
12.3.4	Air filter regulator	2 nos
12.3.5	Air lock relay	4 nos of each type
12.3.6	Complete actuator for each type and model	1 set
12.3.7	Volume booster	2 no each type/size
13.0	<u>CCTV SYSTEM</u>	
13.1	CCTV lenses	10 % or 1 no. of each type
13.2	CCTV filter adapters	10 % or 1 no. of each type

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<u>SR. NO.</u>	<u>EQUIPMENT/PACKAGE NAME</u>	<u>QUANTITY</u>	
17.0	<u>CONTROL PANEL AND LOCAL/REMOTE CONTROL DESK (AS APPLICABLE)</u>		
17.1	Recorder	1(one) No. each type and model	
17.2	Bar graph indicator	10% of total quantity used in the system or minimum 1(one) no. whichever is more for each type and model.	
17.3	Digital indicator	10% of total quantity used in the system or minimum 1(one) no. whichever is more for each type and model.	
17.4	Mosaic/Conventional Type Push button Station	10% of total quantity used in the system or minimum 2(two) nos. whichever is more for each type and model.	
17.5	Mosaic Type Push button Station with LED Indication	10% of total quantity used in the system or minimum 2(two) nos. whichever is more for each type and model.	
17.6	Mosaic Type LED Indication Station	10% of total quantity used in the system or minimum 2(two) nos. whichever is more for each type and model.	
17.7	Simaphore Indicator	2(two)Nos. each type	
17.8	<u>ANNUNCIATION SYSTEM</u> (For offsite / Auxiliary Plants)		
17.8.1	Each type of PCB (for non-PLC driven system)	1(one) No. each	

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<u>SR. NO.</u>	<u>EQUIPMENT/PACKAGE NAME</u>	<u>QUANTITY</u>	
29.7	Solenoid Coil for Pneumatic type Power Cylinder	5Nos. for each type & ratings	
29.8	Position Limit Switch for Pneumatictype Power Cylinder	10Nos. for each type & ratings	
29.9	Air Lock Relay	10Nos. for each type	
29.10	Signal Air Booster Unit	2Nos. for each type	
30.0	<u>MANDATORY SPARES NOT COVERED ABOVE</u>	Bidder to supply 10% electronic modules/ cards or any other electronic components required for system such as annunciation system for offsite/auxiliary plant, online condensate tube cleaning system, ambient air monitoring system, plant simulator.	

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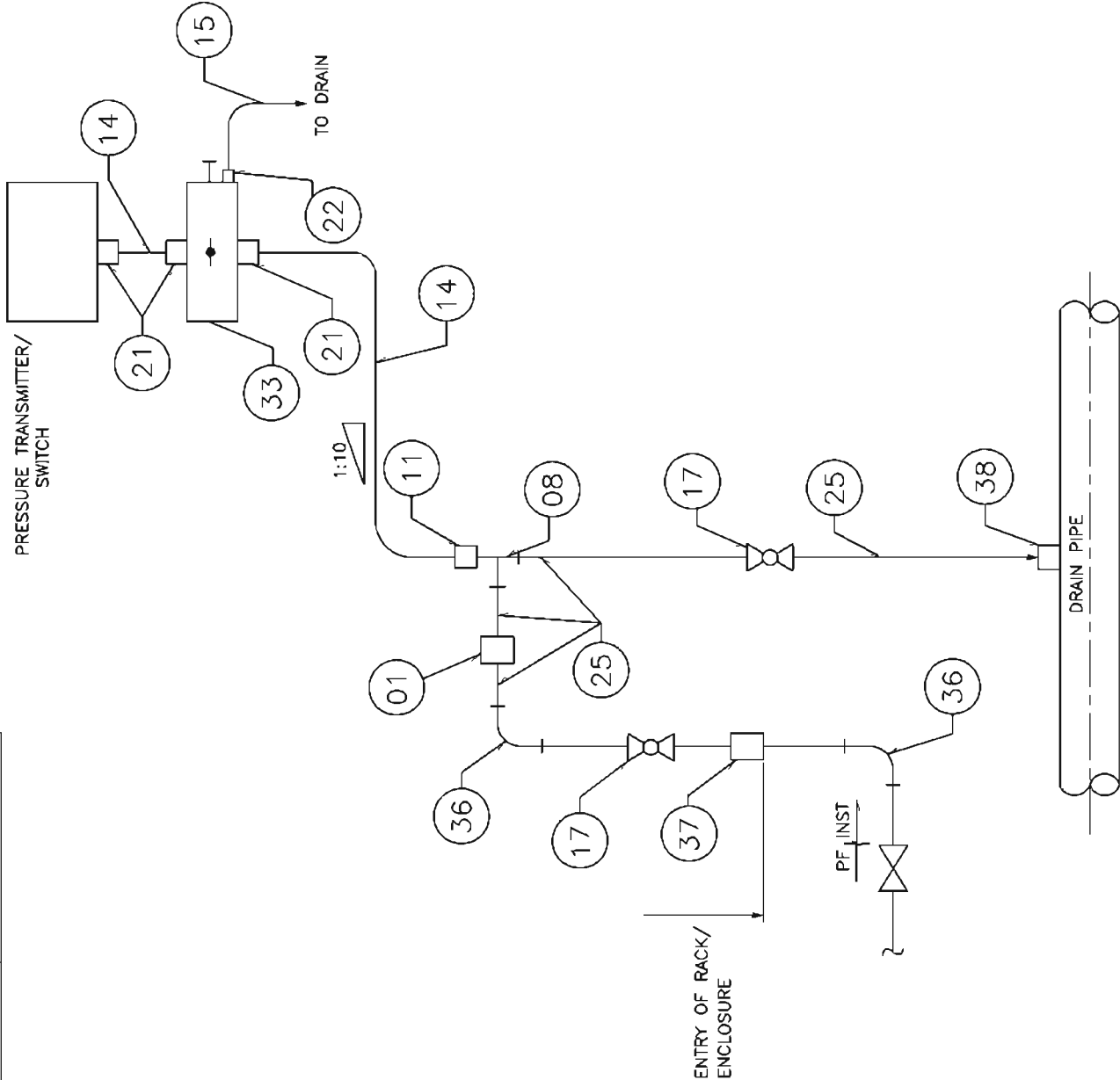
	1X660 MW Bhusawal STPP	SECTION: C SUB SECTION : C&I
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	
DRAWINGS		

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 AND SPECIFICATION OF CONTROL & INSTRUMENTATION.
3. DRAIN PIPE IN RACK AND ENCLOSURE SHALL BE 2" NB SCH 80.

				FOR BID PURPOSE ONLY	
				DO NOT SCALE	DATE : 23-08-2011
ISSUE	BY	CH	DATE	TYPICAL INSTRUMENT INSTALLATION DIAGRAM	
				PROCON ENGINEERS (DIVISION OF NIMOTO CONSULTING ENGINEERS PVT. LTD.) CLIENT : MAHARASHTRA STATE POWER GENERATION CO.LTD. PROJECT : BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT	
				SCALE ~ DIV INST. DR P.N.Z. CH D.J.P.	APPROVED DWG.NO. PE-189-IN-SK-8003 (Srl. 2 of 20) PD

PRESSURE TRANSMITTER/PRESSURE SWITCH
 MOUNTED ABOVE SOURCE POINT



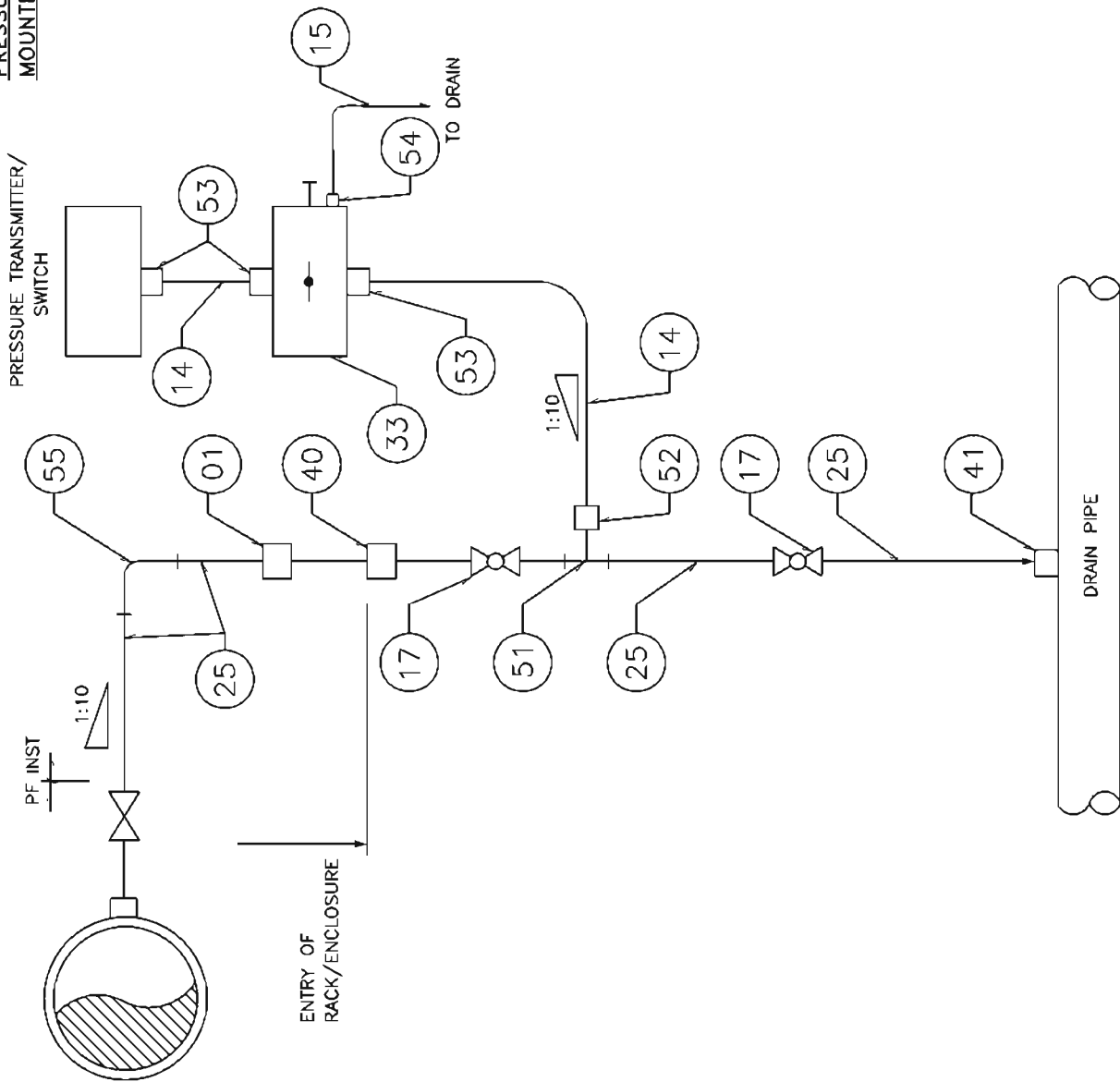
SERVICE : CONDENSER PRESSURE, INSTRUMENT AIR ETC.

BILL OF MATERIAL		
ITEM NO.	QTY./ INST.	DESCRIPTION
08	1	EQUAL TEE (FEMALE) 1/2" SW 3000lbs, CS/AS
11	1	MALE CONNECTOR 1/2" PE x 1/2" OD 3000 lbs OF CS/AS
17	2	GLOBE VALVE 1/2" SW 800lbs OF CS/AS
14	3 MTRS.	TUBE 1/2" OD, 2.1mm THICK, SS 316
21	3	MALE CONNECTOR 1/2" NPT(M) x 1/2" OD 3000 lbs, SS 316
25	15 MTRS.	IMPULSE PIPE 15 NB SCH 80, CS/AS
33	1	2 VALVES MANIFOLD 1/2" NPT(F), SS 316
01	1	FULL COUPLING 1/2" SW 3000lbs, CS/AS
15	0.15 MTRS.	TUBE 8mm OD, 1.0mm THK. SS 316
22	1	MALE CONNECTOR 1/4" NPT(M) x 8mm OD 3000 lbs
36	2	90° ELBOW 1/2" SW 3000lbs, CS/AS
37	1	BULKHEAD UNION/COUPLING CL:3000 lbs, 1/2" NB-SW, AS PER ANSI B16.11, CS/AS
38	1	HALF COUPLING CL:3000 lbs/ 1/2" NB-SW, AS PER ANSI B16.11, CS/AS

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DNV.	P.N.Z.	DATE (RD ISSUE)	23-08-2011
DNV.	D.J.P.	DATE (RD ISSUE)	23-08-2011
MAHARASHTRA STATE POWER GENERATION CO.LTD. BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT		TYPICAL INSTRUMENT INSTALLATION DIAGRAM	
FOR RD ISSUE ONLY		BY	
CHECKED	DATE	CHECKED	DATE
CHEM		CHEM	
CIVIL		CIVIL	
ELEC		ELEC	
MEC		MEC	
MACH		MACH	
REVISIONS	BY	CHECKED	DATE
ISSUE			

PRESSURE TRANSMITTER/PRESSURE SWITCH
 MOUNTED BELOW SOURCE POINT



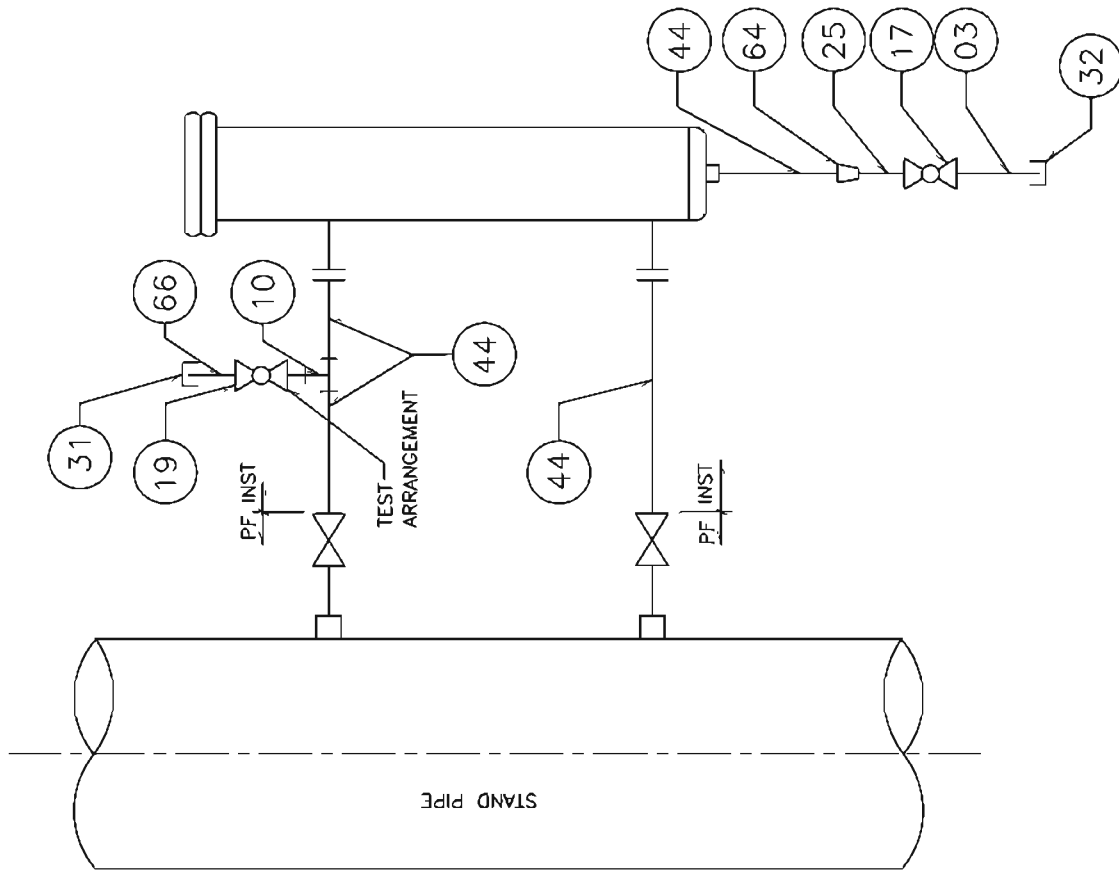
BILL OF MATERIAL		
ITEM NO.	QTY./INST	DESCRIPTION
51	1	EQUAL TEE (FEMALE) 1/2" SW 6000lbs, CS/AS
52	1	MALE CONNECTOR 1/2" PE x 1/2" OD 6000 lbs, CS/AS
17	2	GLOBE VALVES 1/2" SW 800lbs, CS/AS
14	3 MTRS.	TUBE 1/2" OD, 2.1mm THK, SS 316
53	3	MALE CONNECTOR 1/2" NPT(M) x 1/2" OD 6000 lbs, SS 316
25	15 MTRS.	IMPULSE PIPE 15 NB GR.B SCH 80, CS/AS
33	1	2 VALVES MANIFOLD 1/2" NPT(F), SS 316
01	1	FULL COUPLING 1/2" SW 6000lbs, CS/AS
15	0.15 MTRS.	TUBE 8mm OD, 1.0mm THK, SS 316
54	1	MALE CONNECTOR 1/4" NPT(M) x 8mm OD 6000 lbs, SS 316
55	2	90° ELBOW 1/2" SW 6000lbs, CS/AS
40	1	BULKHEAD UNION/COUPLING CL-6000 lbs, 1/2"NB-SW, AS PER ANSI B16.11, CS/AS
41	1	HALF COUPLING CL-6000 lbs, 1/2" NB-SW, AS PER ANSI B16.11, CS/AS

SERVICE : CONDENSATE, FEED WATER ETC.

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BY: D.J.P.	DATE (REVISED)
MAHARASHTRA STATE POWER GENERATION CO.LTD. BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT	
TYPICAL INSTRUMENT INSTALLATION DIAGRAM	

FLOAT OPERATED LEVEL SWITCH



SERVICE : CONDENSATE.

BILL OF MATERIAL		
ITEM NO.	QTY./INST	DESCRIPTION
17	1	GLOBE VALVES 1/2" SW 800lbs, CS/AS
25	0.5 MTRS.	IMPULSE PIPE 15 NB SCH 80, CS/AS
32	1	PLUG 1/2" NPT(M) 3000lbs, CS/AS
10	2	EQUAL TEE (FEMALE) 1" SW 3000lbs, CS/AS
44	2 MTRS.	IMPULSE PIPE 25 NB SCH 80, CS/AS
64	1	REDUCER 1" SW x 1/2" SW 3000lbs, CS/AS
19	1	GLOBE VALVES 1" SW 800lbs, CS/AS
31	1	PLUG 1" NPT(F) 3000lbs, CS/AS
66	1	1" NB SCH 80 SW x 1" NPT(M) SEAMLESS NIPPLE 3000 lbs, CS/AS
03	1	15 NB SCH 80 SW x 1/2" NPT(M) SEAMLESS NIPPLE 3000lbs, CS/AS

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DWG. NO.	PO NO.
PE-189-IN-SK-8003	PO NO. 10

MAHARASHTRA STATE POWER GENERATION CO.LTD.
BHUSAWAL T.P.S. UNIT-6 ; 1 X 660 MW PROJECT

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

1. The construction of the new bridge over the
 2. river at the site of the old bridge is
 3. being completed. The new bridge is
 4. 100 feet long and 20 feet wide.
 5. It will be completed by the end of the
 6. year. The old bridge is being
 7. dismantled. The new bridge is
 8. being built on the same site.
 9. The new bridge is being built
 10. by the same contractor who built
 11. the old bridge. The new bridge
 12. is being built with the same
 13. materials as the old bridge.
 14. The new bridge is being built
 15. with the same design as the old
 16. bridge. The new bridge is being
 17. built with the same foundation
 18. as the old bridge. The new
 19. bridge is being built with the
 20. same piers as the old bridge.

FOR RO ISSUE ONLY		
Cleared		
DEPT	SIGNATURE	DATE
DEON		
CIVIL		
ELERO		
ROC		
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DATE	
APPD	

AREAS	CATEGORIES		
	LEC	WAC	WEC

CPL	CHEM	
	CML	

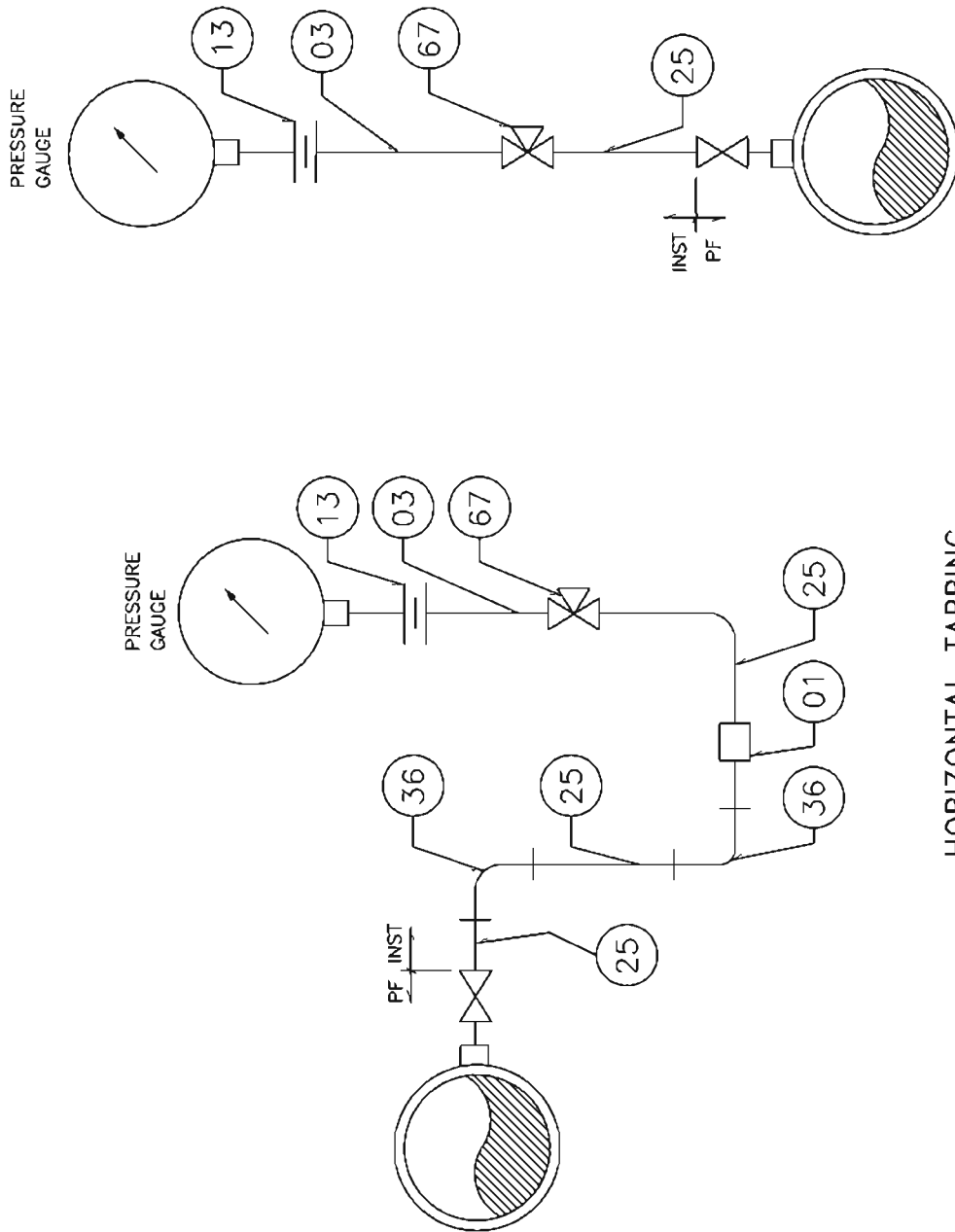
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EVIDENCE

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ISSUE	
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HORIZONTAL TAPPING

VERTICAL TAPPING

SERVICE : WATER, CONDENSATE ETC.

BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
25	15 MTRS.	IMPULSE PIPE 15 NB SCH 80, CS/AS
01	1	FULL COUPLING 1/2" SW 3000lbs, CS/AS
36	2	90° ELBOW 1/2" SW 3000lbs, CS/AS
03	1	1/2" NPT(M) x 1/2" PE, 4" LONG NIPPLE, CS/AS
13	1	NUT & TAIL FITTING WITH CU WASHER 1/2" NPT(F) x 1/2" PE
67	1	3 WAY GAUGE COCK 1/2" SW 3000lbs, CS/AS

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ISSUE		REVISIONS		BY		Cleared		DATE		FOR RO ISSUE ONLY		MAHARASHTRA STATE POWER GENERATION CO.LTD. BRUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT TYPICAL INSTRUMENT INSTALLATION DIAGRAM		MAHARASHTRA STATE POWER GENERATION CO.LTD. BRUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT TYPICAL INSTRUMENT INSTALLATION DIAGRAM		PROCON ENGINEERS (DIVISION OF MASTRO CONSULTING ENGINEERS PVT.LTD.) SCALE ~ APPROVED DATE/RO ISSUED 23-08-2011 PE-189-IN-SK-8003 Rev. 11 of 20	



LEGEND:

FR - FLOW REGULATOR

NOTE:

QUICK DISCONNECT FITTING IS CONNECTED TO FOUR WAY VALVE WHERE INTERMITTENT PURGING IS CALLED IN SCHEME. WAY VALVE WHERE INTERMITTENT PURGING IS CALLED IN SCHEME.

FOR BID PURPOSE ONLY

DO NOT SCALE

MAHARASHTRA STATE POWER GENERATION CO. LTD.
Bhusawal T.P.S. Unit-6 : 1 X 680 MW Project

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

PROCON ENGINEERS
P. NEMOTO CONSULTING ENGINEERS

[illegible]

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BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
27	15MTRS.	IMPULSE PIPE 3/4" NB, CS/AS.
26	A/R	GI PIPE, 1/2" NB.
09	2	FORGED UNEQUAL TEE AS PER ANSI B16:11 SIZE: 2 x 3/4" NB SW x 1/2" NPTF, CL 3000.
46	3	GALVANISED ELBOW CL 3000 SIZE: 1/2" NPTF.
20	1	QUICK DISCONNECTING FITTING MALE/END CONN. TO SUIT 1/2" OD CONN.
02	A/R	NYLON NOSE TO SUIT 1/2" END CONN. PR. TESTING 10 Kg/cm ² g.
14	A/R	SEAMLESS TUBE 1/2" OD, 2.1mm THICK, SS 316.
47	3	BULK HEAD COUPLING TO SUIT 1/2" OD TUBE & 1/2" NB PIPE, SS 316.
65	5	BALL VALVE 1/2" NPT(F), SS 316.
21	18	MALE CONNECTOR 1/2" NPT(M) x 1/2" OD 3000lbs, SS 316.
48	1	INSTRUMENT AIR HEADER 1" NB PIPE, SS 316.
64	1	EQUAL TEE, SS 316, TO SUIT 1/2" OD TUBE.
05	1	PR. GAUGE, 4" DIAL SIZE, RANGE 0-10 Kg/cm ² g CONNECTION 1/2" NPTM
06	1	3 WAY GAUGE COCK 1/2"NPTF x 1/2" OD.

FOR BID PURPOSE ONLY

ISSUE	BY	CH	DATE

PROCON ENGINEERS
(DIVISION OF NIMOTO CONSULTING ENGINEERS PVT. LTD.)

CLIENT : MAHARASHTRA STATE POWER GENERATION CO.LTD.

PROJECT : BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT

DO NOT SCALE

DATE : 23-08-2011

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

SCALE ~

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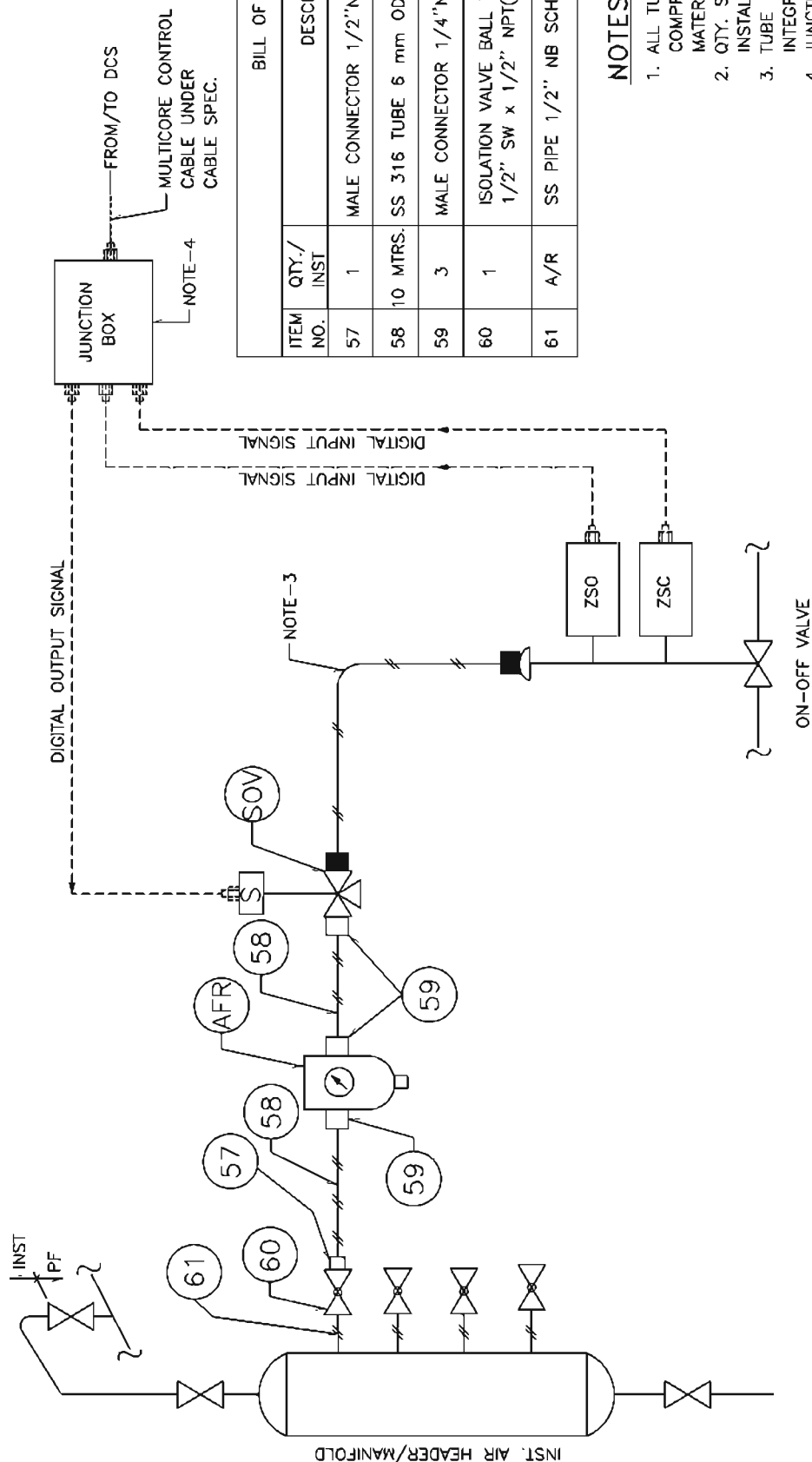
DR P.N.Z.

CH D.J.P.

DWG.NO.PE-189-IN-SK-8003

(SHEET 16 OF 20)

PO



PNEUMATIC SOV HOOK UP SCHEME

LEGEND:

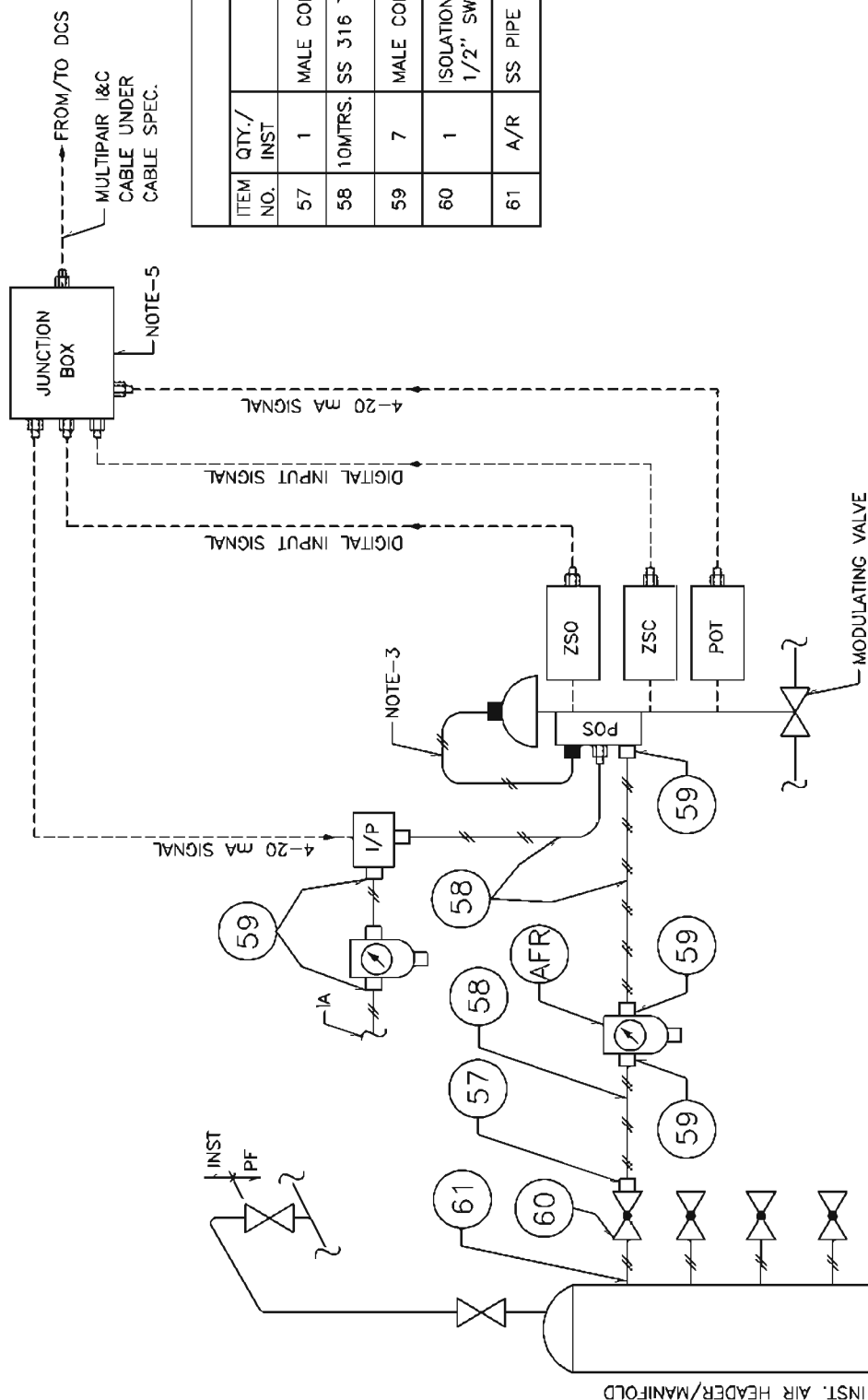
- A/R - AS PER REQUIREMENT
SOV - SOLENOID VALVE
AFR - AIR FILTER REGULATOR

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.

FOR BID PURPOSE ONLY

[illegible]



PNEUMATIC CONTROL VALVE HOOK UP SCHEME

BILL OF MATERIAL		
ITEM NO.	QTY./INST	DESCRIPTION
57	1	MALE CONNECTOR 1 1/2" NPT(M) x 6mm OD COMPRN.
58	10MTRS.	SS 316 TUBE 6mm OD x 1mm THK.
59	7	MALE CONNECTOR 1/4"NPT(M) x 6mm OD COMPRN.
60	1	ISOLATION VALVE BALL TYPE 600 lbs 1/2" SW x 1/2" NPT(F), SS 316.
61	A/R	SS PIPE 1/2" NB SCH 40S.

LEGEND:

- AS PER REQUIREMENT
- POSITIONER TRANSMITTER
- AIR FILTER REGULATOR
- INSTRUMENT AIR

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.

FOR BID PURPOSE ONLY

[illegible]

G.A. DRAWING – TRANSMITTER RACK

FOR BID PURPOSE ONLY

DO NOT SCALE

DATE : 23-08-2011

ISSUE	BY	CH	DATE

PROCON ENGINEERS
(DIVISION OF NIMOTO CONSULTING ENGINEERS PVT. LTD.)

CLIENT : MAHARASHTRA STATE POWER GENERATION CO.LTD.

PROJECT : BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT

G.A. DRAWING-TRANSMITTER RACK

SCALE ~

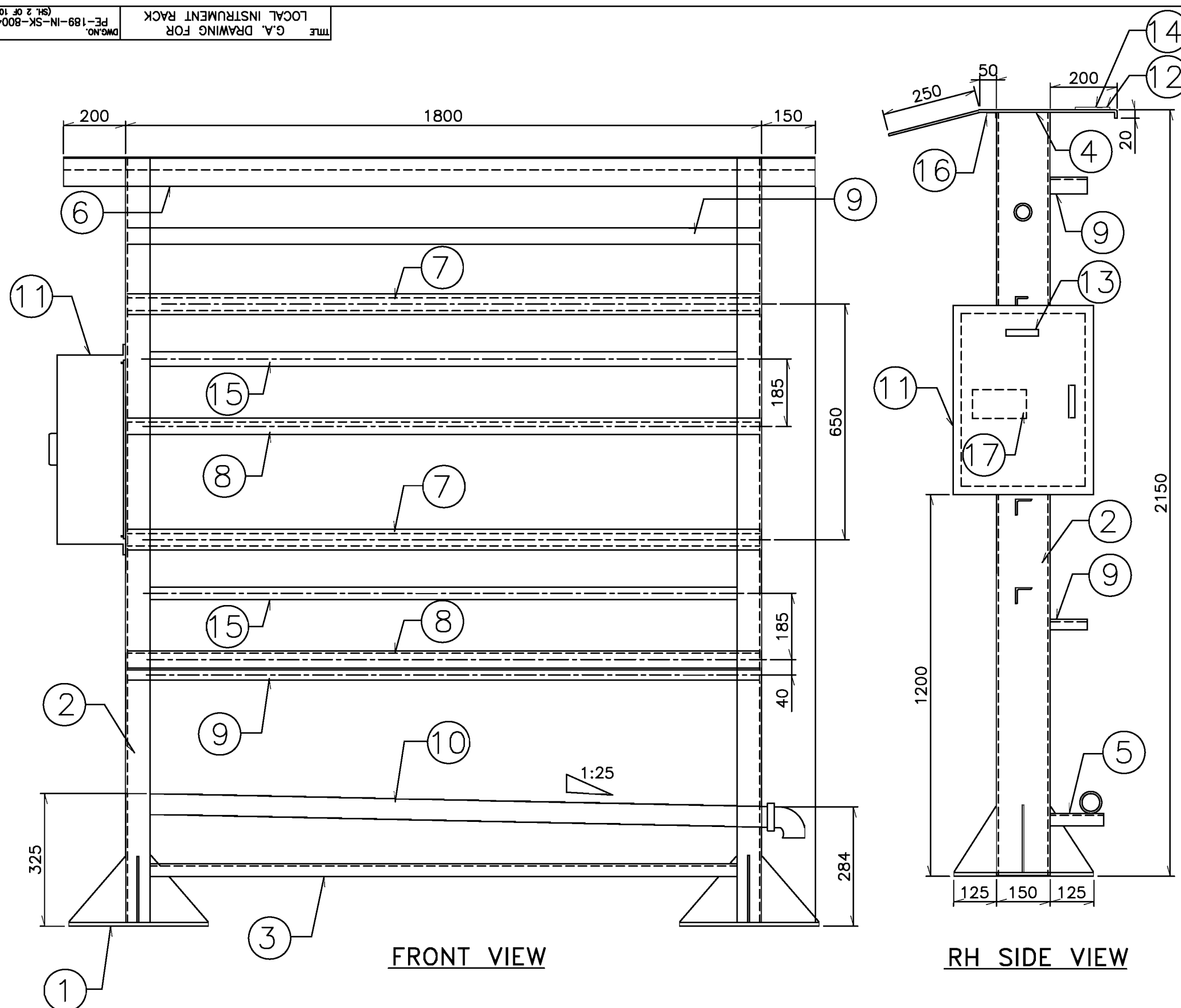
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DIV INST.

DR P.N.Z.

CH D.J.P.

DWG.NO.PE-189-IN-SK-8004 (Sht. 1 of 10) PO



LEGEND:

ITEM NO.	DESCRIPTION
1.	M.S. PLATE 400 x 400 x 10
2.	ISMC 150 x 75 x 6
3.	ISMC 75 x 40 x 5
4.	CANOPY MOUNTING PLATE 5mm THICK.
5.	BRACKET FOR DRAIN PIPE.
6.	CANOPY ASSEMBLY 3.0mm THICK CRCA SHEET.
7.	GI PIPE 2" NB CLASS B FOR TRANSMITTER MOUNTING.
8.	M.S. ANGLE 40 x 40 x 5
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 5mm 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.

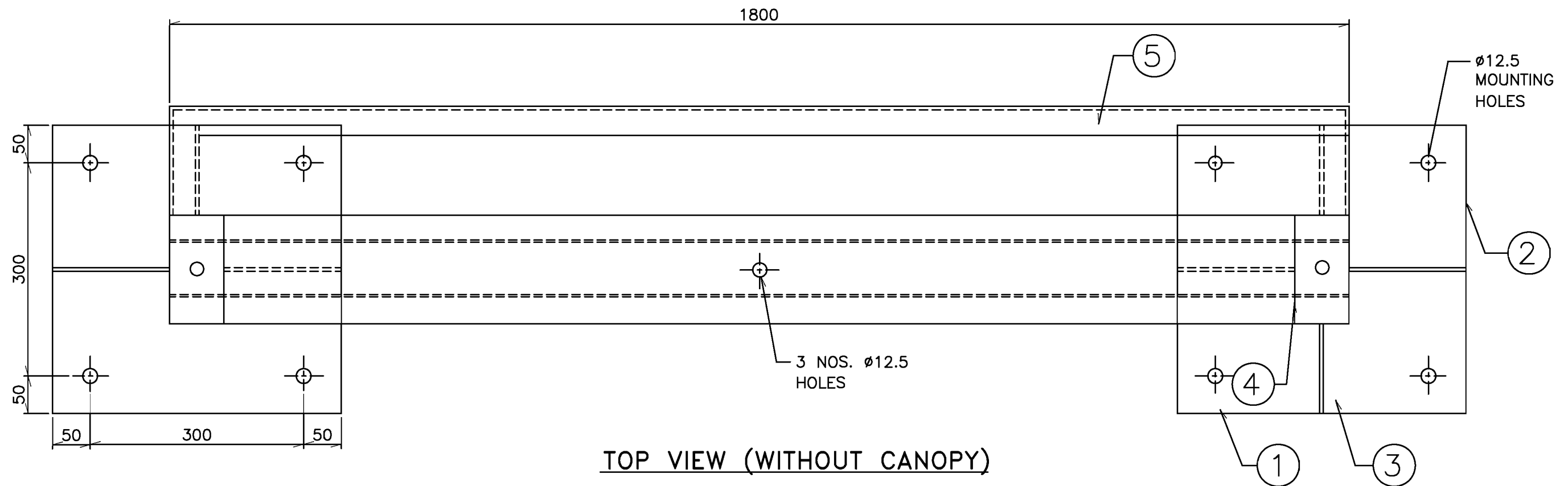
NOTES:

1. POWER SOCKET & TB SHALL BE PROVIDED IN JB.
2. COLOR: RAL 7032. OVERALL THICKNESS > 100 MICRONS.
3. TAG PLATE 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 FINALIZED AT DETAILING.
7. ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE SPECIFIED.

FOR BID PURPOSE ONLY

DO NOT SCALE

ISSUE	REVISIONS	BY	CLEARED					APPD	DATE	FOR RO ISSUE ONLY			MAHARASHTRA STATE POWER GENERATION CO.LTD. BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT G.A. DRAWING FOR LOCAL INSTRUMENT RACK	PROCON ENGINEERS (DIVISION OF NIMOTO CONSULTING ENGINEERS PVT.LTD.)			
			CHEM	CIVIL	ELEC	I&C	MECH			DEPT	SIGNATURE	DATE		SCALE ~	APPROVED	DATE(RO ISSUE)	
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										CIVIL				DR. P.N.Z.		23-08-2011	
										ELEC				CH. D.J.P.			
										I&C				DWG.NO.	PF-189-IN-SK-8004/SH. 21651	ISSUE NO.	
										MECH				CH. D.J.P.		PO	



TOP VIEW (WITHOUT CANOPY)

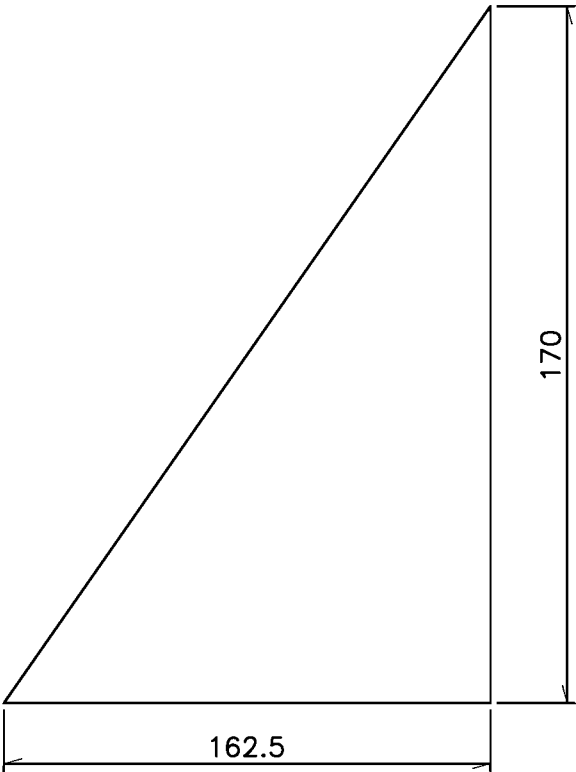
NOTES:

1. M.S. PLATE 400 x 400 x 10.
2. RIB M.S. PLATE 162.5 x 170 x 5 THICK.
3. RIB M.S. PLATE 125 x 170 x 5 THICK.
4. RIB M.S. PLATE 134 x 165 x 5 THICK.
(CANOPY MOUNTING PLATE SUPPORT)
5. BRACKET FOR IMPULSE PIPE SUPPORT.
6. ALL DIMENSIONS ARE IN mm
UNLESS OTHERWISE SPECIFIED.

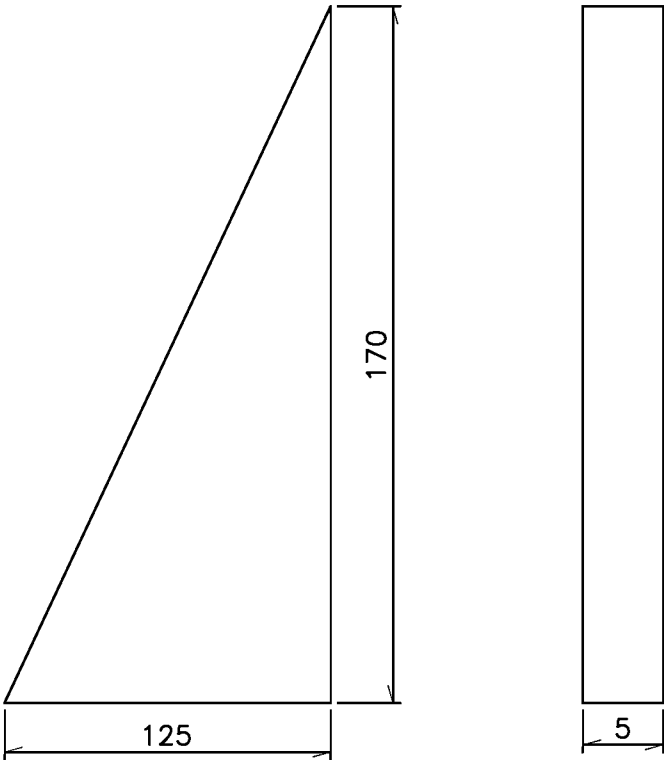
FOR BID PURPOSE ONLY

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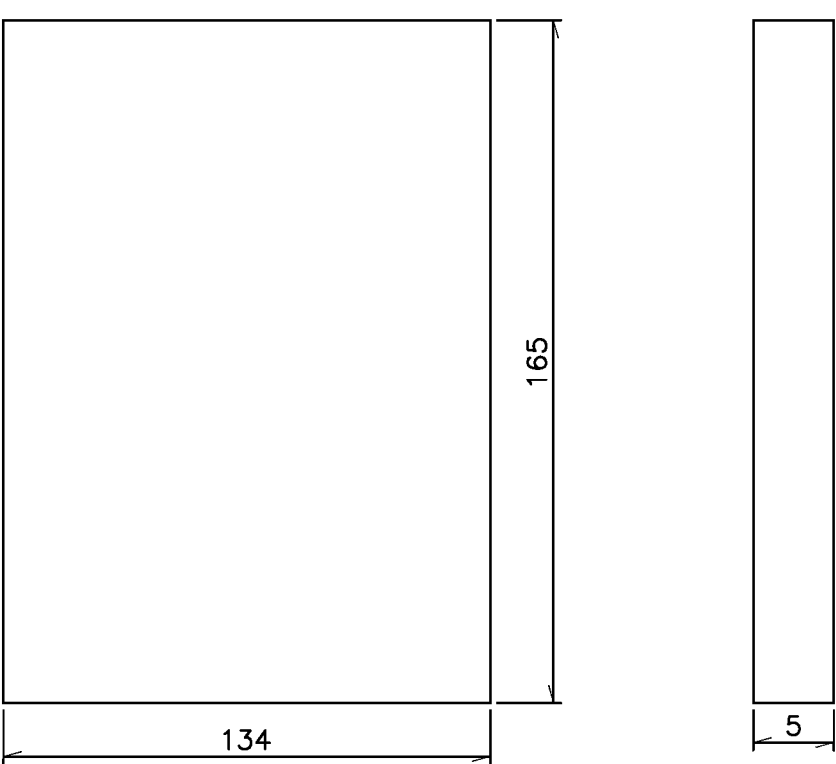
ISSUE	REVISIONS	BY	CLEARED					APPD	DATE	FOR R0 ISSUE ONLY			"P" (PRELIMINARY) ISSUES ARE NOT TO BE USED FOR CONSTRUCTION / FABRICATION BUT ARE ISSUED FOR LIMITED PURPOSES ONLY AS INDICATED IN THE SMALL BLOCK AT THE TOP RIGHT HAND CORNER OF THE TITLE BLOCK. CONSTRUCTION / FABRICATION WORK IS PERMITTED ON "R" (RELEASED) ISSUES ONLY. INFORMATION CONTAINED WITHIN 'HOLD' IS NOT RELEASED FOR CONSTRUCTION / FABRICATION. FIELD MUST GET DESIGN OFFICE TO CLEAR 'HOLD' IN TIME BEFORE PROCEEDING WITH ANY CONSTRUCTION / FABRICATION WORK RELATED TO 'HOLD'.	MAHARASHTRA STATE POWER GENERATION CO.LTD. BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT VIEW OF LOCAL INSTRUMENT RACK W/O CANOPY	PROCON ENGINEERS (DIVISION OF NIMOTO CONSULTING ENGINEERS PVT.LTD.)		
			CHEM	CIVIL	ELEC	I&C	MECH			DEPT	SIGNATURE	DATE			SCALE ~	APPROVED	DATE(R0 ISSUE)
										CHEM					DIV. INST.		DATE(CURRENT ISSUE)
										CIVIL					DR. P.N.Z.		23-08-2011
										ELEC					CH. D.J.P.		ISSUE
										I&C						PE-189-IN-SK-8004(SH. 3 OF 10)	P0
										MECH							



DETAIL OF-1



DETAIL OF-2



DETAIL OF-3

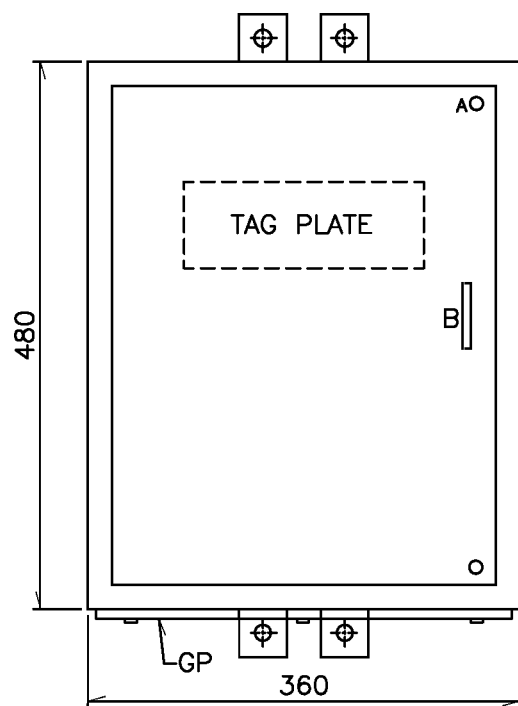
NOTES:

1. RIB M.S. PLATE 162.5 x 170 x 5 THICK.
2. RIB M.S. PLATE 125 x 170 x 5 HICK.
3. RIB M.S. PLATE 134 x 165 x 5 THICK.
4. ALL DIMENSIONS ARE IN mm
UNLESS OTHERWISE SPECIFIED.

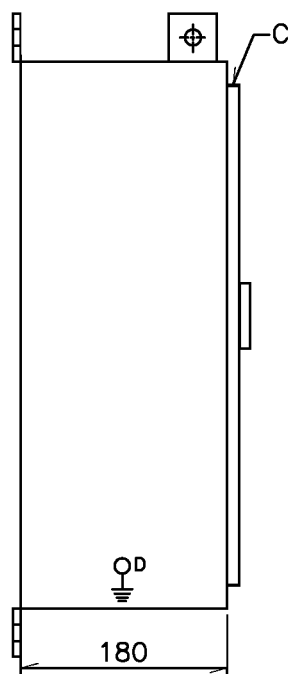
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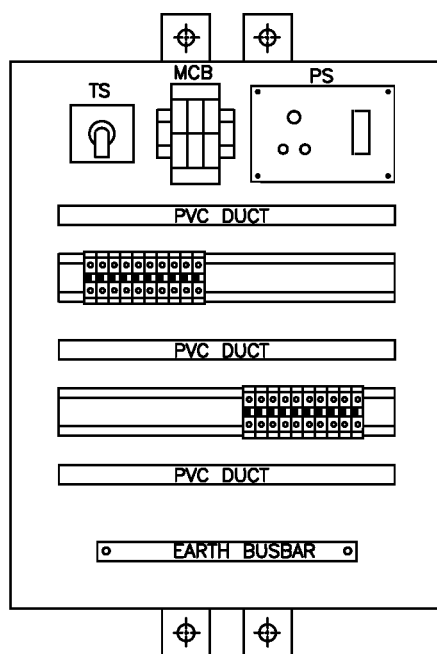
ISSUE	REVISIONS	BY	CLEARED					APPD	DATE	FOR R0 ISSUE ONLY			"P" (PRELIMINARY) ISSUES ARE NOT TO BE USED FOR CONSTRUCTION / FABRICATION BUT ARE ISSUED FOR LIMITED PURPOSES ONLY AS INDICATED IN THE SMALL BLOCK AT THE TOP RIGHT HAND CORNER OF THE TITLE BLOCK. CONSTRUCTION / FABRICATION WORK IS PERMITTED ON "R" (RELEASED) ISSUES ONLY. INFORMATION CONTAINED WITHIN 'HOLD' IS NOT RELEASED FOR CONSTRUCTION / FABRICATION. FIELD MUST GET DESIGN OFFICE TO CLEAR 'HOLDS' IN TIME BEFORE PROCEEDING WITH ANY CONSTRUCTION / FABRICATION WORK RELATED TO 'HOLDS'. DRAWINGS SIGNED BY PROCON ENGINEERS' AUTHORISED REPRESENTATIVE ONLY ARE CONSIDERED VALID DRAWINGS.	 MAHAGENCO MAHARASHTRA STATE POWER GENERATION CO.LTD. BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT G.A. DRAWING OF CLEATS FOR LOCAL INSTRUMENT RACK	PROCON ENGINEERS (DIVISION OF NIMOTO CONSULTING ENGINEERS PVT.LTD.)				
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											DWG.NO. PE-189-IN-SK-8004 (sh. 4 OF 10) P0								



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

INTERNAL FRONT VIEW

NOTES:

1. JB WILL BE MADE OUT OF 2.0 mm CRCA SHEET.
2. PROTECTION CLASS IP-65.
3. COLOR: EXT.-RAL 7032, INT.-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 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. COLOR 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 4Px0.5 SQ.mm TINNED COPPER, TWISTED PAIR, OVERALL SHIELDED 500V GRADE, FRLS PVC.
12. ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE SPECIFIED.

FOR BID PURPOSE ONLY

ISSUE	BY	CH	DATE

PROCON ENGINEERS
(DIVISION OF NIMOTO CONSULTING ENGINEERS PVT. LTD.)

CLIENT : MAHARASHTRA STATE POWER GENERATION CO.LTD.

PROJECT : BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT

DO NOT SCALE

DATE : 23-08-2011

G.A. OF JB LOCAL INSTRUMENT RACK

SCALE ~

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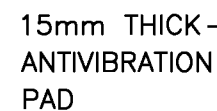
DR P.N.Z.

CH D.J.P.

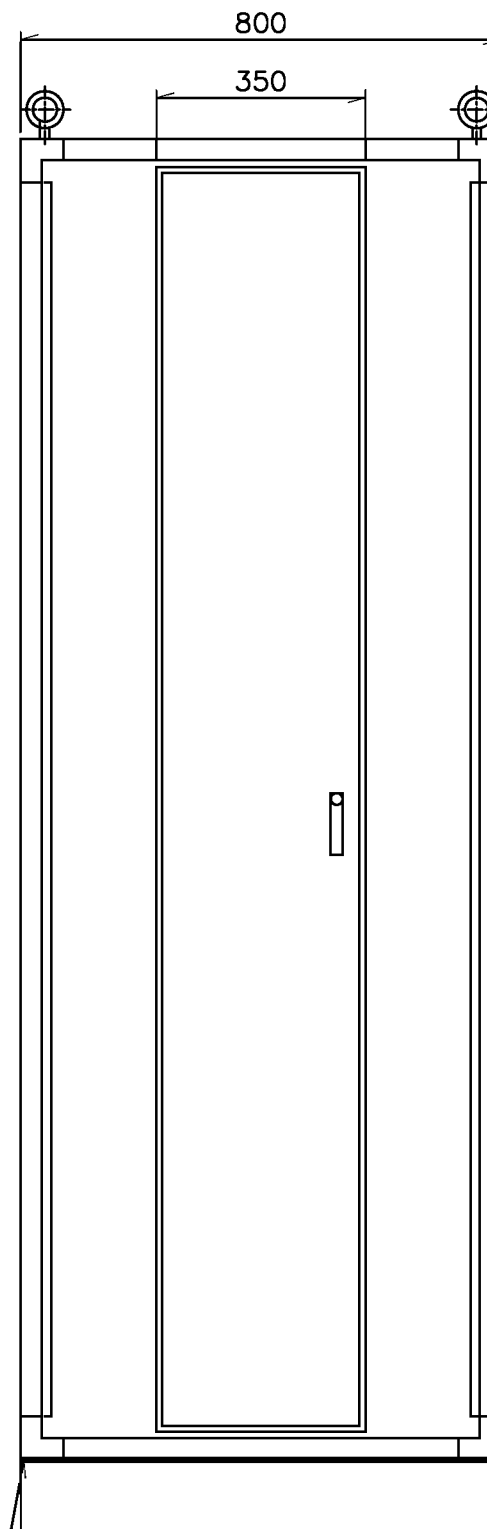
DWG.NO.PE-189-IN-SK-8004

(SHEET 5 OF 10)

PO



FRONT VIEW



LH SIDE VIEW

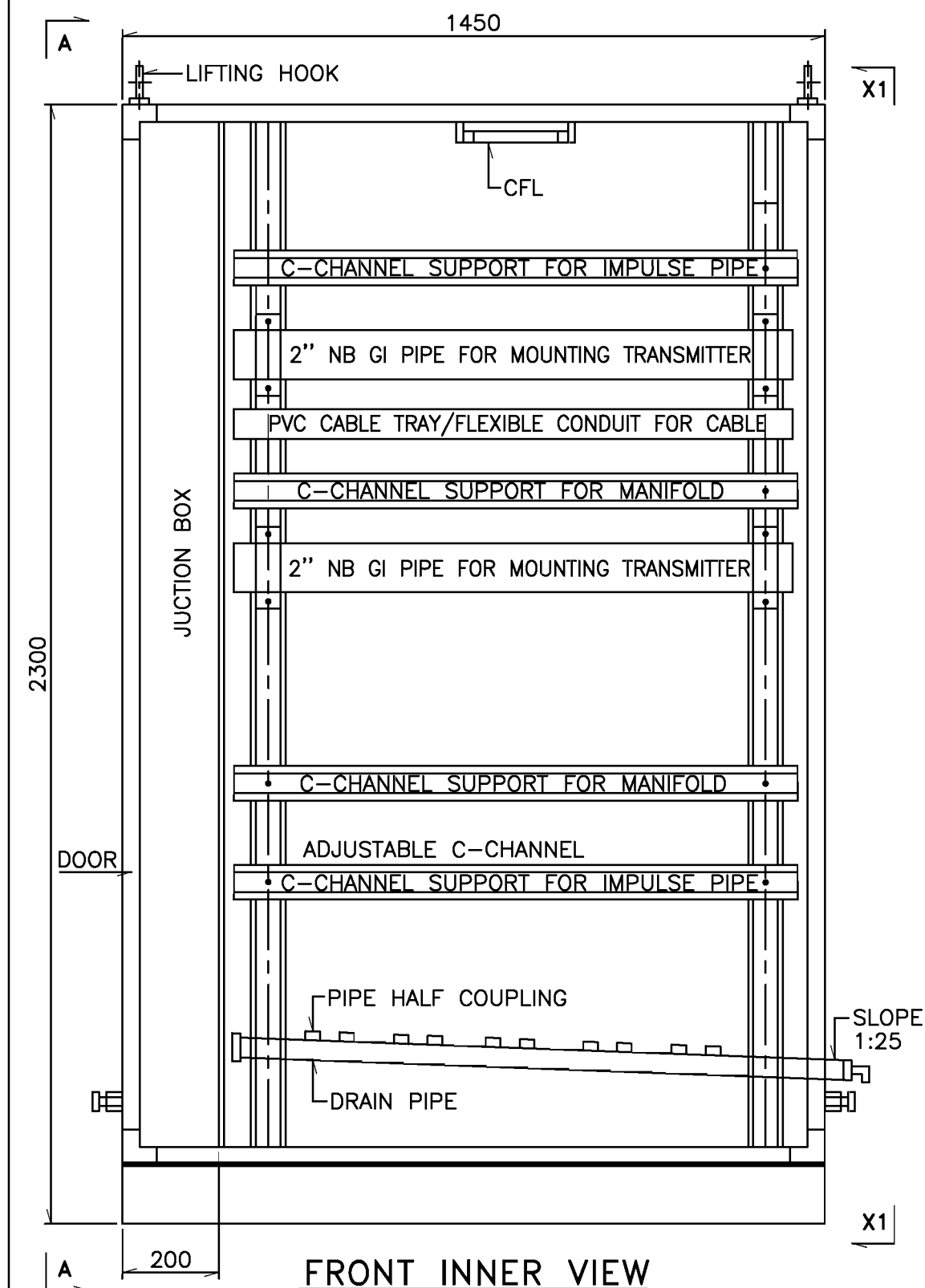
NOTES:

1. DIMENSIONS SHOWN ARE TENTATIVE AND SHALL BE FINALIZED AT DETAILING.
2. ALL SHEETS SHALL BE 3mm THICK CRCA SHEET.
3. ALL DOORS SHALL BE FLUSH/CONCEALED TYPE.
4. COLOR:
EXTERIOR : RAL 7032.
INTERIOR : BRILLIANT WHITE OVER ALL THICKNESS WILL BE > 100 MICRONS.
5. BASE FRAME WILL BE MADE OUT OF ISMC 100 AND COLOR WILL BE BLACK PAINT FINISH.
6. BULKHEAD PLATE FOR TOP AND BOTTOM SHALL BE 1150 x 650 x 6.
7. CABLE GLAND PLATE OF THICKNESS 3mm CRCA SHEET SHALL BE PROVIDED BOTTOM OF JUCTION BOX.
8. ENCLOSURE PROTECTION CLASS SHALL IP-65.
9. TERMINALS INSIDE JUCTION 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 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 INSTRUMENTS.
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.
20. ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE SPECIFIED.

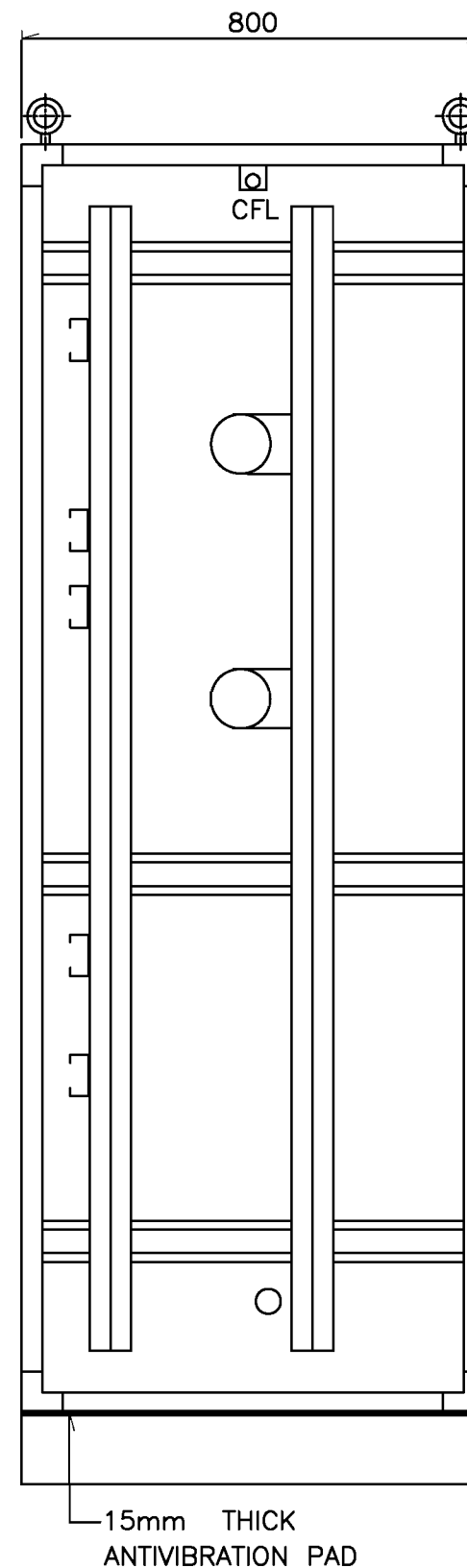
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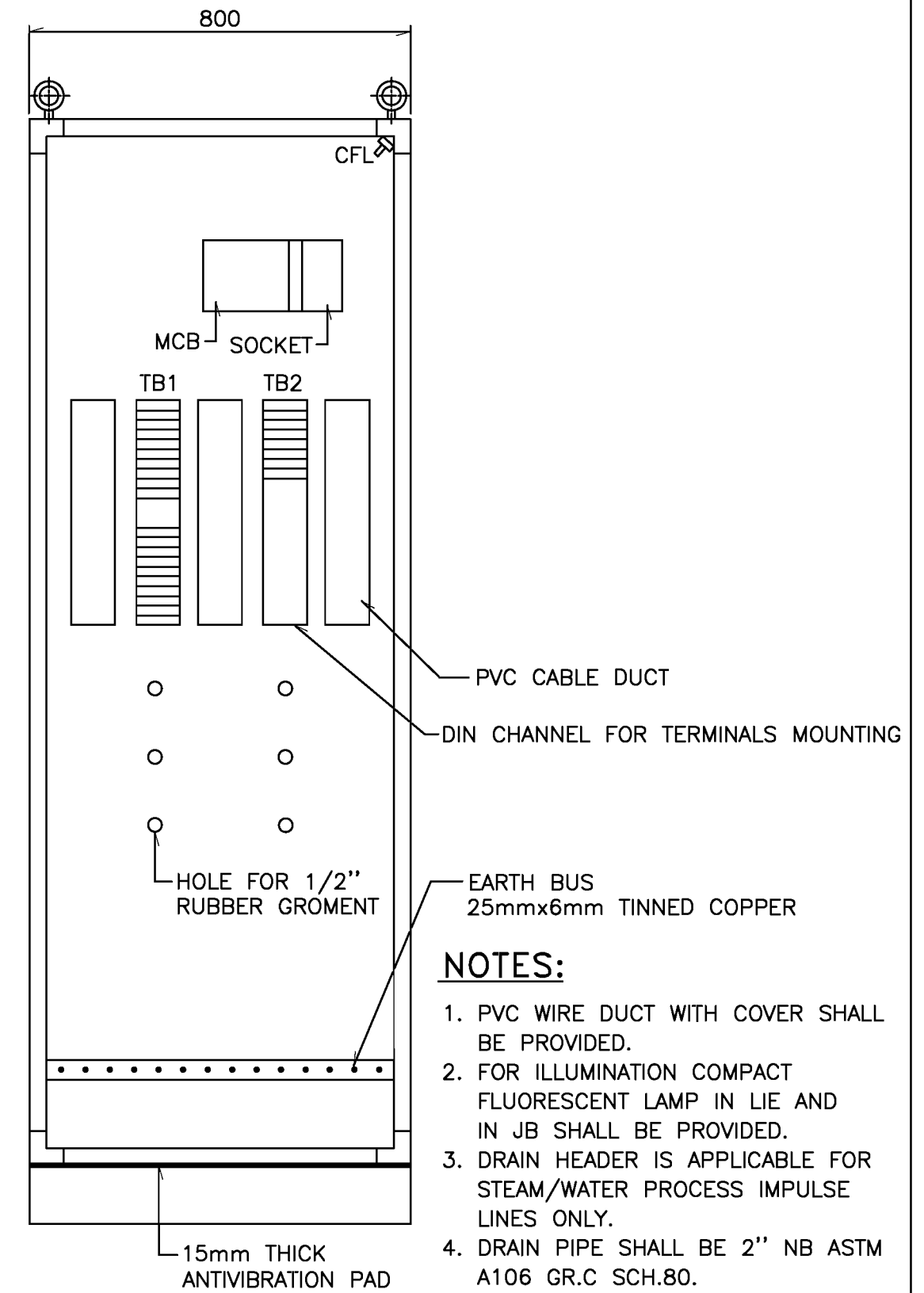
ISSUE	REVISIONS	BY	CLEARED					APPD	DATE	FOR RO ISSUE ONLY			 MAHARASHTRA STATE POWER GENERATION CO.LTD. BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT G.A. DRAWING FOR LOCAL INSTRUMENT ENCLOSURE	PROCON ENGINEERS (DIVISION OF NIMOTO CONSULTING ENGINEERS PVT.LTD.)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
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FRONT INNER VIEW



SIDE VIEW FROM X1-X1



SIDE VIEW FROM A-A

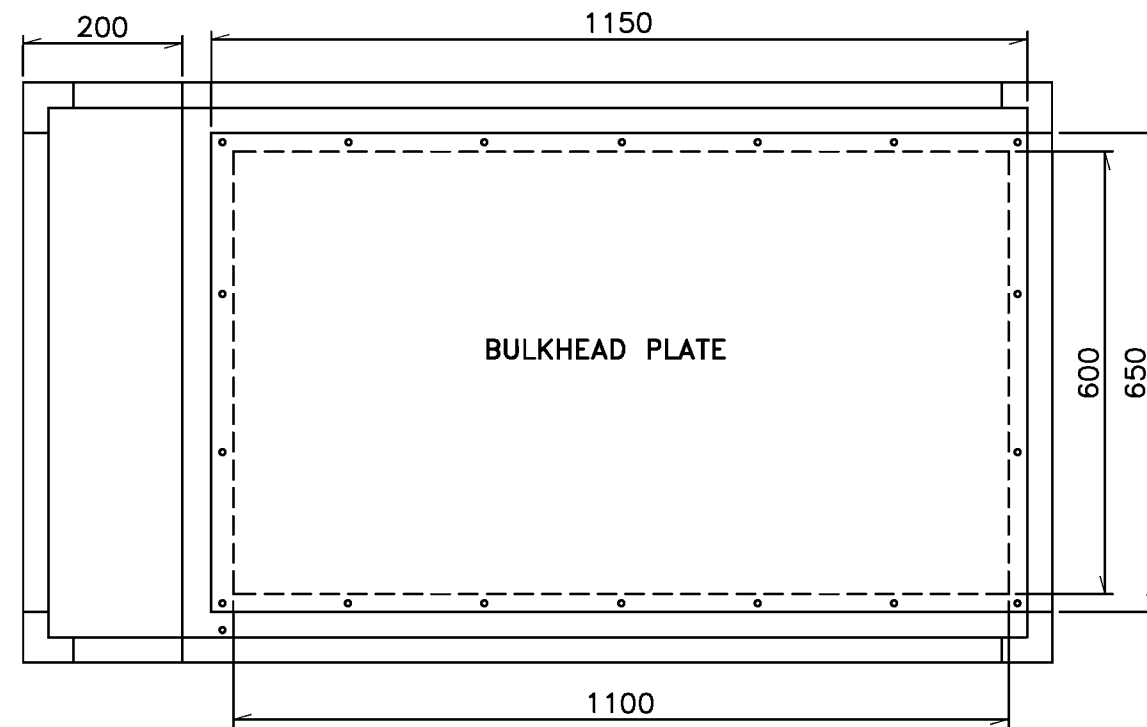
- NOTES:

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 GR.C SCH.80.
5. ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE SPECIFIED.

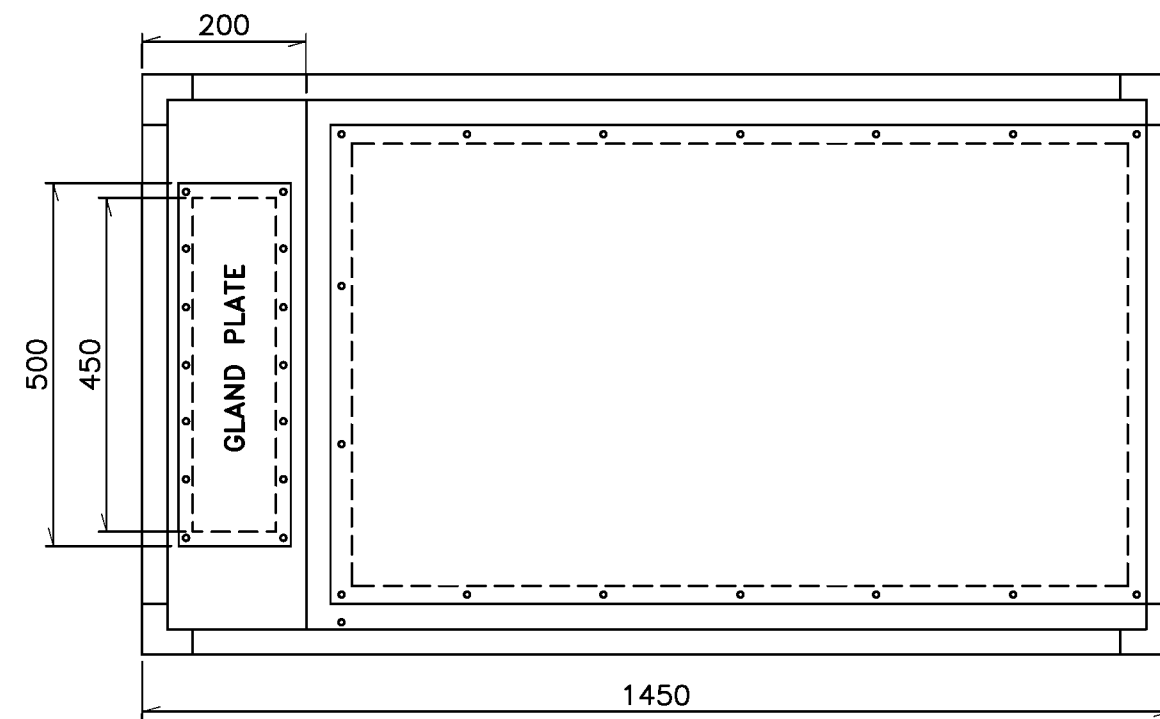
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DO NOT SCALE

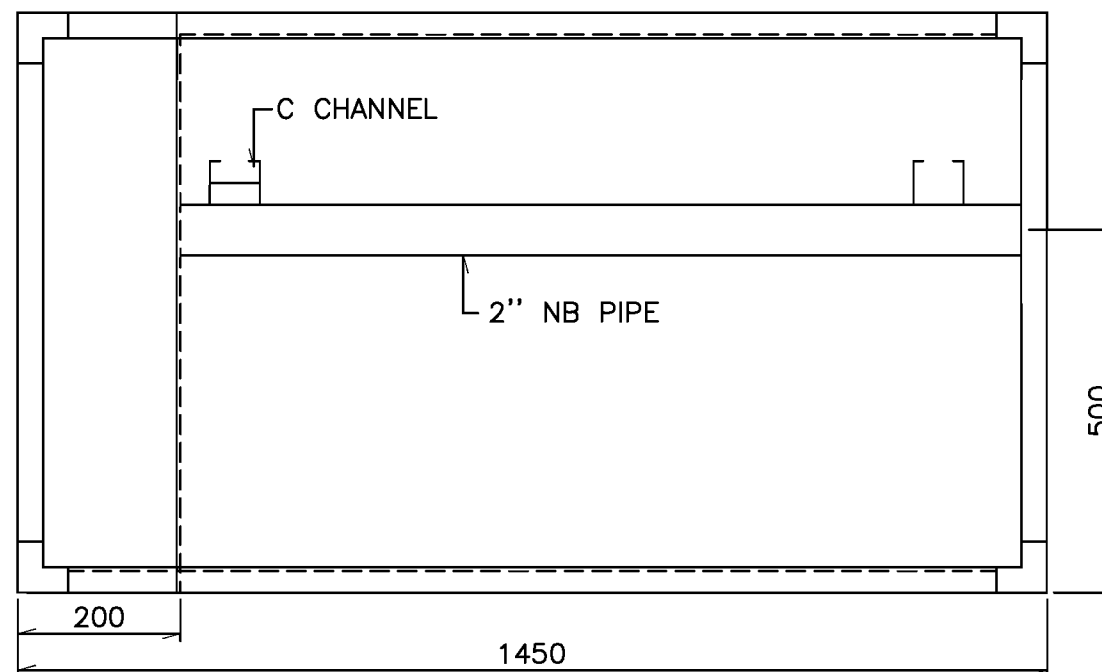
ISSUE	REVISIONS	BY	CLEARED					APPD	DATE	FOR RO ISSUE ONLY			"P" (PRELIMINARY) ISSUES ARE NOT TO BE USED FOR CONSTRUCTION FABRICATION BUT ARE ISSUED FOR LIMITED PURPOSES ONLY AS INDICATED IN THE SMALL BLOCK AT THE TOP RIGHT HAND CORNER OF THE TITLE BLOCK. CONSTRUCTION WORK IS PERMITTED ON "R" (RELEASED) ISSUES ONLY. INFORMATION CONTAINED WITHIN "HOLD" IS NOT RELEASED FOR CONSTRUCTION FABRICATION. FIELD MUST GET DESIGN OFFICE TO CLEAR "HOLDS" IN TIME BEFORE PROCEEDING WITH ANY CONSTRUCTION / FABRICATION WORK RELATED TO "HOLDS". DRAWINGS SIGNED BY PROCON ENGINEERS' AUTHORIZED REPRESENTATIVE ONLY ARE CONSIDERED VALID DRAWINGS.	 MAHARASHTRA STATE POWER GENERATION CO.LTD. BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT			PROCON ENGINEERS (DIVISION OF NIMOTO CONSULTING ENGINEERS PVT.LTD.)					
			CHEM	CIVIL	ELEC	I&C	MECH			DEPT SIGNATURE DATE												
												CHEM				SCALE ~		APPROVED		DATE(RO ISSUE)		
												CIVIL				DR. INST.				DATE(CURRENT ISSUE)		
												ELEC				CH. P.N.Z.						
												I&C				CH. D.J.P.		DWG.NO.	PE-189-IN-SK-8004 (SH. 1658)	ISSUE NO.		
												MECH				INNER G.A. DRAWING FOR LOCAL INSTRUMENT ENCLOSURE						



TOP VIEW



BOTTOM VIEW



TOP VIEW WITHOUT BULKHEAD PLATE

NOTES:

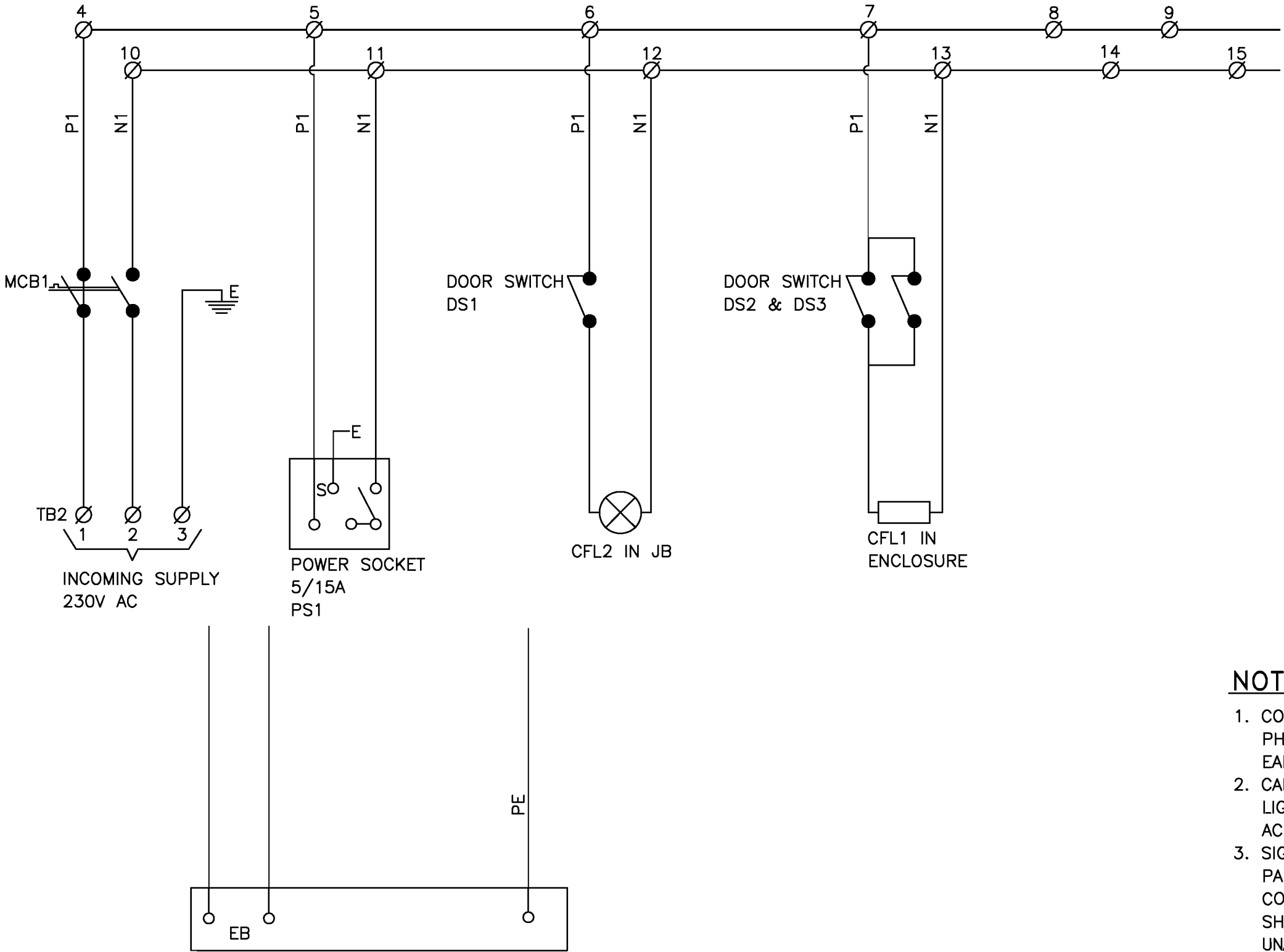
1. BULK HEAD PLATE DIMENSION ARE 1150 x 650 x 6.
2. IMPULSE PIPE ENTRY: BOTTOM ENTRY FOR AIR/FLUE GAS APPLICATIONS.
3. IMPULSE ENTRY: TOP ENTRY FOR STEAM/WATER APPLICATIONS.
4. ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE SPECIFIED.

FOR BID PURPOSE ONLY

DO NOT SCALE

ISSUE	REVISIONS	BY	CLEARED					APPD	DATE	FOR RO ISSUE ONLY			"P" (PRELIMINARY) ISSUES ARE NOT TO BE USED FOR CONSTRUCTION PURPOSES ONLY AS INDICATED IN THE SMALL BLOCK AT THE TOP RIGHT HAND CORNER OF THE TITLE BLOCK. CONSTRUCTION WORK IS PERMITTED ON "R" (RELEASED) ISSUES ONLY. INFORMATION CONTAINED WITHIN 'HOLD' IS NOT RELEASED FOR CONSTRUCTION / FABRICATION. FIELD MUST GET DESIGN OFFICE TO CLEAR 'HOLDS' IN TIME BEFORE PROCEEDING WITH ANY CONSTRUCTION / FABRICATION WORK RELATED TO 'HOLDS'. DRAWINGS SIGNED BY PROCON ENGINEERS' AUTHORISED REPRESENTATIVE ONLY ARE CONSIDERED VALID DRAWINGS.	 MAHARASHTRA STATE POWER GENERATION CO.LTD. BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT	PROCON ENGINEERS (DIVISION OF NIMOTO CONSULTING ENGINEERS PVT.LTD.)				
			CHEM	CIVIL	ELEC	I&C	MECH			DEPT	SIGNATURE	DATE			SCALE ~	APPROVED	DATE(RO ISSUE)		
										CHEM					DIV. INST.		DATE(CURRENT ISSUE)		
										CIVIL					DR. P.N.Z.		23-08-2011		
										ELEC					CH. D.J.P.	DWG.NO.	ISSUE		
										I&C						PE-189-IN-SK-8004 (SH. 1 OF 2)	PO		
										MECH									

POWER WIRING CIRCUIT



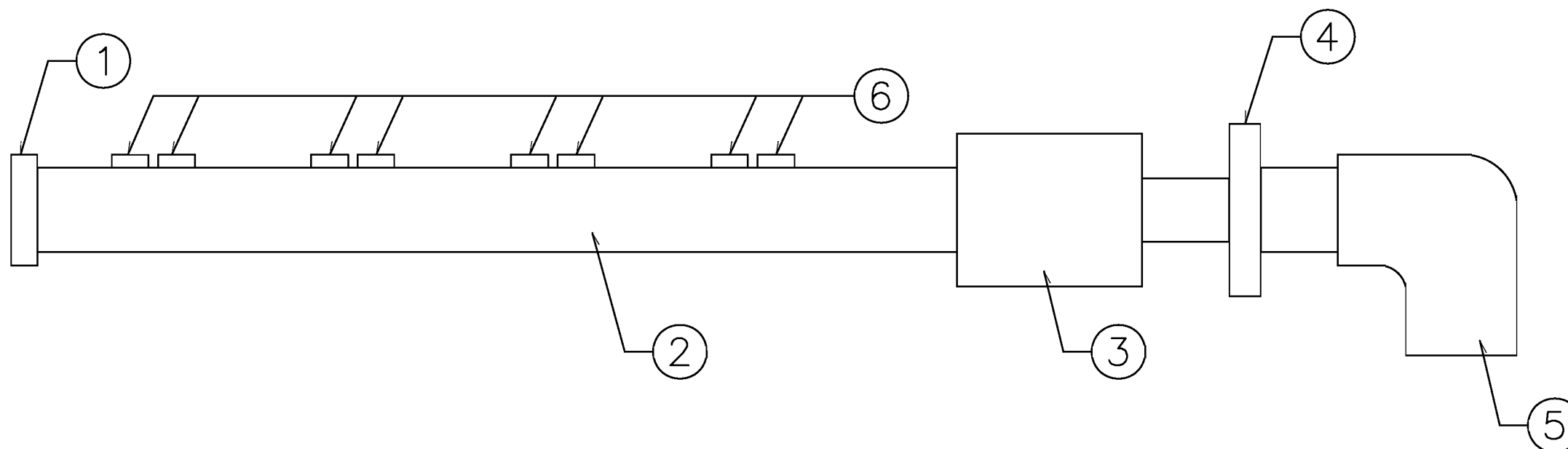
NOTES:

- COLOR CODING FOR POWER SUPPLY: PHASE-RED, NEUTRAL-BLACK AND EARTH-GREEN.
- CABLE ROUTING FROM TB TO PANEL LIGHT WILL BE 1.5 sq.mm 1100V AC GRADE.
- 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.

FOR BID PURPOSE ONLY

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			CHEM	CIVIL	ELEC	I&C	MECH			DEPT	SIGNATURE	DATE			SCALE ~	APPROVED	DATE(R0 ISSUE)
										CHEM					DIV. INST.		DATE(CURRENT ISSUE)
										CIVIL					DR. P.N.Z.		23-08-2011
										ELEC					CH. D.J.P.	DWG.NO. PE-189-IN-SK-8004 (Sh. 9 OF 10)	ISSUE
										I&C							P0
										MECH							



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.

FOR BID PURPOSE ONLY

DO NOT SCALE

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			CHEM	CIVIL	ELEC	I&C	MECH			DEPT	SIGNATURE	DATE						SCALE ~	APPROVED		DATE(RO ISSUE)
										CHEM					DIV. INST.			DATE(CURRENT ISSUE)			
										CIVIL					DR. P.N.Z.			23-08-2011			
										ELEC					CH. D.J.P.	DWG.NO.	PE-189-IN-SK-8004		ISSUE NO.		
										I&C											
										MECH											

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4.0 <u>LIST OF APPROVED VENDORS – CONTROL & INSTRUMENTATION</u>			
<u>SR. NO.</u>	<u>NAME OF EQUIPMENT / ITEM</u>		<u>APPROVED VENDORS</u>
1.0	<u>FIELD / PRIMARY INSTRUMENTS:</u>		
1.1	RTD & THERMOCOUPLES	(a)	PYRO ELECTRIC INSTRUMENTS GOA PVT. LTD.
		(b)	GENERAL INSTRUMENTS CONSORTIUM, MUMBAI
		(c)	DETRIVE, MUMBAI
		(d)	TEMSSENS INSTRUMENTS(I) PVT. LTD, UDAIPU
1.2	SMART ELECTRONIC TRANSMITTERS (PRESSURE, DIFF. PRESSURE)	(a)	EMERSON PROCESS MANAGEMENT (I) LTD
		(b)	FUJI, JAPAN
		(c)	YOKOGAWA, JAPAN/ YOKOGAWA INDIA
		(d)	ABB, GERMANY / FARIDABAD
		(e)	HONEYWELL, USA / PUNE
1.3	DISPLACER TYPE LEVEL TRANSMITTER	(a)	CHEMTROL MIL
		(b)	DRESSER, COIMBTORE
		(c)	V-AUTOMAT, DELHI
		(d)	ECKARDT, GERMANY
1.4	LEVEL TRANSMITTERS (DISPLACEMENT TYPE)	(a)	DRESSER MASONIELAN, FRANCE (DRESSER VALVES INDIA LTD. COIMBATORE)
		(b)	CHEMTROLS, MUMBAI (ECKARDT, GERMANY)
		(c)	ECKARDT, GERMANY

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<u>SR. NO.</u>	<u>NAME OF EQUIPMENT / ITEM</u>		<u>APPROVED VENDORS</u>
1.5	LEVEL TRANSMITTERS (ULTRASONIC TYPE)	(d)	ENDRESS+HAUSER, GERMANY/INDIA
		(e)	KROHNE, FRANCE
		(f)	PEPPERL+FUCHS, GERMANY/INDIA
		(g)	VEGA, GERMANY
		(h)	KAB INSTRUMENTS LTD.
1.6	RADAR TYPE LEVEL TRANSMITTERS	(a)	SIEMENS MILLTRONICS
		(b)	ENDRESS & HAUSER
		(c)	SBEM
		(d)	EMERSON
		(e)	AMETEKEDREXELBRROK (CHEMTROLS)
1.7	TEMPERATURE TRANSMITTERS	(a)	EMERSON PROCESS (FORMERLY FISHER ROSEMOUNT), USA/DAMAN
		(b)	ABB, GERMANY / FARIDABAD
		(c)	FUJI, JAPAN
		(d)	HONEYWELL, USA / PUNE
		(e)	YOKOGAWA, JAPAN/ YOKOGAWA INDIA
		(f)	MOORE, USA
1.8	MAGNETIC LEVEL SWITCHES	(a)	LEVCON INSTRUMENTS PVT. LTD., KOLKATA
		(b)	V.AUTOMAT, NEW DELHI
		(c)	ASIAN INDUSTRIAL VALVES, CHENNAI
1.9	LEVEL SWITCHES CONDUCTIVITY TYPE	(a)	BHARAT HEAVY ELECTRICALS LTD.
		(b)	YARWAY, USA

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<u>SR. NO.</u>	<u>NAME OF EQUIPMENT / ITEM</u>		<u>APPROVED VENDORS</u>
		(c)	LEVELSTATE, UK
		(d)	SOLARTON, UK (PRESENTLY CALLED AS MOBREY)
		(e)	CHEMTROL
		(f)	LEVEL STATE (HITECH SYSTEMS)
		(g)	MOBREY
1.10	FLOW SWITCHES	(a)	SWITZER, CHENNAI
		(b)	KRONHE MARSHALL
		(c)	GENERAL INSTRUMENTS MUMBAI
		(d)	CHEMTROL
1.11	BYPASS ROTAMETER	(a)	IEPL, HYDERABAD
		(b)	PLACKA INSTRUMENTS INDIA PVT. LTD., CHENNAI
		(c)	TRAC, HYDERABAD
		(d)	EUREKA, PUNE
1.12	ROTAMETER	(a)	INSTRUMENTATION ENGINEERS PVT. LTD.
		(b)	SIGMA INSTRUMENTS CO.
		(c)	EUREKA INDUSTRIAL EQPT. PVT. LTD.
		(d)	TELACE EQUIPMENT PVT. LTD.
1.13	FLOW INTEGRATOR (ELECTRONIC TYPE)	(a)	ABB, GERMANY / FARIDABAD
		(b)	MASIBUS, GANDHINAGAR
		(c)	YOKOGAWA, JAPAN/ YOKOGAWA INDIA
		(d)	LEKKTROTEK, PUNE
		(e)	EMERSON

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<u>SR. NO.</u>	<u>NAME OF EQUIPMENT / ITEM</u>		<u>APPROVED VENDORS</u>
		(f)	ENDRESS & HAUSER
		(g)	FORBES MARSHALL
1.14	GAUGES (PRESSURE, DIFF. PRESSURE)	(a)	A N INSTRUMENTS PVT. LTD., KOLKATA
		(b)	GENERAL INSTRUMENTS CONSORTIUM, GOA/ MUMBAI
		(c)	GOA THERMOSTATIC INSTRUMENTS, GOA
		(d)	FORBES MARSHALL LTD., HYDERABAD
		(e)	WAAREE INDUSTRIES, MUMBAI
		(f)	H.GURU INSTRUMENTS (SOUTH INDIA), BANGALORE
		(g)	WIKI INSTRUMENTS INDIA PVT. LTD., PUNE
		(h)	GOA INSTRUMENTS PVT. LTD.,
		(i)	MONOMETER, MUMBAI
		(j)	BELLS CONTROLS LTD., KOLKATA
		(k)	SWITZER INSTRUMENTS LTD., CHENNAI
		(l)	WIKI ALEXANDER WIEGAND GMBH&CO., GERMANY
		(m)	BUDENBURG GUAGE CO. LTD
		(n)	INSTRUMENTATION PVT. LTD., BANGALORE
		(o)	INDOSONIC INSTRUMENT, MUMBAI
		(p)	PRECISION
		(q)	ASHCROFT

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<u>SR. NO.</u>	<u>NAME OF EQUIPMENT / ITEM</u>		<u>APPROVED VENDORS</u>
1.15	TEMPERATURE GAUGE	(a)	GOA THERMOSTATIC INSTRUMENTS, GOA
		(b)	GENERAL INSTRUMENTS CONSORTIUM,
		(c)	A.N. INSTRUMENTS PVT. LTD., KOLKATA
		(d)	H. GURU INSTRUMENTS (SOUTH INDIA), BANGALORE
		(e)	FORBES MARSHALL, HYDERABAD
		(f)	WIKI INSTRUMENTS INDIA PVT. LTD., PUNE
		(g)	WAREE, DADRA GOA INSTRUMENTS PVT. LTD.,
		(h)	BELLS CONTROLS LTD., KOLKATA
		(i)	SWITZER INSTRUMENTS LTD., CHENNAI
		(j)	WIKI ALEXANDER WIEGAND GMBH&CO., GERMANY
		(k)	BUDENBURG GUAGE CO. LTD.
		(l)	INDOSONIC INSTRUMENT, MUMBAI
1.16	SWITCHES (PRESSURE, DIFF. PRESSURE)	(a)	INDFOSS INDUSTRIES LTD., GHAZIABAD
		(b)	SWITZER INSTRUMENTS COMPANY, CHENNAI
		(c)	SOR INC., USA
		(d)	PYROELECTRIC, GOA
		(e)	DRESSER INDUSTRIES INC, USA
		(f)	REGULATEURS GEORGIN, FRANCE



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<u>SR. NO.</u>	<u>NAME OF EQUIPMENT / ITEM</u>		<u>APPROVED VENDORS</u>
		(g)	DELTA CONTROLS LTD., U.K.
		(h)	KDG INSTRUMENTS LTD. U.K.
		(i)	ASHCROFT
		(j)	DWAYER, USA
		(k)	GENERAL INSTRUMENTS CONSORTIUM
1.17	TEMPERATURE SWITCH	(a)	INDFOSS INDUSTRIES LTD., GHAZIABAD
		(b)	SWITZER INSTRUMENTS COMPANY, CHENNAI
		(c)	GENERAL INSTRUMENTS CONSORTIUM, MUMBAI
		(d)	SOR INC., USA
		(e)	PYROELECTRIC, GOA DRESSER INDUSTRIES INC, USA
		(f)	REGULATEURS GEORGIN, FRANCE
		(g)	DELTA CONTROLS LTD., U.K.
		(h)	KDG INSTRUMENTS LTD. U.K.
1.18	AIR FILTER REGULATOR	(a)	PLACKA, CHENNAI
		(b)	SHAVO NORGREN, INDIA
1.19	MASS FLOW METER (CORROLIOUS PRINCIPLE)	(a)	EMERSON PROCESS MANAGEMENT (I) LTD
		(b)	ABB
		(c)	YOKOGAWA
		(d)	ENDRESS+ HAUESER
		(e)	GE SENSING & INSPECTION TECHNOLOGIES
		(f)	FORBES MARSHALL

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<u>SR. NO.</u>	<u>NAME OF EQUIPMENT / ITEM</u>		<u>APPROVED VENDORS</u>
1.20	I/P CONVERTER	(a)	ECKHARDT, GERMANY
		(b)	MTL, CHENNAI
		(c)	ABB
		(d)	WATSON SMITH (PRESENTLY NORGREN)
		(e)	EMERSON PROCESS MGMT ASIA PACIFIC LTD.
		(f)	MOORE CONTROLS
1.21	FLOW ELEMENTS	(a)	INSTRUMENTATION LTD.
		(b)	MICRO PRECISION PRODUCTS
		(c)	ENGINEERING SPECIALITIES PVT. LTD.
		(d)	GENERAL INSTRUMENTS
1.22	LEVEL GAUGES (FLOAT TYPE)	(a)	SB ELECTRO
		(b)	SIGMA
		(c)	V AUTOMAT
		(d)	LEVCON
		(e)	CHEMTROLS
		(f)	ASIAN INDUSTRIAL VALVES
1.23	ORP TRANSMITTERS	(a)	FORBES MARSHALL
1.24	DENSITY METER (NUCLEONIC TYPE)	(a)	ENDRESS + HAUSER
		(b)	THERMO MEASURE TECH.
		(c)	CHEMTROL (THERMO FISHER)
1.25	DENSITY METER (NON-NUCLEONIC TYPE)	(a)	ENDRESS + HAUSER
		(b)	THERMO MEASURE TECH.
		(c)	CHEMTROL (THERMO FISHER)

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<u>SR. NO.</u>	<u>NAME OF EQUIPMENT / ITEM</u>		<u>APPROVED VENDORS</u>
1.26	SOLID MASS FLOW METER	(a)	SIEMENS MILLTRONICS
		(b)	CHEMTROL (THERMO FISHER)
		(c)	SIEMENS INSTRUMENTS, CANADA
1.27	PULL CORD SWITCH	(a)	JAYASHREE ELECTRODEVICES PVT. LTD.
		(b)	A.G. SYSTEM CONTROLS, MUMBAI
1.28	BELT SWAY SWITCH	(a)	JAYASHREE ELECTRODEVICES PVT. LTD.
		(b)	A.G. SYSTEM CONTROLS, MUMBAI
1.29	ZERO SPEED SWITCH	(a)	A.G. ELECTRONICS
		(b)	JAYASHREE ELECTRODEVICES PVT. LTD.
1.30	PROXIMITY SWITCH	(a)	AW
		(b)	JAYASHREE ELECTRODEVICES PVT. LTD.
1.31	LEVEL SWITCH (RF TYPE)	(a)	EIP ENVIRO LEVEL CONTROLS
2.0	<u>DCS, HMI, MONITORING AND PLC SYSTEMS:</u>		
2.1	DDCMIS	(a)	ABB.
		(b)	YOKOGAWA
		(c)	SIEMENS.
		(d)	BHEL
		(e)	EMERSON PROCESS MANAGEMENT
		(f)	MHI
2.2	PLC	(a)	ALLEN BRADLEY.
		(b)	SCHNEIDER
		(c)	ROCKWELL

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<u>SR. NO.</u>	<u>NAME OF EQUIPMENT / ITEM</u>		<u>APPROVED VENDORS</u>
		(d)	GE FANUC
2.3	MASTER SLAVE CLOCK	(a)	SYMMETRICOM INC., USA
		(b)	HOPF, GERMANY
		(c)	HATHWAY, USA
		(d)	SERTEL ELECTRONICS, CHENNAI
		(e)	ADVANCE MICRONIC
2.4	DOT MATRIX PRINTER	(a)	HP / EPSON / WIPRO / TVS / SAMSUNG
2.5	LASER & COLOUR INKJET PRINTERS	(b)	HP / EPSON / CANON / IBM / XEROX / SAMSUNG
2.6	COMPUTERS FOR OPERATOR / ENGINEER / HISTORY STATION, SHIFT SUPERVISOR, STORIAN, SOFT LINK STATION FOR INTERFACING WITH OTHER SYSTEMS, PERFORMANCE CALCULATION AND SER STATION	(a)	IBM
		(b)	DELL
		(c)	HP/COMPAQ
2.7	TFT MONITOR	(a)	LG / SAMSUNG / HP / COMPAQ / IBM / DELL
2.8	VIBRATION MONITORING SYSTEM & TURBO-SUPERVISORY INSTRUMENTS	(a)	ROCKWELL AUTOMATION, USA
		(b)	BENTLEY NEVADA, USA / INDIA
		(c)	SHINKAWA, JAPAN / FORBES MARSHALL,
		(d)	VIBROMETER, SWITZERLAND
2.9	LARGE VIDEO SCREENS	(a)	BARCO BELGIUM / BARCO, INDIA
		(b)	PLANAR, USA / PYROTECH, INDIA
		(c)	CHRISTIE, USA / CHRISTIE, INDIA

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<u>SR. NO.</u>	<u>NAME OF EQUIPMENT / ITEM</u>		<u>APPROVED VENDORS</u>
		(d)	SYNELEC
		(e)	DELTA, THAILAND / DELTA POWER SYSTEMS, INDIA
2.10	HART COMMUNICATOR	(a)	HONEYWELL, USA/PUNE
		(b)	EMERSON PROCESS (FORMERLY FISHER ROSEMOUNT), USA / DAMAN
		(c)	YOKOGAWA, JAPAN / YOKOGAWA, INDIA
		(d)	MERIAM, USA / CHEMTROLS, MUMBAI
		(e)	ABB, GERMANY / INDIA
		(f)	FUJI, JAPAN
2.11	HART MANAGEMENT SYSTEM	(a)	PEPPERL+FUCKS, GERMANY / INDIA
		(b)	MTL, UK / INDIA
		(c)	EMERSON PROCESS, USA / DAMAN
2.12	ALARM ANNUNCIATION SYSTEM	(a)	PROCON, CHENNAI
		(b)	I I C, HYDERABAD
		(c)	MINILEC, PUNE
		(d)	IIC, MUMBAI
		(e)	PIRIE, MUMBAI
		(f)	PECON, VADODARA
		(g)	POSITRONICS
2.13	RCMS (ROTATING MACHINE CONDITION MONITORING SYSTEM)	(a)	VIBROTECH (M/S MEGITT INDIA PVT. LTD.)
		(b)	M/S SKF INDIA LTD.
2.14	ACOUSTIC PYROMETER	(a)	BONNENBERG + DRESCHER GMBH, GERMANY

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2.15	ACOUSTIC STEAM LEAK DETECTION SYSTEM (ASLD)	(a)	HI-TECH SYSTEM & SERVICES LTD, NEW DELHI (AMI MAKE)
		(b)	SARTECH INTL, CHENNAI (INSTROTECH MAKE INSPECTA FFT
2.16	EPABX SYSTEM	(a)	SIEMENS
		(b)	BPL
2.17	FURNACE TV CAMERA SYSTEM	(c)	HITECH SYSTEM & SERVICES LTD. (M/S LENOX INSTRUMENT COMPANY INC., USA
3.0	<u>ELECTRICAL & SECONDARY INSTRUMENTS:</u>		
3.1	DIGITAL INDICATOR	(a)	ABB, GERMANY / FARIDABAD
		(b)	MASSIBUS, GANDHINAGAR PYROTECH, UDAIPUR
		(c)	LEKTROTEK, PUNE
		(d)	GOSEN / CAMILLE BAUER / METRAWATT YOKOGAWA, JAPAN / INDIA
		(e)	SIEMENS
3.2	BARGRAPH INDICATORS	(a)	ABB, GERMANY / FARIDABAD
		(b)	MASSIBUS, GANDHINAGAR
		(c)	PYROTECH, UDAIPUR
		(d)	LEKTROTEK, PUNE
		(e)	GOSEN / CAMILLE BAUER / METRAWATT
		(f)	M-SYSTEM, JAPAN (CHINO LAXSONS DAMAN)
		(g)	SIEMENS

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3.3	PEN, POINT AND CHARTLESS RECORDERS	(a)	EUROTHERM, UK
		(b)	TATA HONEYWELL
		(c)	YOKOGAWA, JAPAN (YOKOGAWA, INDIA)
		(d)	CHINO (LAXSON), JAPAN
		(e)	ABB, UK / GERMANY
		(f)	FUJI ELECTRIC, JAPAN
3.4	TRANSDUCERS	(a)	SEIMENS
		(b)	AUTOMATIC ELECTRIC LTD., MUMBAI
		(c)	PYROTECH, UDAIPUR
		(d)	SOUTHERN TRANSDUCERS, CHENNAI
		(e)	ACCORD, PUNE MECO, MUMBAI
		(f)	ABB
		(g)	SITU, MUMBAI
		(h)	RISHABH
		(i)	ADEPT, PUNE
3.5	ELECTRICAL ANALOG (PANEL) METERS	(a)	AUTOMATIC ELECTRIC LTD., MUMBAI
		(b)	MECO, MUMBAI
		(c)	RISHAB, NASIK
3.6	SELECTOR SWITCHES AND CONTROL SWITCHES	(a)	KAYCEE
		(b)	ALSTOM
		(c)	L & T
		(d)	SIEMENS

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3.7	MOSAIC ANALOG (MOVING COIL) INDICATORS	(a)	GOSSEN, GERMANY
		(b)	WEIGEL, GERMANY
3.8	MOSAIC DIGITAL INDICATORS	(a)	GOSSEN, GERMANY
		(b)	WEIGEL, GERMANY
3.9	INTERPOSING RELAYS FOR COMMAND OUTPUT TO MCC	(a)	JYOTI
		(b)	H&B
		(c)	ALSTOM
		(d)	ELASTA
		(e)	OEN SIEMENS
		(f)	ABB
3.10	RELAYS / AUX. CONTACTORS	(a)	TELEMECANIQUE & CTRLS
		(b)	ABB
		(c)	SIEMENS
		(d)	GEC – ALSTOM
		(e)	L & T
3.11	LIMIT SWITCHES	(a)	BHARTIYA CUTLER & HAMMER, FARIDABAD
3.12	MINIATURIZED PUSH BUTTONS / ILPB (24X48MM) MOSAIC GRID COMPATIBLE	(a)	SIEMENS
		(b)	TEW, GERMANY (OLD NAME SUBKLEW)
4.0	<u>CONTROL DESKS & PANELS:</u>		
4.1	UNIT CONTROL PANELS (UCP)/ ELECTRICAL CONTROL PANEL (ECP)/ CONTROL DESK (MOSAIC GRID BASED)	(a)	BHEL EDN
		(b)	PYRO TECH, UDAIPUR
		(c)	INSTRUMENTATION LTD. KOTA
		(d)	KHODAY CONTROL SYSTEMS, BANGALORE

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		(e)	CHEMIN CONTROLS, PONDICHERRY
4.2	CRT DESK / OPERATOR DESK	(a)	PYRO TECH, UDAIPUR
		(b)	INSTRUMENTATION LTD. KOTA
		(c)	KHODAY CONTROL SYSTEMS, BANGALORE
		(d)	CHEMIN CONTROLS, PONDICHERRY
4.3	MOSAIC GRID/ MOSAIC TILES & OTHER MOSAIC ITEMS	(a)	SYMO, SWITZERLAND
		(b)	TEW, GERMANY (OLD NAME SUBKLEW)
		(c)	PYROTECH
4.4	LOCAL PANELS / DISTRIBUTION BOARDS	(a)	CONTROL & SCHEMATICS
		(b)	PYROTECH
		(c)	RITTAL
		(d)	L&T
4.5	TERMINAL BLOCKS	(e)	ELMEX
		(f)	PHOENIX
		(g)	WAGO
5.0	<u>ANALYSERS:</u>		
5.1	SWAS ANALYSERS	(a)	POLYMETRON / ZELLWEGGER – ANALYTICALS
		(b)	ABB
		(c)	ORION, USA
		(d)	ROSEMOUNT ANALYTICAL-CHEMPURE,
		(e)	HACH ULTRA FRANCE,
		(f)	HACH USA

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		(g)	YOKOGAWA
		(h)	AMETECH
		(i)	FORBES MARSHALL
		(j)	EMERSON
5.2	SWAS (STEAM AND WATER ANALYSIS SYSTEM) PANELS	(a)	ABB KENT, U.K.
		(b)	ABB LTD. FARIDABAD
		(c)	FORBES MARSHAL
		(d)	EMERSON PROCESS MANAGEMENT INSTRUMENTATION LTD., KOTA
		(e)	YOKOGAWA
5.3	CO ANALYSER (IN SITU TYPE)	(a)	AMETEK, USA / SINGAPORE
		(b)	CODEL INTERNATIONAL LTD. UK
		(c)	LAND COMBUSTION UK
5.4	OXYGEN IN FLUE GAS ANALYSER (ZIRCONIA PROBE TYPE)	(a)	AMETEK, USA / SINGAPORE
		(b)	LAND INSTRUMENTS, UK
		(c)	EMERSON PROCESS MANAGEMENT (I) LTD
		(d)	YOKOGAWA, JAPAN
		(e)	ENOTECH, GERMANY
		(f)	ABB, UK
		(g)	TELEDYNE, USA
		(h)	FUJI (AIC)
5.5	SMOKE DENSITY ANALYSER / PARTICULATE EMISSION ANALYSER / OPACITY ANALYSER	(a)	DURAG, GERMANY
		(b)	CODEL, UK
		(c)	LAND COMBUSTION UK

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		(d) EMERSON
		(e) ABB
		(f) FUJI (AIC)
5.6	NOX / SO2 ANALYSER (IN SITU)	(a) CODEL, UK
		(b) FORBES MARSHALL
		(c) LAND COMBUSTION, UK
5.7	OZONE ANALYSER	(a) BMT MESSTECHNIK, GMBH
5.8	RESIDUAL OZONE ANALYSER	(a) ECO SENSORS / KAUFFMANN UMWITTECHNIK .EK
5.9	OZONE LEAK DETECTOR	(a) OTTPL
6.0	<u>CONTROL VALVES / ACTUATORS / SOLENOID VALVES:</u>	
6.1	ELECTRICAL ACTUATORS FOR REGULATING & OPEN / CLOSE VALVES	(a) ROTORK CONTROL (INDIA) LTD.,
		(b) AUMA (INDIA) LTD.,
		(c) LIMITORQUE INDIA LTD.
6.2	PNEUMATIC ACTUATORS-REGULATING & OPEN / CLOSE	(d) INSTRUMENTATION LTD., PALGHAT
		(e) KELTRON CONTROLS, KERALA
6.3	SH/RH SPRAY CONTROL VALVES	(a) MIL CONTROLS LTD.
	SH/RH SPRAY BLOCK VALVES	(b) INSTRUMENTATION LTD. PALGHAT
	FEED CONTROL VALVES	(c) FISHER SANMAR LTD.
		(d) CONTROL COMPONENT INC., USA
		(e) HORA (HOLTER REGELARMATUREN GMBH & CO.)
6.4	LFO/HFO CONTROL, AND TRIP VALVES, FLOW CONTROL, PRESSURE	(a) MIL CONTROLS LTD.
		(b) INSTRUMENTATION LTD. PALGHAT

CONSULTANT : PROCON ENGINEERS

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	CONTROL, TEMP. CONTROL, AND BURNER TRIP VALVES, BALL VALVES	(c)	FOURESS ENGG (I) LTD, BANGALORE
		(d)	SAMSON CONTROLS , PUNE
6.5	SOOT BLOWER PRESSURE REDUCING VALVE	(a)	MIL CONTROLS LTD.
		(b)	INSTRUMENTATION LTD., PALGHAT
		(c)	FISHER SANMAR LTD.
		(d)	CONTROL COMPONENT INC., USA
		(e)	HORA (HOLTER REGELARMATUREN GMBH & CO.)
6.6	APRDS CONTROL VALVES	(a)	INSTRUMENTATION LTD.
		(b)	CONTROL COMPONENT INC., USA
		(c)	HORA (HOLTER REGELARMATUREN GMBH & CO.)
6.7	CONTROL VALVES- NON CRITICAL	(a)	DEZURIK COPES VULCAN LTD., U.K.
		(b)	CONTROL COMPONENT INC., USA
		(c)	FISHER SANMAR LIMITED
		(d)	INSTRUMENTATION LTD
		(e)	MIL CONTROL LTD.
		(f)	FISHER XOMOS SANMAR LTD.
		(g)	HORA (HOLTER REGELARMATUREN GMBH & CO.)
6.8	SOLENOID VALVE	(a)	ASCO, CHENNAI
		(b)	ROTEX AUTOMATION LTD., GUJRAT
		(c)	AVCON CONTROLS, MUMBAI
6.9	HP/LP BYPASS VALVES	(a)	BOPP & REUTHER SR GMBH CONTROL COMPONENTS INC (CCI)

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6.10	ELECTRO-HYDRAULIC ACTUATOR	(a)	LEONARDO AUTOMATION (INDIA) PVT. LTD.
7.0	<u>ERECTION HARDWARES:</u>		
7.1	LOCAL INSTRUMENT RACK (LIR) AND LOCAL INSTRUMENT ENCLOSURES (LIE)	(a)	PYROTECH, UDAIPUR
		(b)	INSTRUMENTATION LTD., KOTA
		(c)	ELECTRONICS CORPORATION OF INDIA LTD., HYDERABAD
		(d)	CHEMIN CONTROLS, PONDICHERY
		(e)	PRAMMEN INDUSTRIES
7.2	INSTRUMENT VALVES	(a)	EXCEL HYDRO PNEUMATICS PVT. LTD., MUMBAI
		(b)	BHEL
		(c)	METPRESS ENGINEERING WORKS, KOLKATA
		(d)	BALDOTA VALVE & FITTING CO. PVT. LTD., MUMBAI
		(e)	AURA INC., NEW DELHI
		(f)	INSTRUMENTATION LTD. PALGHAT
		(g)	PRECISION ENGG. INDUSTRIES, MUMBAI
		(h)	VIKAS INDUSTRIAL PRODUCTS, NEW DELHI
7.3	VALVE MANIFOLDS	(a)	EXCEL HYDRO PNEUMATICS PVT. LTD., MUMBAI
		(b)	METPRESS ENGINEERING WORKS, KOLKATA

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		(c)	BALDOTA VALVE & FITTING CO. PVT. LTD., MUMBAI
		(d)	AURA INC., NEW DELHI
		(e)	PRECISSION ENGG. INDUSTRIES, MUMBAI
		(f)	HP VALVES AND FITTINGS, CHENNAI
7.4	COMPRESSION FITTINGS / SOCKET WELD FITTINGS	(a)	SWAGELOCK, USA
		(b)	ASTEC VALVES & FITTINGS PVT. LTD.
		(c)	MET-LOK HYDRO PNEUMATICS PVT. LTD.
7.5	CONDENSATE POTS	(a)	EXCEL HYDRO-PNEUMATICS PVT. LTD., MUMBAI
		(b)	MICROPRECISION, FARIDABAD
		(c)	INSTRUMENTATION LTD. PALGHAT
		(d)	METPRESS ENGINEERING WORKS, KOLKATA
		(e)	BALDOTA VALVES & FITTINGS CO. PVT. LTD., MUMBAI
		(f)	PRECISSION ENGG. INDUSTRIES, MUMBAI
7.6	IMPULSE & SAMPLE PIPINGS	(a)	TPS TECHNITUBE ROHREN WERKE GMBH, GERMANY
		(b)	MAHARASHTRA SEAMLESS LTD.
		(c)	BHEL
		(d)	CHOKSI TUBE COMPANY LTD., INDIA
		(e)	INDIAN SEAMLESS METAL TUBES LTD., INDIA
		(f)	MANNESMANN AG, GERMANY

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		(g)	TOUVAY AND CAUVIN GULF EC, DUBAI
		(h)	JINDAL SAW PIPES LTD., INDIA
		(i)	SUMITOMO CORPORATION, JAPAN / KAWASAKI
		(j)	RATNAMANI METALS & TUBES LTD., AHMEDABAD
7.7	JUNCTION BOX (FRP)	(a)	DEVI POLYMERS, CHENNAI
		(b)	SUCHITRA INDUSTRIES, BANGALORE
		(c)	RITTAL
		(d)	PYROTECH
		(e)	L&T
		(f)	HENSEL ELECTRIC INDIA PVT. LTD., SRIPERUMBUDUR
7.8	AIR CYLINDER	(a)	VELJAN HYDRAIR, HYDERABAD
		(b)	NUCON INDUSTRIES, HYDERABAD
		(c)	PRECISION ENGG. (PREAC), BANAGALORE
		(d)	ASCO, CHENNAI
8.0	<u>CABLES:</u>		
8.1	CONTROL CABLES	(a)	DELTON CABLES, FARIDABAD
		(b)	UNIVERSAL CABLES, SATNA
		(c)	NICCO CABLE, KOLKATA
		(d)	POLYCAB, DAMAN
		(e)	GAYOLENE, MUMBAI
		(f)	RELIANCE ENGRS, BANGALORE
		(g)	CORDS CABLES, RAJASTHAN

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		(h)	PARAMOUNT CABLES, ALWAR
		(i)	THERMOCABLES, BANGALORE,
		(j)	KEI INDUSTRIES LTD., CHENNAI
8.2	INSTRUMENTATION CABLE	(a)	DELTON CABLES, FARIDABAD
		(b)	UNIVERSAL CABLES, SATNA
		(c)	NICCO CABLE, KOLKATA
		(d)	POLYCAB, DAMAN
		(e)	GAYOLENE, MUMBAI
		(f)	RELIANCE ENGRS, BANGALORE
		(g)	CORDS CABLES, RAJASTHAN
		(h)	PARAMOUNT CABLES, ALWAR
		(i)	THERMOCABLES, BANGALORE / HYDERABAD
		(j)	KEI INDUSTRIES LTD., CHENNAI
		(k)	CABLE CORPRN OF (I) LTD., CHENNAI
		(l)	RPG CABLES LTD., CHENNAI
		(m)	FORT GLOSTER INDUSTRIES LTD. KOLKATA
		(n)	DECO CABLES, DELHI
		(o)	KRISHNA CABLES, GWALIOR
		(p)	THERMAPADS (P) LTD
		(q)	ELKAY TELELINKS LTD.
		(r)	INCAB INDUSTRIES LTD
		(s)	TORRENT CABLE LTD.
8.3	COMPENSATING CABLES	(a)	DELTON CABLE

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		(b)	TOSHNIWAL, MUMBAI RELIANCE, BANGALORE
		(c)	LAPP INDIA, MUMBAI/ BANGALORE
		(d)	CORDS CABLES, RAJASTHAN
		(e)	PARAMOUNT CABLE
8.4	SPECIAL CABLES (PTFE /FEP INSULATED CABLES)	(a)	TOSHNIWAL CABLE
		(b)	RELIANCE CABLES
		(c)	LAPP INDIA, MUMBAI
		(d)	PARAMOUNT CABLES
		(e)	FINOLEX, PUNE
8.5	POWER CABLES (LT)	(a)	DELTON CABLES, FARIDABAD
		(b)	UNIVERSAL CABLES, SATNA
		(c)	NICCO CABLE, KOLKATA
		(d)	CORDS CABLES, RAJASTHAN
		(e)	FORTGLASTER INDUSTRIES
		(f)	INCAB, PUNE
		(g)	CCIL, BANGALORE
		(h)	KEI INDUSTRIES LTD., CHENNAI
		(i)	POLYCAB, DAMAN PARAMOUNT CABLES, ALWAR
9.0	<u>UPS / DC SYSTEM:</u>		
9.1	UPS WITH ACDB	(a)	HI-REL ELECTRONICS
		(b)	EMERSON NETWORK (FORMERLY TATA LIEBERT)
		(c)	DB POWER ELECTRONICS
9.2	24 VDC BATTERY CHARGER	(a)	CALDYNE, KOLKATA

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	WITH DCDB	(b)	AMARARAJA, TIRUPATI
		(c)	CHHABI ELECTRICALS, JALGAON
		(d)	HBL POWER SYSTEMS, HYDERABAD
		(e)	MASS TECH CONTROLS
9.3	BATTERY (TUBULAR/PLANTE) (TUBULAR) (TUBULAR)	(a)	EXIDE, KOLKATA
		(b)	HBL NIFE, HYDERABAD UNION BATTERY (BUI PUNE)
9.4	BATTERY (NICKEL- CADMIUM)	(a)	HBL POWER SYSTEMS, HYDERABAD
		(b)	AMCO, BANGALORE

Laboratory Instruments:

Bidder shall submit the vendor list with credentials for Mahagenco's approval.

NOTE : The vendors indicated in the above list are Mahgenco's approved vendors, however, the product of above vendors proposed for this project shall meet the requirements stipulated in 'Proven Product' Cl. No. 5.0 of Vol. V, Section I of Tender Specification.



**1x660MW BHUSAWAL TPS
VENTILATION SYSTEM
STANDARD TECHNICAL SPECIFICATIONS**

SPECIFICATION No: PE-TS-415-554-A001

SECTION : I

SUB-SECTION : D

REV. 00

SECTION: I

SUB-SECTION: D

STANDARD TECHNICAL SPECIFICATIONS



**STANDARD TECHNICAL SPECIFICATION
FOR
AIR WASHER**

SPECIFICATION NO.PES-554-01

VOLUME II B

SECTION D

REV. 00

DATE: NOV 2012

SHEET 1 OF 3

**STANDARD TECHNICAL SPECIFICATION
FOR
AIR WASHER**

	STANDARD TECHNICAL SPECIFICATION FOR AIR WASHER	SPECIFICATION NO.PES-554-01	
		VOLUME II B	
		SECTION D	
		REV. 00	DATE: NOV 2012
		SHEET 2 OF 3	

1.

GENERAL

1.1.1

This specification covers the design, manufacture, construction features, installation, commissioning and conducting performance test at site.

2.

CODES AND STANDARDS

The design/manufacture and performance of air washer shall comply with all currently applicable statutes, regulations and safety codes in the locality where the air washer is installed. The equipments shall also conform to the requirements of the latest editions of applicable Indian/British/US standards. Nothing in this specification shall be construed to relieve the vendor of this responsibility. In particular the equipments shall conform to the latest editions of the following standards:-

2.1.1

IS:277: Galvanised steel sheets

2.1.2

IS:1239: Mild steel tubes

2.1.3

IS: 2062:

3.

DESIGN/CONSTRUCTION FEATURES

3.1

GENERAL

3.1.1

The air washer shall be designed for max. air velocity of 2.8M/sec. Circulating water quantity shall be 1.0 CMH for every 1000 CMH of air flow, unless otherwise stated in data sheet A. The minimum saturating efficiency of air washer shall not be less than 90% Minimum length of air washer shall be 2500 mm.

3.2

TANK (SUMP)

3.2.1

The air washer tank shall either be masonry or metallic construction as specified in data sheet A. Masonry tank shall be provided by purchaser whereas metallic tank shall be of welded construction, fabricated from not less than 6mm thick MS plates, and inside, outside surfaces shall be provided with anti corrosive paint (Zinc sprayed to coating thickness of 75 micron min.).

3.2.2

The air washer tank shall have a minimum depth of 600mm and tank construction shall be such that the suction screen can be replaced while the air washer is under operation. The inlet and outlet ends of tank shall be suitably constructed to accommodate distribution plates and eliminator plates.

3.3

DISTRIBUTION PLATE

3.3.1

The distribution plate shall be fabricated from minimum 18 gauge thick GSS and shall have minimum 50% free area. The angles used for supports shall be galvanised.

3.3.2

The distribution plate shall be built up of number of sections for easy handling.

3.4

HEADERS AND STAND PIPE

3.4.1

The air washer shall be of two bank construction (one cross flow and other unit flow). The piping up to and including 100mm dia meter shall be of galvanised steel and above 100mm dia shall be black steel (subsequently spray galvanized to coating thickness as per approved TDS). All piping shall be adequately supported.

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3.5	SPRAY NOZZLES		
3.5.1	Spray nozzles shall be made of HDP (High density polyethylene) and shall be self cleaning type. The nozzles shall be designed to produce fine atomised spray and shall be spaced to give, uniform coverage of the air washer section. The pressure drop through the nozzle shall be in the range of 1.4 kg/cm2 g to 2.4 Kg/cm2g		
3.6	ELIMINATOR PLATE		
3.6.1	Eliminator plate shall be fabricated from 22 gauge thick GSS (Zinc coating thickness as per approved TDS).The eliminator section shall have minimum 6 bends. Spacer bars, tie rods and supports shall be of galvanised steel construction. Eliminator box shall be complete with suitable drop tray and drain pipe.		
3.7	SUCTION SCREENS		
3.7.1	Suitable no. of suction screens shall be provided by vendor and one set of spare screens shall be furnished along with each air washer.		
3.8	INSPECTION DOOR AND MARINE LIGHT		
3.8.1	Air tight inspection door of 600x700mm, metallic construction shall be provided. The air washer shall be equipped with marine light as required.		
3.9	MAKE UP, DRAIN AND QUICK FILL CONNECTION		
3.9.1	The air washer shall be provided with quick fill and make up connection. The quick fill valve shall be a globe valve. Float valve for making connection shall be backed up by a gate valve. Drain connections complete with isolating valves shall be provided for both suction and main tank. Over-flow pipe shall be provided for main tank and shall be connected to drain pipe, before the isolating valve or drain. In case of masonry tanks suitable pipe pieces with stiffener plates shall be provided by Vendor for use during casting of masonry tank.		
4.	DATA TO BE FURNISHED BY VENDOR AFTER AWARD OF CONTRACT		
4.1.1	Performance curve for air washer		
4.1.2	GA drg.		
4.1.3	Foundation drag. weight, dynamic loading etc.		
4.1.4	O&M manual		



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S.No. DESCRIPTION

DETAILS

GENERAL

1. Designation Air washers for power house building.
2. Nos. required Refer Section-C of Specific Technical Requirement
3. Service Evaporative Cooling of TG Hall & electrical bay
4. Location As per section-C/ Tender Layout Drg.

DESIGN DATA

5. Type Sheet metal type, as per schedule of Ventilation system.
6. Capacity M3/hr Refer Section-C of Specific Technical Requirement
7. Inlet air temperature (Refer design data.)
8. Saturation Efficiency (min). To achieve saturation efficiency of 90%
9. Allowable Pressure drop through Spray nozzle 2.4 Kg/cm² (g) max.
9. Pressure drop across Spray chamber 15 to 20 mm WG.

MATERIALS

11. Moisture Eliminators plates 24 SWG Galvanized Sheet (Vertical and brake type)./ 100% Virgin PVC of minimum finished thickness of 2 mm.
12. Moisture Eliminators Frame 22 SWG G.I. Sheets.
13. Distribution plates 18 G GSS to have 50% free area.
14. Tank MS
15. Casing Black M.S. (10 SWG min.)
16. Louvers 20 G GSS sheet & frame of 18 G galvanized steel angle. Louvers with Bird screen of galvanized wire mesh of 10 mm square.
17. Piping MS Heavy Class Galvanized to IS: 1239 Part I, OR IS –3589 depending upon size.



**AIR WASHER
DATA SHEET - A**

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- | | | |
|-----|----------------------|--|
| 18. | Suction Screen Water | Brass (40 mesh size 2 nos for each air washer) |
| 19. | Spray nozzles | Brass/Bronze with chrome plating or suitable plastic material (Nylon/Polymer) and shall be self cleaning type. |
| 20. | Flooding Nozzles | Nylon/Polymer. |
| 21. | Banks | Two spray banks each connected to individual header |

EQUIPMENT SELECTION CRITERIA

- | | | |
|-----|--|------------------------------------|
| 22. | Face Velocity through louver. | Not to exceed 2.5 m/s |
| 23. | Max. Pressure drop | Not to exceed 6.5 mm Wg when clean |
| 24. | Saturation efficiency | Not less than 90%. |
| 25. | Face velocity of air through spray chamber. | Not to exceed 2.5 m/s. |
| 26. | Allowable pressure drop for washing chamber. | 15 to 20 mm Wg. |

NOTE:

- 1) All parts coming in contact with moisture for air washer shall be spray galvanized/epoxy painted
(2 coat of rust preventing epoxy primer & 2 coat of finished paint from both sides.)
- 2) Moisture eliminator shall have bends at 30 Degree with the direction of air flow & shall have effectively hooked edges for trapping the water.



**STANDARD TECHNICAL SPECIFICATION
FOR
VENTILATION FANS**

SPECIFICATION NO.PES-554-03

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**STANDARD TECHNICAL SPECIFICATION
FOR
VENTILATION FANS**

	STANDARD TECHNICAL SPECIFICATION FOR VENTILATION FANS	SPECIFICATION NO.PES-554-03	
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1.	GENERAL	This specification covers the design, manufacture, testing of performance at manufacturer's/sub-contractors works, delivery at site, handling at site, erection and commissioning of ventilation fans.	
2.	CODE AND STANDARDS	The design, manufacture and performance of equipment shall comply with all currently applicable statutes, regulations and safety codes in the locality where it is to be installed. The equipment shall conform to latest edition of applicable Indian Standards or their equivalent standards. Nothing in this specification shall be construed to relieve the vendor of this responsibility. In particular the equipment shall conform to the latest editions of the Following standards.	
2.1.1	IS:4894	-Centrifugal fans	
2.1.2	IS:3588	-Electric Axial Flow fans	
2.1.3	IS:2312	-Propeller type A.C. ventilation fans	
2.1.4	IS-3963	-Roof extractor units	
2.1.5	BS:848	-Method of performance test for fans.	
2.1.6	AMCA publication 99 standards handbook		
2.1.7	AMCA standard 210, Test code for air moving devices.		
3.	DESIGN AND CONSTRUCTION		
3.1	THE ENCLOSED DATA SHEET A GIVES THE NECESSARY DETAILS FOR CENTRIFUGAL/AXIAL/ROOF EXTRACTOR UNITS ETC.		
3.2	WELDING PROCESS AND WELDERS EMPLOYED FOR FABRICATION SHALL BE QUALIFIED AS PER ASME SEC. IX		
3.3	CASING		
3.3.1	The centrifugal fans casing shall be of welded construction fabricated with heavy gauge material (min 3 mm) with flanges (min. 5 mm) on inlet and out let side for direct connection and shall be rigidly reinforced and supported by structural angles. The seams shall be permanently sealed airtight. Horizontal Split casings shall be provided on large size fans. Casing drain (at bottom) with threaded plug/ with valve shall be provided, as required. All mounting/ connecting holes shall be drilled off centre.		
3.3.2	The axial flow casing for supply fans/roof extractors shall be of heavy gauge construction (min 3 mm) properly reinforced for rigidity and shall be complete with suitable supports. Access doors with suitable locking arrangement shall be provided in the casing for easy access to the motor and impeller. External junction box/ Terminal box on casing with IP-55 protection shall be provided, if required. Wiring for motor from external junction box/ Terminal box shall be through flexible conduit.		
3.3.3	Suitable motor brackets designed for rigid mounting of motors, shall be provided for roof extractors and wall mounted exhaust/ supply fans.		

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3.4	IMPELLER
3.4.1	Centrifugal fan impeller shall have die formed, aerofoil or laminar blades welded to the rim and back plate and shall have non-overloading, self cleaning characteristics. Rim shall be spun to have smooth contour. If required, intermediate stiffening rings shall be provided. Shaft sleeves shall be furnished, if specified. The impeller, pulley and shaft sleeve shall be secured to the shaft by key and/or nuts (threaded opposite to direction of rotation of impeller). The impeller shall be statically and dynamically balanced.
3.4.2	The axial fan impeller shall be of high efficiency aerofoil design. The blades shall be mounted on a streamlined hub and the impeller shall be mounted directly on the motor shaft. Impeller shall be in one piece however; fabricated blades will be acceptable up to 450 mm impeller diameter.
3.4.3	Roof ventilator impeller may either be centrifugal or axial type. Backward inclined blades shall be provided for centrifugal impellers. Blades may be die-formed or cast. Axial flow impeller shall be directly mounted to motor shaft whereas centrifugal impeller may either be direct-driven or belt-driven. The shaft of belt-driven centrifugal fan shall be solid cold rolled carbon steel, ground and polished. However, direct mounted impellers are preferred.
3.5	BEARINGS:
3.5.1	The centrifugal fan bearing may be ball, roller or sleeve bearings of self-aligning heavy duty type with adequate capacity and life. Make of Bearings to be specified. Bearings shall be oil/grease lubricated and provided with fittings for lubrication from outside and shall be located in easily accessible position to facilitate maintenance.
3.6	INLET CONES AND GUARDS
3.6.1	Centrifugal fans inlet shall be spun to have a smooth contour. Inlet screen, if provided, shall be galvanised wire mesh of 25 mm square with wire thickness of min. 1.5 mm.
3.6.2	Inlet cone, outlet bell and suitably designed guards shall be provided.
3.7	GUIDE VANES:
3.7.1	In case of vane axial fans guide vanes shall be provided on discharge side.
3.8	BASE PLATE AND VIBRATION ISOLATORS
3.8.1	Base plate and vibration isolators, which may be double deflection rubber in shear or rubber in compression type or spring type shall be provided. With each fan rubber bushes, washers wherever needed for vibration isolator in sufficient nos. shall be included, as required, to ensure isolation of foundation from vibration of equipment. For roof ventilators suitable mounting arrangement shall be provided such that there is no ingress of rain water into the building.
3.9	HOOD AND COWL
3.9.1	Roof exhaustors shall be provided with hinge type hood providing easy access to motor and impeller. Weather proof lockable type disconnect switch shall be provided such that hood can open only when the disconnect switch is in 'off'

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position. On larger size of roof ventilators hoods may be of split construction. 15 mm mesh galvanised bird screen shall be provided.

3.9.2 Rain protection cowls shall be designed to suit wall exhausters/supply fans for protecting fans from rain. The cowls shall be provided with bird screen of heavy gauge expanded metal netting.

3.10 SPEED

3.10.1 The speed of axial flow fans/roof ventilators shall not exceed 960 RPM for impeller dia exceeding 450 mm and shall not be greater than 1440 with impeller dia less than 450 mm.

4. MOTORS

Drive motors shall be of totally enclosed type, suitable for horizontal/vertical mounting as applicable and shall comply with the requirments of the specifications furnished elsewhere for motors.

5. ACCESSORIES

Accessories as specified in Data sheet-A and as required for satisfactory trouble free & safe operation of fans shall be provided.

TESTING AND INSPECTION

List of TCs arranged as per Approved Quality Plan shall be furnished along with copy of TCs at the time of inspection by BHEL

- Visual inspection of sheets/plates, angles, channels etc. – Pitting, lamination in sheets/ plates, angles and channels shall be avoided.- visual inspection by main contractor of BHEL.
- Sheets/ Plates - Test certificate shall be furnished for physical and chemical properties for sheets / plates- for review by BHEL
- Shaft: Mechanical and chemical— review by BHEL
- Motors (of approved make): Routine TC ,FLP TC if applicable
- Workmanship and dimensional check as per manufacturing drg. and approved Drgs.- by main contractor of BHEL.- Shall be checked by BHEL/ Customer during final inspection.
- Balancing of impellers- Dynamic balancing certificates shall be furnished –grade 6.3 or better to ISO-1940. Balancing weights shall be positively locked/ welded to avoid loosening. - witness by manufacturer - TC to be furnished for review by BHEL(consisting of weight of impeller, radius of correction and balancing rpm). For spare impellers Dynamic Balancing shall be witnessed by BHEL.
- Performance test of one Centrifugal fan or Axial Fan /per type/per size as per applicable standard – by BHEL.

Centrifugal/ Axial fans 100% run tested by main contractor of BHEL. Run test by BHEL/Customer may be at random or 100%- Vibration shall be within satisfactory zone of VDI 2056 (group- G) machines when measured on bearing housing and noise level <85 dbA at 1 metre distance. Max. Temp. on bearing housing- 40 degrees Centigrade + ambient



CENTRIFUGAL FAN
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No. Particulars

Data

1 General Information

1.1 Fan Designation/application.
system/

Refer schedule of Ventilation
Air washers & UAF Units.

1.2 Nos. required/capacity
Technical

Refer Section-C of Specific
Requirement

1.3 Location

Refer layout drg. Attached.

2.0 Design Data

2.1 Type

DIDW for Air Washer and SISW for
UAF

2.2 Type of blades

backward curved

2.3 Arrangement

To suit application as per layout.

2.4 Discharge direction

To suit application as per layout.

2.5 Duty

Continuous

2.6 Capacity at site (Cubic Meter/hr) & static pressure.
Technical

Refer Section-C of Specific
Requirement

2.7 Suction pressure (mm Wg)

As per system requirement.

2.8 Fluid

Atmospheric Air.

2.9 Suction Temperature

Refer weather data attached.

2.10 Suction humidity

Refer weather data attached.

3.0 Materials

3.1 Fan Scroll

Heavy Gauge Mild Steel to IS: 2062
with galvanised

3.2 Fan Casing (side plates & stiffeners)

Heavy Gauge Mild Steel to IS: 2062 /
IS: 1079 / Eq. Minimum 3 mm thick
casing.

3.3 Impeller

Mild Steel/plate to IS: 2062

3.4 Impeller hub

Mild Steel/plate to IS: 2062

3.5 Impeller back plate blade & shroud

Mild Steel to IS: 2062 / IS: 1079 / Eq.



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- | | | |
|------|---|--|
| 3.6 | a) Shaft
b) Shaft sleeve | EN-8 or eqv.
-do- |
| 3.7 | Support frame and structure. | Mild Steel to IS: 2062 |
| 3.8 | Flexible connection at outlet
impregnated canvas with MS Flanges and cleats (3mm thick). | Fire resistant type plastic |
| 3.9 | V Belt | ISI marked (Reinforced rubber section to
IS: 4776) |
| 3.10 | V Pulley
per | Cast Iron multi groove to grade FG 20 as

IS: 210. Having taper lock type
M.S./C.I. |
| 3.11 | Slide rails | G.I. according to supplier's design |
| 3.12 | Connection pieces | M.S. Galvanized / Epoxy painted. |
| 3.13 | Bolts & nuts | Hard synthetic rubber |
| 3.14 | Vibration isolating pads, washers and spring
if any. | |
| 4.0 | <u>ACCESSORIES</u> | |
| 4.1 | Common base plate | Required. |
| 4.2 | Anchor bolts | -do- |
| 4.3 | Vibration Isolators | Hard synthetic rubber |
| 4.4 | V-belt pulleys | -do- |
| 4.5 | V-belts | Reinforced rubber of appropriate
section |
| 4.6 | Belt guard | Required. |
| 4.7 | Outlet damper | Required(M.S. Heavy Gauge) |
| 4.8 | Inlet guard | Required. |
| 4.9 | Inlet Vane (variable) | Not required. |
| 4.10 | Drain valve | Required. |
| 4.11 | Acoustic silencers | Not required. |
| 5.0 | <u>Motor</u> | |
| 5.1 | Motor by | Bidder |



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5.2 Starter by

BHEL

6.0 Painting of fans including base frame

Galvanized / epoxy painting (as per
Section-C & painting specifications)

NOTE:

- 1) Motors shall have 15 % margin on duty power point.
- 2) Fan shall be designed to operate with in 9% and 25% of system throttling line.
- 3) Opposed Multiple louvers damper shall be provided at fan outlet. Louvres shall be of 2 mm thick
MS (galvanized). Casing shall be of 3.15 mm thick MS (galvanized).



VENTILATION FAN (R.E.UNIT)
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General Information

- | | | |
|----|---------------|---|
| 1) | Designation | Roof extractor Units for areas as per schedule of ventilation system. |
| 2) | Nos. required | As per schedule. |
| 3) | Service | Continuous |
| 4) | Location | Roof of respective areas. |
| 5) | Area | As per schedule |

Design Data

- | | | |
|-----|-------------------------------|--|
| 6) | Type | axial flow type. |
| 7) | Air delivery capacity system. | as per schedule of ventilation |
| 8) | Fluid | Atmospheric Air. |
| 9) | Temperature | 50 Deg. C |
| 10) | Static Pressure required | As per Section 'C' schedule of ventilation system. |
| 11) | Outlet air velocity | Not more than 12 m/sec. |

Materials

- | | | |
|-----|--|---|
| 12) | Casing/cowl/hood | M.S. Sheet to IS: 2062 /IS: 1079/Eq. |
| 13) | Impeller
617 | Cast Aluminium alloy to A-6M IS-
Grade LM6 |
| 14) | Support frame and structure.
2062). | M.S. of adequate thickness (IS- |

ACCESSORIES

- | | | |
|-----|--------------------------|------|
| 15) | Vibration isolating pads | Yes. |
| 16) | Base frame for mounting | Yes. |
| 17) | Wire Guard at inlet. | Yes. |
| 18) | Disconnect switch | Yes. |



VENTILATION FAN (R.E.UNIT)
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19) Gravity damper at outlet

Yes

Motor

20) Motor by

Bidder

21) Starter by

Bidder

22) Type of motor

Conforming to IS: 325 latest/as per specification.

23) Free delivery test

Yes.

24) Performance test at specified duty point.

Yes

25) Speed

Not more than 1500 RPM

NOTE:

1. Motors shall have 15% on duty power Point.



VENTILATION FAN (R.E.UNIT)

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Ventilation Fan (Axial Flow Type)

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No. Particulars

Data

General Information

- 1) Designation
- 2) Nos. required in
- 3) Service air.
- 4) Location
- 5) Area

Supply/Exhaust Fans.

Refer schedule of Ventilation system section-C under specific technical requirement.

To exhaust warm air/to supply fresh

Wall mounted.

Same as above in 2.

Design Data

- 6) Type supply
- 7) Air delivery capacity system.
- 8) Fluid
- 9) Temperature
- 10) Static Pressure required
- 11) Outlet Air Velocity

Axial fans suitable for 415V/3 phase for Motor.

As per schedule of ventilation

Atmospheric Air.

Refer Section of specific technical requirement

As per Section 'C' schedule of ventilation system.

Not more than 12 m/sec.

Materials

- 12) Casing
- 13) Impeller 617)
- 14) Hub
- 15) Support frame and structure. (Galvanized/
- 16) Neoprene rubber pads

M.S. (IS-2062)

Cast Aluminium. (Alloy A-6M, IS-

Al Alloy.

M.S. of adequate thickness Painted) IS-2062.

As required.



Ventilation Fan (Axial Flow Type)

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- | | | |
|-----|---|--|
| 17) | Coned inlet for wall exhausters/supply fans | MS (IS-2062) |
| 18) | Supporting frame for mounting. | Required. |
| 19) | Protective screen at inlet. | Yes (Min 14 SWG Galvanized wire knitted in 1" square mesh. |
| 20) | Rain Protection Cowl | Aluminum or hot dip Galvanized after fabrication from M.S. |

Motor

- | | | |
|-----|------------|--------|
| 21) | Motor by | Bidder |
| 22) | Starter by | BHEL |

NOTE:

- 1) For Battery Room, motor for fan shall be of flame proof type & fan of spark proof construction with Epoxy painting.
- 2) Gravity type damper shall be provided at the outlet of axial fan for exhaust application.
- 3) Motor shall have 15% margin over Duty Point.



Ventilation Fan (Axial Flow Type)

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**STANDARD TECHNICAL SPECIFICATION
FOR
LOW PRESSURE AIR DISTRIBUTION
SYSTEM**

SPECIFICATION NO.PES-554-02

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**STANDARD TECHNICAL SPECIFICATION
FOR
LOW PRESSURE AIR DISTRIBUTION SYSTEM**



TECHNICAL SPECIFICATION
LOW PRESSURE AIR DISTRIBUTION
SYSTEM

SPECIFICATION NO.PES-554-02

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SECTION D

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1. GENERAL

This specification covers the design, manufacture, construction features, installation, inspection testing and air balancing of air distribution system upto a total pressure of 95mm w.g. The specification is intended to cover the air distribution for air conditioning system and ventilation system not involving localised exhaust.

2. CODES AND STANDARDS

2.1.1 The design, construction and performance of complete system shall conform to all currently applicable statutes, regulations, safety codes in the locality where the equipment are to be installed.

2.1.2 Unless specified otherwise the equipments shall generally conform to latest applicable Indian Standards. Nothing in this specification shall be construed to relieve the vendor of this responsibility. In particular the equipment shall generally conform to latest editions by the following standards:-

- a) IS: 655 - Specifications for metal air ducts
- b) IS:277 - Specifications for galvanised steel sheets
- c) IS:737 - Specification for wrought aluminium and aluminium alloy sheet and strip.

3. MATERIAL

3.1.1 Metal air ducts shall be either of galvanised steel sheets or aluminium sheets, as indicated in data sheet-A.

3.1.2 The rolled steel sheets before galvanising shall be properly annealed or normalised so as to allow fabrication of ducts without developing cracks. Zinc coating on the steel shall be as per IS 277 Gr. 275 / as specified in Data Sheet A.

3.1.3 The aluminium sheets shall be of grade S1C or NS3 and shall be suitable for duct fabrication work as per IS-737 latest.

4. CONSTRUCTION/FABRICATION

The thickness of sheets, the type of bracing and other fabrication details shall generally conform to requirements given hereunder unless specified otherwise in data sheet A and/or indicated on drawings.

4.1 RECTANGULAR DUCTS

4.1.1

S.No.	Max Side	Sheet Thickness		Type of transverse Joint connections	Bracings
		(mm) GI	(mm) Al		
a)	Up to 600	0.63 (24G)	0.80	S-drive, pocket or bar slips or flanged joints on 2.5m centres	None
b)	601 to 750	0.63	0.80	S-drive, 25mm pocket or	25x25x3 mm MS



TECHNICAL SPECIFICATION
LOW PRESSURE AIR DISTRIBUTION
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		(24G)		25mm bar slips or flanged joints on 2.5m centres	angles, 1.2m from joints
c)	751 to 1000	0.80 (22G)	1.00	S-drive, 25mm pocket or 25mm bar slips or flanged joints on 2.5m centres	25x25x3 mm MS angles, 1.2m from joints
d)	1001 to1500	0.80 (22G)	1.00	40x40x3mm MS angle, flanged connections or 40mm pocket or40mm bar slips with 35x3mm bar reinforcing on 2.5m centres	40x40x3 mm MS angles, 1.2m from joints
e)	1501 to2250	1.00 (20G)	1.50	40x40x3mm MS angle, flanged connections or 40mm pocket or40mm bar slips, 1M maximum centres, with 35x3mm bar reinforcing	40x40x3 mm diagonal angles or 40x40x3mm angles, 600mm from joints
f)	2251 & above	1.25 (18G)	1.80	50x50x3mm MS angles,connections or 40mm pocket or 40 mm bar slips, 1M maximum centres with 35x3mm bar reinforcing.	50x50x3mm diagonal angles or 50x50x3mm angles 600 mm from joints.
g)	No bracing is required if transverse joints are less than 600mm apart				
h)	For ducts larger than 2250mm, special handling and supporting methods shall be provided as per the approval of Purchaser				

- 4.1.2 All rectangular ducts having either dimension larger than 450mm shall be cross broken except these ducts which are insulated with sand cement plaster. Air outlet connections on ducts need not be cross broken.
- 4.1.3 The seams on duct cones shall be of Pittsburgh type. Longitudinal seams shall be smooth inside the ducts.
- 4.1.4 The flanges used for transverse joints shall be joined together with GI bolts (grade 4.6) and nuts spaced at 125mm centres as per following:
- Upto 1000mm - 6 mm dia GI bolts
 - 1001 to 1500 - 8 mm dia GI bolts
 - 1501 and above - 10mm dia GI bolts
- 4.1.5 The MS angle flanges shall be connected to ducts with rivets at approx. 100mm centres. The flanged joints shall have 6mm thick felt packing stuck to flanges with shellac varnish. The holes in the felt packing shall be burnt through. The ducts are to be tapped 6mm across the MS flanges.
- 4.1.6 MS angles used for bracings shall be tack welded to the ducts or rivetted at 125mm centres, as applicable.



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LOW PRESSURE AIR DISTRIBUTION
SYSTEM

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4.2 ROUND DUCTS

4.2.1

S.No.	Duct dia-mm	Sheet Thickness		Reinforcing
		(mm) GI	(mm) Al	
a)	Up to 150	0.63 (24G)	0.80	None
b)	151 to 600	0.80 (22G)	1.00	None
c)	601 to 1000	1.00 (20G)	1.50	40x40x3mm girth MS
d)	1001 to 1250	1.00 (20G)	1.50	40x40x3mm girth MS angles at 2.0 meter centres
e)	1251 & above	1.25 (18G)	1.80	40x40x3mm girth MS angles at 1.2m centres

4.2.2 The seams on round ducts may be continuously welded or grooved longitudinal seam. In case of welding of GI sheet, zinc rich paint shall be applied on the welded zone.

4.2.3 Round ducts shall either be joined by welding or the ducts shall be swedged 40mm from the ends such that larger end will butt against the swedge and is held in place with sheet metal screws.

4.3 DUCT SUPPORTS

Unless specified otherwise on drawings, rectangular ducts with larger side of 2250mm or above shall be supported by 15mm MS rods and 50x50x3mm and MS angles while those below 2250 mm shall be supported by 10mm MS rods and all angles shall be given a coat of primer paint. The duct supports shall be at a distance not exceeding 1800mm. The MS rods shall be fixed to MS angle cleats, which in turn are fixed to ceiling slab by suitable anchor fasteners. All anchor fasteners, MS angle cleats, coach screws, hooks and other supporting material required shall be provided by vendor.

However, If ducts are thermally insulated, the MS angles and supports shall not be in direct contact with ducts, for which purpose wooden pieces/ Resin bonded fibre glass sheets (50 mm thick) shall be used in between.

4.4 FLEXIBLE CONNECTIONS

Wherever the sheet metal ducts connects to intake or discharge of fan units a flexible connection of at least 150mm width made by closely woven double layer Fire resistant or canvas shall be provided. The same shall be attached to angle iron frames on equipment and to similar frame on duct or casing by means of a steel band or collar fitting over the end of the flexible connection and bolted through angle iron frame so as to clamp securely between the band and the angle frame.

4.5 TRANSFORMATIONS AND BREACHES

All curves, bends, offsets and other transformations shall be made for easy and

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noiseless flow of air. The throat of every branch duct shall be sized to have a velocity not exceeding that in the main duct to which the branch is connected.

4.6 CAULKING

Wherever duct passes through wall, the opening between masonry and duct work shall be neatly caulked or sealed to prevent movement of air from one space to adjoin by space with a rated fire resistant material.

4.7 EASEMENT

Normally pipe hangers, light fitting rods etc. shall not be allowed to pass through the ducts. Wherever, It becomes absolutely essential to pass these hangers/rods etc. Through the ducts, prior approval of purchaser shall be taken and light streamlines easement around the same shall be provided to maintain smooth air flow.

4.8 ACCESS DOORS

Access doors shall be provided in ducts, plenums etc. on both sides to allow access and servicing of equipment viz. pipes, dampers, coils, valves, heaters etc.

All access doors shall be adequately sized and lined suitably with felt to prevent air leakage. The doors shall be of built-up construction, structurally strong and shall have at least two hinges each, and shall be with two rust proof window sash locks of approved type. All doors shall be so set as to flush with outer finish of duct insulation etc.

4.9 DAMPERS AND SPLITTERS

4.9.1 Dampers and splitters shall be provided at suitable points for proportional volume control of the system. Splitters and dampers shall be made of minimum 18 gauge GSS of quadrant type with locking device mounted outside the duct at accessible location.

4.9.2 Fire Dampers

Fire dampers/fire doors shall be provided as specified in Data Sheet -A and shall be installed at locations indicated on drawings and/or as required/approved by purchaser, including all openings in passage of duct work through fire walls and floors etc. The fire damper shall be of electrical type with damper motor actuated by thermal sensor or fusible link type.

4.9.3 Gravity operated back draft dampers shall be provided to ensure pressurisation of rooms as specified. These dampers shall be designed such as not to allow infiltration of outside air while forced exit of air shall be achieved through this damper. The louvres shall be freely mounted on spindles to allow the dampers to open with the pressure developed by the fan. The dampers shall be provided with flange at inlet.

4.9.4 Vanes

Unless otherwise shown in the drawings all elbows shall be such that the throat radius is 75% of the duct width. In case throat radius is smaller, suitable single thickness vanes of approved details shall be provided.

4.9.5 Flashing

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For the ducts penetrating roofs or outside walls, provision of flashing shall be made by the ducting vendor.

4.10 DIFFUSERS AND GRILLS

The type and quantity of diffusers and grills is indicated on enclosed drawings/data sheet A. The size/quantity of diffusers/ grills indicated in the drawing/data sheet is indicative and is for vendor’s reference purpose only. Vendor shall ensure that the diffusers/grills offered are of requisite capacity, throw and terminal velocity. The pressure drop and noise levels shall be as per data sheet. A enclosed. The diffusers/grills shall be approved by purchaser.

Unless specified otherwise the diffusers/grills shall be of mild steel land painted with two coats of primer paint. Supply air grills shall be complete with volume control dampers. Supply air grills shall be double deflection type while Return Air grills can be single deflection type. Ceiling outlets/diffusers shall have volume control dampers, fixed grids and blanking baffles. All volume control dampers shall be operated by a key from the front of grills/diffusers.

Suitable vanes shall be provided in duct collars to have uniform air distribution. Blank-off baffles wherever required, shall also be provided.

4.11 PLENUMS AND RA BOXING

All plenum chambers and/or connections to fans, dampers etc. shall be constructed in 18 gauge GI sheet. supported on 40x40x6mm MS angle frames. All vertical angles shall be riveted at appox. 125mm. centres to the casing. Suitable caulking compound (Pecora or equivalent) shall be inserted between the base of the angle and all masonry construction to which angles are fastened.

Return air boxing requirements if any are indicated in data sheet-A and the same shall be provided by vendor. The return air box shall be fabricated out of GI sheets shall be insulated with 25mm thick fibre-glass.

4.12 ACCOUSTIC LINING

The ducts shall be lined acoustically from inside as given in data- sheet A and/or section C of the specification.

4.13 PAINTING

Wherever specified the ducts shall be painted or lined with suitable anti-corrosive paint/ lining as per approval of purchaser. In particular the ducts coming in contact with acid fumes shall be epoxy coated, inside and outside.

4.14 THERMAL INSULATION

Thermal insulation shall be as per data sheet - A and the insulation shall conform to enclosed spec. no. PES-553-08.

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5.

INSPECTION AND TESTING

5.1

INSPECTION & TESTING DURING FABRICATION–BY MAIN VENDOR

5.1.1

Visual inspection of GI sheets and angles, channels etc. – dents, black spots, chipping of zinc coating, white dust on galvanised sheets shall be avoided. Pitting , lamination in angles and channels shall be avoided.- visual inspection by Main Vendor.

5.1.2

Galvanised sheets - Test certificate shall be furnished for visual check, coating thickness, adhesion test, sheet thickness, uniformity of coating –review of TC by BHEL/Customer

5.1.3

Check for dimensions & mass as per latest IS-277.

5.1.4

Check for defect, twists, ungalvanised spots as per IS-2629.

5.1.5

Bend test & wrapping test as per IS-277.

5.1.6

Zinc coating test on samples as per IS-6745.

5.2

INSPECTION & TESTING AT SITE.

5.2.1

The duct branches, elbows etc. shall be inspected and the joints and connections etc, are to be checked before they are assembled in position.

5.2.2

After completion, all duct systems shall be checked and tested for air leakage, tightness, velocity, pressure drop, vibration and noise etc.

6.

BALANCING

6.1.1

The entire air distribution system shall be balanced by vendor to supply the air quantities as required in various rooms so as to maintain the requisite temperature and air flow in the conditioned spaces. The final balance of air quantities through each grill/diffuser etc. shall be recorded and submitted to purchaser for approval. Proper steps shall be taken to have a uniform temperature in all enclosures, with utmost care for noise level to be within tolerance limit

6.1.2

All instruments required for testing/balancing etc. of the air distribution system shall be provided by vendor.

7.

DATA TO BE FURNISHED BY VENDOR AFTER THE AWARD OF CONTRACT

7.1

Fabrication drawings of ducts and grilles, louvers, dampers, etc, including typical details of grilles dampers etc.

7.2

Test certificates in line with scope of inspection.

7.3

Other dimensional drawings & documents as may be required by purchaser for better understanding of the system & for preparation of operation, maintenance & instruction manual.



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- | | | |
|----|--|--|
| 1) | General (List of areas) | As per schedule/tender drgs of Ventilation system. |
| 2) | i) GSS Duct Work | |
| | a) Type | Zinc coating (Refer Section-C of Specific Technical Requirement) |
| | b) 1.25 mm thk ducting | Bidder to estimate as per Drawings/sketch |
| | c) 1.0 mm thk ducting | Separately for Ventilation system. |
| | d) Any other size | (area wise) |
| | e) Battery Room ducting. sides. | MS with epoxy painting on both sides. |
| 3) | Special painting epoxy | MS Ducts in Battery Room to be painted. Both interior & exterior) |
| 4) | Thermal Insulation | Required in duct for vent. System exposed to Sun only (furnished by Cement sand plaster) |
| 5) | SA grilles (for each size) (SQ.M) schedule/tender | To suit airflow as per drgs. |
| 6) | Exhaust Gravity/Manual relief dampers (for each size & to maintain a slight positive pressure inside.) | -do- |
| | a) Frame | 1.6mm M.S. |
| | b) Louver | 0.8mm Al. |

NOTE:

- 1) Ducting shall be as per IS-655 standard.
- 2) Opposed blade type volume control damper (gang operated) shall be provided at each supply air grilles.
- 3) Bidder to provide suitable gasketing at each duct flange.(Asbestos shall not be used).
- 4) Supply Air Grills shall have 2 (two) set of adjustable louvres.
- 5) Bidder to indicate unit rates for variable items like ducting, grilles with & without volume control damper, gravity damper, thermal insulation, etc.
- 6) Grilles, frames & louvres shall be of at least 18 SWG sheet and 20 SWG MS respectively.



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- 6) Fire damper shall be solenoid operated in accordance with NFPA. The solenoid shall be charged during open condition and shall be de-energising to close.
- 7) Access door in ducting system shall be provided as required.
- 8) MS Angle (painted) shall be used only as duct supports.
- 9) Velocity thru duct shall not exceed 12 M/sec for Ventilation system.
- 10) All exhaust/return air grilles shall have one set of louvres in the front or thick rat-proof wire net guards.



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1.0 GENERAL

This specification covers the design, material, constructional features, manufacture, assembly, inspection and testing at manufacturer's of his subcontractor's works, suitable painting requirements of centrifugal pumps and drives complete with all accessories as specified hereinafter.

2.0 CODES AND STANDARDS

2.1 The design, manufacture, inspection, testing & performance of the pumps as specified hereinafter, shall comply with the requirements of the latest revision of the following standards as indicated below (as applicable):

- a) IS-1520 :Horizontal centrifugal pumps for clear, cold and fresh water
- b) IS-5120 :Technical requirements - Rotodynamic special purpose pump
- c) IS-1710 :Vertical turbine pumps for clear, cold and fresh water
- d) Hydraulic Institute Standards of USA
- e) BS - 599 :Method of testing Pumps
- f) PTC - '6' :Centrifugal Pumps Power test code
- g) API - 610

Wherever standards for certain aspects materials etc., not mentioned, the same shall be as per the applicable Indian or International standards.

2.2 In case of any conflict between the above codes/standards and this specification, the later shall prevail and in case of any further conflict in this matter, the decision of Purchaser's engineer shall be final and binding.

3.0 DESIGN REQUIREMENTS

3.1 The pumps shall be of heavy duty suitable for long periods of uninterrupted service and shall be standard product of the manufacturer thoroughly proven for satisfactory performance and reliability

3.2 The materials of construction of various components shall be as indicated under Data Sheet-A and where not specified to the applicable Indian/British/American standards.

3.3 All pressure containing components including the pump casing, nozzles and stuffing box housing shall be designed, fabricated and tested in accordance with applicable Indian standards if not specified otherwise.

3.4 The pump shall be suitable for handling the fluid as specified in Data Sheet-A

4.0 CONSTRUCTIONAL FEATURES

4.1 Pump Casing

4.1.1 Pump casing may be axially or radially split or barrel type construction as specified in the pump data specification sheet. The casing shall be designed to withstand the maximum pressure developed by the pump at the pumping temperature.



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4.1.2 Pump casing shall be provided with adequate number of vent and priming connections with valves, unless the pump is made self venting & priming. Casing drain, as required, shall be provided complete with drain valves.

4.1.3 Pump shall preferably be of such construction that it is possible to service the internals of the pump without disturbing suction and discharge piping connections.

4.1.4 Under certain conditions, the pump casing nozzles will be subjected to reactions from external piping. Pump design must ensure that the nozzles are capable of withstanding external reactions not less than those specified in API-610.

4.2 Impeller

Unless specifically indicated under Data Sheet-A enclosed, the pump impellers shall be of closed vane type. The impellers shall be secured to the shaft and shall be retained against circumferential movement by keying, pinning or lock rings. Impellers shall be statically and dynamically balanced individually. The assembled rotor shall be dynamically balanced and checked for eccentricity.

4.3 Wearing Ring

Renewable wearing rings for the casing and/or the impellers and renewable shaft sleeves, shall be provided for all pumps. Length of the shaft sleeves must extend beyond the outer faces of gland packing or seal and plate so as to distinguish between the leakage between shaft & shaft sleeve and that past the seals/gland.

4.4 Shaft

Shaft size selected shall take into consideration the critical speed which shall be away from the operating speed as recommended in applicable Code/Standard. The critical speed shall also be at least 10% away from runaway speed.

4.5 Bearings

Bearings and hydraulic devices (if provided for balancing axial thrust) of adequate design shall be furnished for taking the entire pump load arising from all probable conditions of continuous operation throughout its Range of Operation and also at the shut off condition. The bearing shall be designed on the basis of 20,000 working hrs minimum for the load corresponding to the duty point. Proper lubricating arrangement for the bearings shall be provided. The design shall be such that the bearing-lubricating element does not contaminate the liquid being pumped. Where there is a possibility of liquid entering the bearing, suitable arrangement in the form of deflectors or otherwise shall be provided ahead of bearing assembly. Bearings shall be easily accessible without disturbing the pump assembly.

4.6 Stuffing Boxes

Packed type stuffing boxes of adequate depth with lantern rings shall be provided to minimize the leakage. In all cases where the pump suction is below atmospheric pressure, the shaft packing shall be sealed by the liquid pumped by tapping off from the pump discharge itself and all pipes, valves, fittings etc., required for this shall be furnished by the manufacturer.

4.7 Shaft Couplings



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The pumps shall be directly coupled to their drives through heavy duty flexible coupling. Suitable coupling guards shall be provided along with the coupling. The pump and its drive motor shall be mounted on a common base plate.

4.8 Base Plate and sole Plate

Unless otherwise stated the data specification sheet, a common base plate mounting both for the pump and drive shall be furnished. The base plate shall be of rigid construction, suitably ribbed and reinforced. Base plate and pump supports shall be so constructed and the pumping unit so mounted as to minimize misalignment caused by mechanical forces such as normal piping strain, hydraulic piping thrust, etc. Suitable drain taps and drip lip shall be provided.

If required in the data specification sheet, steel sole plates shall be provided, below the base plate.

4.9 Prime Mover

The drive motor selected shall conform to the requirements of the enclosed motor specifications.

4.10 Lifting arrangement

Each pump and motor shall incorporate suitable lifting attachments e.g. lifting lugs or eye bolts etc., to facilitate erection and maintenance.

5.0 Performance Requirements

5.1 The pump shall be designed to have best efficiency at the specified duty point. The pump set shall be suitable for continuous operation at any point within the Range of Operation as stipulated in the data specification sheets.

5.2 Pump shall have a continuously rising head capacity characteristics from the specified duty point towards shut off point, the maximum being at shut off. Power capacity characteristic will be non-overloading type i.e. 110% of the design flow the power required to drive the pump will be practically the same as that at the design flow.

5.3 Wherever specified in data sheet, pumps of each category shall be suitable for parallel operation. The head vs capacity, input power vs. capacity characteristics, etc., shall match to ensure equal load sharing and trouble free operation throughout the range.

5.4 The pump motor set shall be designed in such a way that there is no damage due to the reverse flow through the pump which may occur due to any malfunction of the system.

6.0 Drive Rating

6.1 The power rating of the drive shall be selected such that a minimum margin of 15% is available over the pump input power required at the rated duty point. However, the drive rating shall not be less than the maximum power requirement at any point within the 'Range of Operation' specified.



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6.2 In cases where parallel operation of the pumps are specified the actual drive rating is to be selected by the bidder considering overloading of the pumps in the event of tripping of one of the operating pumps.

6.3 The bidder under this specification shall assume full responsibility in the operation of the pump and the drive as one unit.

7.0 SCOPE OF INSPECTION AND TESTING

7.1 Castings

7.1.1 Witnessing pouring and thereafter physical testing of castings of 'Critical' nature such as casings, impellers, diffusers.

7.1.2 Identification and correlation with test reports for all tests as per the relevant material specifications for castings of 'Major' nature such as suction bell, discharge elbow, stuffing box, gland, wearing rings, shaft sleeves etc.

7.1.3 Foundry's conformity certificate for castings of 'Minor' nature such as base plates, covers etc.

7.1.4 Verification of heat treatment charts (as applicable)

Note: Casting defects shall not be filled by any method until and unless approved by BHEL/their customer

7.2 Forgings and

7.2.1 Identification and correlation with mill test certificates for all tests as per the relevant specifications for important forgings like casings, stage bodies, diffusers, shaft material.

7.2.2 Verification of heat treatment charts (time temperature) (as applicable).

7.3 Fabricated items

7.3.1 Identification and correlation with mill test certificates for material of items such as discharge bellows, column pipes etc.

7.3.2 Approval of welding procedure specifications and qualifications of weld procedures and personnel.

7.3.3 Dye penetrant tests of weldment as per ASTM E-165 and acceptance norm as per ASME Sec.VIII, Div.1, Appendix 8

7.3.4 Verification of heat treatment charts (time temperature), (as applicable)

7.3.5 Hydro test as per para 7.5.1 below.

Note: For para 7.1.2, 7.2.1 and 7.3.1 above; in case correlating test certificates are not available, material shall be identified by BHEL and physical tests conducted by the supplier in the presence of BHEL



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7.4 In process Inspection and Testing

7.4.1 Dye penetrant testing after machining for impellers including vanes, pump shaft, diffusers as per applicable code; in absence of which, as per ASTM E - 165. No defect shall be permitted on moving parts. On static parts acceptance norms are as per ASME Sec.III NB 2546.

7.4.2 Ultrasonic testing of dynamic duty component, i.e. pump shafts (50mm dia and above) and static duty forgings i.e. Barrel, casting (15mm and above wall thickness) as per applicable code, in absence of which as per ASTM E388 and acceptance norms as stipulated hereunder.

7.4.3 Acceptance norms for UT for dynamic duty components. the following defects are unacceptable :

- Cracks, flakes, seams and laps
- Defects giving indications longer than that from a 4mm equivalent flaw.
- Group of defects with maximum indications less than that from a 4mm equivalent flaw, which cannot be separated at testing sensitivity, if the back echo is reduced to less than 50%.
- Defects giving indications of 2 to 4mm dia. equivalent flaw separated by distance less than four times the size of the larger of the adjacent flaw.

7.4.4 For static duty components - as per NB 2542.2 of ASME Sec. III.

7.4.5 Hydro tests of all pressure parts such as casings, column pipes, discharge elbows etc., at two times duty point pressure or 1.5 time shut off pressure, whichever is higher for 30 min., without any leakage.

Note : In case the pump is required to boost certain pressure, the inlet pressure head shall also be taken into consideration to compute test pressures.

7.4.6 Static and dynamic balancing of individual impellers and also assembled rotors as per V.D.I. 2060 Q 6.3 or ISO 1940 G 6.3.

7.5 Performance Test

7.5.1 Pump testing with unit supply motor as per specifications and acceptance norms cited elsewhere, in absence of which as per IS 5120 latest edition. Performance shall be checked for minimum of 7 points (including shut off head and over load) following characteristics shall be checked:

Capacity V/s Head

Capacity V/s Power absorbed by pump

Capacity V/s pump efficiency

Note : For pump of fire protection system, performance test shall be conducted up to 150% of rated capacity

7.5.2 NPSH test in case specifically mentioned elsewhere



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7.5.3 Vibration and noise level measurement. Acceptance norms shall be as per manufacturers standards.

7.5.4 Overall dimensions as per GA drawings

7.5.5 Examination after selective opening up after running for pumps operating at speed over 1800 rpm and capacity exceeding 68M3/hr.

7.5.6 Painting and packing as per technical specification.

7.6 Test at site

The pumps will be tested at site by the purchaser to verify their performance. If the pumps fail to operate smoothly or within the required performance all such deficiencies shall be rectified by the manufacturer by making suitable alternatives in the pump set and additional tests required to show the effect of such alterations shall be performed by him.

7.7 Performance Guarantee

The vendor shall guarantee the material and workmanship of all components as well as the operation of the pump as per requirement of this specification.

The vendor shall also guarantee for each pump the total dynamic head at the specified rated capacity and also corresponding efficiency, brake horse power and shut off head.

8.0 CLEANING, PROTECTION & PAINTING

Before shipment of the equipment to be supplied under this specification the necessary cleaning, flushing etc., as per manufacturers standard shall be done to remove all dirt, scales etc. Shop coats of rust inhibiting paints, lacquers etc., shall be applied to various parts as necessary. Flanges, inlet and outlet pipe, etc shall be protected.

9.0 DRAWINGS, TECHNICAL DOCUMENTS AND OTHER INFORMATION REQUIRED WITH THE PROPOSAL

9.1 Fully dimensioned outline GA drawings of the pump motor assembly unit for each type and size offered. This drawing should include:-

- i) Foundation base plate and sole plate details as applicable
- ii) Civil foundation and anchor bolts details and loading data
- iii) Minimum submergence required for the pump (if applicable)

9.2 Cross sectional drawing of the equipment showing the details of assembly of components and their material of construction with standard applicable codes.

9.3 Performance characteristics (Discharge capacity vs head, BHP and efficiency of the pumps.



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- 9.4 Motor speed torque curve superimposed on pump speed torque curve. Required NPSH of pump.
- 9.5 Experience list about the supply and successful operation of similar pumps for similar application.
- 9.6 A comprehensive write up or brochure on the details of manufacturing and testing facilities in the shop of the manufacturer.
- 9.7 Quality plan for the equipment being offered, in BHEL format as practiced in the manufacturer's works and Field Quality Plan for receipt, storage erection, commissioning & testing at site.
- 9.8 Data sheet-B with all the particulars filled in.

10.0 DRAWINGS AND DATA AFTER AWARD OF CONTRACT

The vendor shall furnish the drawings and other technical documents as required in Data Sheet-C enclosed with this specification

10.1 MANUFACTURERS NAME AND TAG. PLATES

Each pump shall have a permanently attached brass/metal tag on the body indicating the following information both in Hindi and English.

- a) Manufacturer's name and trade mark
- b) Design Capacity and Head
- c) Design
- d) Purchaser's tag no. as furnished during the contract. The purchaser's tag no. will be indicated by the Purchaser on the drawing submitted for approval by the vendor.

11.0 DRAWINGS/DOCUMENTS TO BE FURNISHED BY VENDOR AFTER THE AWARD OF CONTRACT.

- 11.1 Certified GA drawings of pump motor assembly weights, crane
- 11.2 Detailed cross sectional drawings of the pump and motor assembly and all equipment & accessories supplied under the this specification along with details of material of construction with applicable standard codes
- 11.3 Foundation drawings with details of foundation pocket indicating static as well as dynamic load and other data with dimensions.
- 11.4 Certified characteristics curves (discharge capacity vs. head, BHP and efficiency) of each type of pump and motor.
- 11.5 Material and other test certificates as required by the application clauses of this specification.
- 11.6 Motor speed torque curves super imposed on pump speed torque curves.
- 11.7 Quality plan along with complete details of testing and inspection requirements of centrifugal pumps in BHEL format. Vendor shall also furnish Field Quality Plan.



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11.8 Installation , operation and maintenance manual.

11.9 Other drawings and data, if necessary.



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<u>S.No.</u>	<u>DESCRIPTION</u>	<u>DETAILS</u>
1)	Designation	Air washer Pumps.
2)	Type	Horizontal Centrifugal Type.
3)	Quantity	As per section-C
4)	Installation	On floating type foundation inside Air
Washer		Room
5)	Fluid to be handled	Filtered Water.
6)	Temperature of Fluid	To suit.
7)	Capacity Cum/Hr TDH at	To suit system requirements however head shall Not be less than 35 MWC.
8)	Duty	-----Continuous (24Hr./day)-----
9)	Suction condition	-----Flooded-----
10)	Type of drive	Direct (flexible coupling)
11)	Type of prime mover	LV Ac Motor.
12)	Maximum speed	Not more than 1500 RPM
13)	Type of lubrication	Grease Lubrication

MATERIALS OF CONSTRUCTION

<u>S.No.</u>	<u>DESCRIPTION</u>	<u>DETAILS</u>
a)	Impeller	Bronze
b)	Pump Shaft	Carbon Steel C-45, IS-1570 or class-IV, IS- 1875
c)	Casing	Cast Iron, grade-20, IS- 210
d)	Wearing ring	Bronze
e)	Shaft Sleeve	Bronze
f)	Base Plate/frame	Cast Iron to Grade FG-200 IS-210/fabricated Mild steel



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- | | | |
|-----------|---------------------|--|
| g) | Counter Flanges | Mild Steel |
| h) | Stuffing box bush | Deep Bronze packing to be renewable with Case. |
| i)
not | Stuffing box gland | Flexible graphite or PTFE (Asbestos shall be used) |
| j) | Pump Motor Coupling | Pin & Bush type (Flexible) |
| k) | Bolt and Nuts | MS |

15) **ACCESSORIES REQUIRED**

The following accessories shall be provided by the bidder for each pump.

- | | | |
|----|--|-----|
| a) | Priming funnel | Yes |
| b) | Drain piping upto
Common drain point. | Yes |
| c) | Vent | Yes |
| d) | Suction & Discharge
Pressure gauges | Yes |
| e) | Companion flanges | Yes |
| f) | Common base plate | Yes |
| g) | Suction strainer. | Yes |
| h) | Isolating valve. | Yes |
| i) | NRV at pump outlet at inlet/outlet | Yes |
| j) | Any special requirements | Yes |
| k) | Inspection & Testing | Yes |



**STANDARD TECHNICAL
SPECIFICATION
FOR
AIR FILTER**

SPECIFICATION NO.PES-554-04

VOLUME II B

SECTION D

REV. 02

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**STANDARD TECHNICAL SPECIFICATION
FOR
AIR FILTER**



**STANDARD TECHNICAL
SPECIFICATION
FOR
AIR FILTER**

SPECIFICATION NO.PES-554-04

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1. GENERAL

This specification covers the design, manufacture, inspection and testing at manufacturer's work or his sub-contractor's works of Air filters to be used for air-conditioning and ventilation system:

2. CODES AND STANDARDS

This design, manufacture and performance of AIR FILTERS shall comply with all currently applicable statutes, regulation and safety codes in the locality where the equipment will be installed. The equipment shall also conform to latest applicable Indian/British/USA standards. Nothing in this specification shall be construed to relieve the vendor of this responsibility. The following standards, in particular, shall be applicable for certified ratings of filters and for conducting performance test, if required.

a) BS EN - 779 -Methods of test for air filters used in air conditioning and general ventilation.

3. GENERAL

The enclosed Data sheet A gives the type and other particulars of filters required.

3.1 POLY FIBRE AIR FILTERS

Filtering media shall consist of a suitable fibrous material (e.g. polyethylene extruded sections coir etc.) packed into a 20 gauges GSS framework, complete with handles etc. The filter element shall be supported by galvanised steel wire mesh of 10mm. sq. on either side, Velocity across the filters shall not exceed 2.5 M/sec. Average efficiency E_m (%) shall be ≥ 80 as per BS EN - 779..

3.2 DRY FABRIC AIR FILTERS

Filter element shall be pressed felt filter fabric or suitable material recommended by the manufacturer, stitched on to galvanised wire gauge support and crimped to form deep folds. Suitable aluminium spacers shall be provided to ensure uniform distribution of air flow through filters. Filter casing shall be provided with neoprene sponge rubber sealing, The filter shall have Average efficiency E_m (%) of ≥ 95 as per BS EN - 779.

3.3 PANEL TYPE METALLIC FILTERS (DRY/VISCOUS)

Filter shall consist of V-fold galvanised wire mesh interspaced with flat layers of galvanised wire mesh. The density of media shall increase in the direction of air flow. Edges of wire mesh shall be suitably hemmed to prevent abrasion during handling. The media shall be supported on either side by galvanised expanded metal casing. The framework shall be at least 18 gauge GSS. Filter shall be either dry or wetted type as per data sheet=A. The oil shall be mineral oil of approved quality and make. As a the filter frame made of Aluminium alloy conforming to IS:737 can be considered unless use of aluminium is prohibited otherwise due to site conditions being saline/corrosive.

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All filters shall be capable of being cleaned of their accumulated dust by tap water flushing. The dry metallic filter shall have Average arrestance Am (%) shall be ≥ 90 . However oil wetted air filters shall have Average Efficiency Em (%) ≥ 90 as per BS EN - 779..

3.4

ABSOLUTE FILTERS (HEPA)

Filters shall be constructed by pleating a continuous sheet of filter medium into closely spaced pleats separated by heavy corrugated aluminium spacers. They shall be individually tested and certified to have an efficiency of not less than 99.97% when tested with 0.3 micron dioctylphthalate smoke as per IS:2831. The clean filter initial static pressure drop shall not be greater than 25mm WC at rated capacity. A neoprene sponge rubber sealing shall be provided on either face of filter frame.

3.5

WATER REPELLANT NYLON FILTERS

This shall be constructed of water repellent nylon fabric with continuous water spraying on it from a header for keeping it clean. Efficiency of this filter shall be 85% down to 10 microns. This filter shall be used for unitary air filtration system only.

4.

INSPECTION & TESTING

The scope of inspection for air filters shall be as below:

List of TCs arranged as per Approved Quality Plan shall be furnished along with copy of TCs at the time of inspection by BHEL.

4.1.1

Dimensional inspection of frame & filter media – TC from Manufacturer- review by BHEL/Customer.

4.1.2

Witnessing by BHEL/Customer of type tests on one per type per size air filters for the following properties.

a)

Gravimetric efficiency.

b)

Pressure drop in clean & dirty (choked - %age to be specified) condition.

c)

Efficiency as per BS EN - 779.

4.1.3

Verification of type test certificates for similar type & size of filters for sodium flame test as per BS-3928 (if applicable- refer data sheet) - by BHEL/Customer

5.

DATA TO BE FURNISHED BY VENDOR AFTER AWARD OF CONTRACT

5.1.1

GA Drawing

5.1.2

Drawing showing material/construction detail

5.1.3

Installation and\service manual

5.1.4

Rating curves/charts

5.1.5

Test certificates

Elect. diagrams (when automatic cleaning type)



**AIR FILTER
DATA SHEET - A**

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Description

Data

1) General

1.1 Service	Ventilation system .
1.2 Location	Main power house bldg. & Blower room of both the unit.
1.3 Nos.	Refer Section 'C' of Specification.
1.4 Total air flow/type	Refer Section 'C' of Specification.
1.5 Temperature	As per project information.
1.6 Relative Humidity	100%
1.7 Gas Composition	Atmospheric Air (Dusty) as prevalent in power station.
1.8 Filter Media	Synthetic non woven
1.9 Efficiency	Average arrestance efficiency of 65-80 % for Dry panel filter (pre-filters) and average arrestance efficiency of 80-90 % for fine filters.
1.10 Allowable pressure drop	2.5 mm & 6.5 mm in clean and dirty condition respectively for dry panel filters (pre filters). 12 mm in clean condition for fine filters.
1.11 Frame Work	18 G, GSS.
1.12 Mounting	Ladder Type M.S Angles (galvanised)
1.13 Size	600 x 600 mm

Note:-

- 1) Face velocity of air across the filters shall not exceed 2.5 m/sec.



**STANDARD TECHNICAL
SPECIFICATION
FOR
THERMAL INSULATION FOR COLD
SURFACES**

SPECIFICATION NO.PES-554-06

VOLUME II B

SECTION D

REV. 01

DATE: NOV 2012

SHEET 1 OF 5

**STANDARD TECHNICAL SPECIFICATION
FOR
THERMAL INSULATION FOR COLD SURFACES**

बी.एच.ई.एल. 	TECHNICAL SPECIFICATION THERMAL INSULATION FOR COLD SURFACES	SPECIFICATION NO.PES-554-06	
		VOLUME II B	
		SECTION D	
		REV. 01	DATE: NOV 2012
		SHEET 2 OF 5	
1.	SCOPE	This specification covers design, manufacture, testing at manufacturers works, supply, application & finishing of insulation for cold piping, air conditioning ducting & equipment for low temperature service.	
2.	CODES & STANDARDS	The design, manufacture and performance of materials covered under this specification shall comply with all currently applicable statues, regulations & safety codes in the locality where the equipment/material are to be installed. The material shall also conform to the latest applicable Indian/British/American codes & standards. Nothing in this specification shall be construed to relieve the vendor of his responsibility. In particular, the material shall conform to the latest editions of the following standards :-	
2.1.1	IS:3069 :	Glossary of terms & symbols & units relating to thermal insulation materials.	
2.1.2	IS:4671 :	Expanded polystyrene for thermal insulation purposes.	
2.1.3	IS:3677 :	Mineral wool for thermal insulation	
2.1.4	IS:8183 :	Resin bonded mineral wool	
2.1.5	IS:702		
3.	DESIGN REQUIREMENTS		
3.1.1	The insulating material as well as protective covering shall be new & unused, non-corrosive, vermin/rodent proof and shall be guaranteed to withstand continuously & without deterioration the maximum/minimum temperatures to which they may be subjected to, under specified site conditions.		
3.1.2	The insulation material must be light weight, strong, free from shots & coarse fibre & shall provide high insulation efficiency at low weight & coat. It should be non-hygroscopic & should not rot. It shall not settle or shake down even when subjected to prolonged vibrations.		
3.1.3	The insulation material, density and thickness etc. Shall be as specified in DATA SHEET A.		
4.	APPLICATION DETAILS		
4.1.1	The surface to be insulated shall be thoroughly cleaned and allowed to dry. Pressure/hydrostatic tests, if any, shall be carried out before application of insulation.		
4.1.2	A layer of solvent free, anticorrosive paint shall be applied & allowed to dry.		
4.1.3	Hot industrial bitumen of grade 85/40 or 85/25 conforming to latest IS:702 shall be uniformly applied @ 1.5 kg/sq.m on the surface to be insulated. A similar layer shall also be applied on the inside surface & edges of the insulation. A suitable cold adhesive compound may also be used in place of bitumen.		

	TECHNICAL SPECIFICATION THERMAL INSULATION FOR COLD SURFACES	SPECIFICATION NO.PES-554-06	
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4.1.4

Insulation in the form of pipe sections/rolls slabs of specified density & thickness shall be stuck to the coated surface with joints staggered & well butted & secured. The adjoining sections shall be tightly pressed together. All the joints shall be sealed with bitumen/equivalent adhesive. Voids if any shall be packed with suitably cut pieces of insulation material.

4.1.5

In case of double layer application both circumferential & longitudinal joints shall be suitably staggered.

5.

VAPOR SEALING & INSULATION FINISH

The insulation shall be treated for vapor sealing & weather proofing & finished as specified in DATA SHEET A The acceptable types of finishes are outlined below:-

5.1

FINISHING SYSTEM I: EXTERNAL INSULATION WITH PLASTER FINISH

5.1.1

A thick vapor seal of hot bitumen @ 2.5 kg/Sqm shall be applied on the outer surface of insulation & allowed to dry.

5.1.2

The surface shall then be wrapped with 20mm (3/4"_ hexagonal mesh of 24 SWG GI wire, butting all the joints & laced down with 22 SWG GI lacing wire.

5.1.3

12.5mm (1/2 inch) thick sand cement plaster in the ratio of (1:1) shall be applied in two layers, the second layer being brought to a smooth finish. A water proofing compound shall be added to the cement before its application.

5.2

FINISH SYSTEM II: EXTERNAL INSULATION WITH PLASTER FINISH OVER POLYTHENE.

5.2.1

The insulation shall be covered with 500 g polythene/polythene bonded Hessians (PBH) with 50mm overlap on longitudinal & circumferential joints. Overlaps shall be sealed with synthetic adhesive in case o-f polythene & liberal coat of bitumen in case of PBH:

5.2.2

The surface shall then be wrapped with 20mm (3/4") mesh of 24 SWG GI wire butting all the joints & laced down with 22 SWG GI lacing wire.

5.2.3

12.5mm thick (1/2 inch) sand cement plaster in ratio of(4:1) shall be applied in two layers, the second layer being brought to a smooth & even finish similarly as described above.

5.3

FINISH III:EXTERNAL INSULATION WITH SHEET METAL FINISH

5.3.1

The insulation shall be covered with 500g polythene with 50mm overlaps at joints which shall be sealed with synthetic adhesive or equivalent compound.

5.3.2

The polythene shall be covered with 24 gauge GI/aluminum sheet

5.3.3

25mm wide x 22 SWG GI/aluminum peripheral straps shall be fixed over the GI/aluminum sheet at 300mm centres to secure.

5.4

FINISH IV: EXTERNAL INSULATION WITH PLASTER & WATER PROOFING COMPOUND

For ducts & piping exposed to atmosphere, the finish shall be as follows:

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5.4.1

A thick vapor seal of hot bitumen at 2.05 kg/sq.m shall be applied on the outer surface of insulation & allowed to dry.

5.4.2

The surface shall then be wrapped with 20mm (32/4") hexagonal mesh of 24 SWG GI Wire butting all the joints & laced down with 223 SWG GI lacing wire.

5.4.3

12.5mm thick (1/*2 inch) sand cement plaster in ratio of (4:1) shall be applied in two layers, the second layer being brought to a smooth finish with water proofing compound added to the cement.

5.4.4

3mm (1/8") thick coat of water proofing compound shall be applied & wrapped with fibre glass RP tissue. A final coat of 3mm thick water proofing compound shall then be applied over the fiberglass RP tissue & allowed to dry. Alternatively, in place of water proofing as desired above, tar felt type 3 grade 1 of IS 1322 with joints overlapped by 75mm shall be fixed & sealed with bitumen & over this 24 SWG. 25mm hexagonal GI mesh shall be fixed with 22 swig. GI lacing wire & finally bitumen paint shall be applied over wire netting.

6.

INSULATION OF PUMPS & VALVES

For all inspection covers & hatches on equipment, pump casing & valve bodies, flanges etc. the insulation shall be applied such as to facilitate removal with minimum damage to the insulation. This shall be achieved by encasing the insulation in 22 gauge aluminum sheet metal boxes, which shall be bolted together around the equipment to permit easy removal & replacement. Proper care shall be taken to maintain continuity of vapor seal between the static & removable partitions of the insulation.

The tenderer may offer thickness of insulation & finishes other than that specified in DATA SHEET A. However, calculations/reasons in support of alternative proposal shall be furnished for purchaser’s approval.

7.

INSPECTION & TESTING (REFER SPEC. NO - PES-553.00)

All necessary tests, as required to ensure that the material supplied conform to the requirements of applicable codes & standards, shall be carried out at manufacturer’s works & test certificates including these for material/accessories shall be furnished for purchasers approval.

8.

PAINTING

8.1.1 Pipe work having insulation & cladding shall be provided with color identification for the fluids handled and for indicating direction of flow.

8.1.2 Equipment surfaces having insulation and cladding shall also have identification numbers and any other relevant data provided on the insulated surface.

8.1.3 All painting for insulated surfaces shall conform to the requirement specified elsewhere.

9.

DATA TO BE FURNISHED AFTER AWARD OF CONTRACT

9.1.1 Final version of data sheet ‘B’ incorporating changes if any along with design data.

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9.1.2	Test certificates/reports giving result of insulation to ensure conformance to applicable codes & standards & in particular the following :- i) Thermal conductivity test ii) Sound absorption coefficient test iii) Corrosion test iv) Sulphur content, moisture content, shot content, moisture absorption etc. v) Compressive strength & cross breaking strength test.		
9.1.3	Sketches/technical literature/sectional drgs. indicating insulation materials finish and method of application etc.		
9.1.4	Manual dealing with safety aspects & instructions for combating fire arising out of insulation work		
9.1.5	Instructions on maintenance of insulation work.		



INSULATION
DATA SHEET - A

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INSULATION MATERIAL :

Insulation	Code	Thermal Conductivity MW/cm °C	Density Kg/m ³
Resin bonded mineral wool / glass wool	IS:8183	0.49 at 50 °C	At least 24 (For Thermal Insulation) 48 for Acoustic insulation
Mineral Wool Pipe Section (min. Gr.2)	IS:9842	0.43 at 50 °C	At least 81
Expanded Polystyrene	IS:4671	0.37 at 50°C	At least 15

TYPE OF INSULATION :

S.No.	Surface	Insulation Material	Insulation Form	Thickness (mm)
i)	Supply & Return air duct for air-conditioning system	Resin bonded Glass Wool (IS:8183)	Roll / Slab	50
ii)	Refrigerant Piping	a) Expanded Polystyrene or b) Mineral Wool	Pipe Section Pipe Section	75 75
iii)	AHU drain pipe (Suction & Liquid line)	a) Expanded Polystyrene or b) Mineral Wool	Pipe Section Pipe Section	25 25
iv)	AHU casing and condensate pan	a) Expanded Polystyrene or b) Mineral Wool	Slabs Slabs	25 25
v)	Chilled water piping, valves & specialties	a) Expanded Polystyrene or b) Mineral Wool	Pipe Section Pipe Section	75 75
vi)	Chiller	a) Expanded Polystyrene or b) Mineral Wool	Slabs Slabs	100 100
vii)	Chilled Water Pumps	a) Expanded Polystyrene or b) Mineral Wool	Slabs Slabs	50 50
viii)	Expansion tank with pipe	a) Expanded Polystyrene or b) Mineral Wool	Slabs/Pipe Section Slabs/Pipe Section	50 50



INSULATION
DATA SHEET - A

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ix) Acoustic insulation of Duct

Glass Wool

Slab

25

	1x660MW BHUSAWAL TPS VENTILATION SYSTEM LIST OF MAKES OF SUB-VENDOR ITEMS	SPECIFICATION NO. PE-TS-415-554-A001	
		SECTION : I	
		SUB-SECTION : E	
		REV 00	

ANNEXURE-I

LIST OF MAKES OF SUB-VENDOR ITEMS

SL No	ITEM	VENDOR
1	AIR WASHER & UAF*	HYDERABAD POLUTION CONTROL
		SK SYSTEM
		ADVANCE VENTILATION
		DRAFT AIR
		BLUE STAR
		VOLTAS
		STERLING WILSON
		ROOTS COOLING SYSTEM
		C DOCTOR
		TAP
		Pack Plast
		Industrial projects and products
2	CENTRIFUGAL FAN	FLAKT
		KRUGER
		DRAFT AIR
		HYDERABAD POLUTION CONTROL
		ADVANCE VENTILATION
		PATEL AIR
		NICOTRA
		SK SYSTEM
		MARATHON
		CB DOCTOR
		SARLA
		Comefri
3	FRESH AIR/ SUPPLY/ EXHAUST/ RE UNIT FANS / PROPELLAR	HYDERABAD POLUTION CONTROL
		SK SYSTEM
		ADVANCE VENTILATION
		KRUGER
		NICOTRA
		MARATHON
		FLAKT
		CB DOCTOR
		SARLA (SITAL)
		PATEL AIR
		KHAITAN
4	PUMPS	BEST & CROMPTON
		JYOTI
		SAM TURBO
		KBL
		KSB

		M&P
		VOLTAS
		BEACON-WEIR
		WORTHINGTON
		Flowmore
		SULZER PUMPS INDIA LTD.
		BHARAT PUMPS & COMPRESSORS LTD
		FLOWSERVE INDIA CONTROL PVT LTD
		V-FLOW PUMPS & SYSTEMS CO
		Kishore pumps
5	LV MOTORS (FLAME PROOF)	As per Annexure I of sub section C3 Technical specification of Electrical portion
6	LV MOTORS (NON FLAME PROOF)	
7	AIR FILTER	PUROLATOR
		FMI
		ANFILCO
		TENACITY
		JOHN FOWLER
		SPECTRUM
		AIR TECH
		PUROMATIC
8	INSULTATION MATERIAL	BEARDSHEL
		K-FLEX
		PARAMONT
		ARMAFLEX
		SUPREME

		LLOYDS
		UP TWIGA
		AEROCELL
9	FIRE DAMPER	TSC
		CARRYAIRE
		RAVISTAR (SYSTEM AIR)
11	BUTTERFLY VALVES	Audco
		Fouress Engg
		INTER VALVE
		BDK
		WEIR BDK
		TYCO
		CRANE PROCESS
		KEystone
		Fluidline
		INSTRUMENTATION LTD
		R and D MULTIPLES (METAL CAST) PVT LTD
		SURYA VALVES AND INSTRUMENTS MFG CO
		PENTAIR VALVES AND CONTROLS INDIA PRIVATE LIMITED
		UPADHAYA VALVES MANUFACTURERS PRIVATE LIMITED
		VENUS PUMPS AND ENGG. WORKS
12	NON RETURN VALVE	Leader Valves
		H SARKAR
		Fluidline
		HI-TECH
		CRESCENT VALVES
		A V VALVES
		Bankim
		SHIVADURGA
		SURYA VALVES AND INSTRUMENT MANUFACTURING
		ATAM VALVES
		GM DAULI & SONS
		KBL
		VENUS PUMPS AND ENGINEERING WORKS
13	STEEL GATE/GLOBE/NR VALVES(WATER SYSTEM)	CRESCENT VALVES
		BDK
		Audco
		Fouress Engg
		KIRLOSKAR BROTHERS LTD.
		SANT VALVES

		BOMBAY METAL & ALLOYS
		Bankim
		Leader Valves
		H SARKAR
		AV Valves
		VENUS PUMPS
		Fluidline
14	STEEL GATE/GLOBE/NR VALVES(WATER SYSTEM)	HI –TECH
		SHIVADURGA
		SURYA VALVES AND INSTRUMENT MANUFACTURING
		ATAM VALVES
		GM DAULI & SONS
		KBL
15	Pipes (MS/GI) - ERW	SURYA ROSHNI
		TISCO
		DADU PIPES
		INDUS TUBES
		WELSPUN
		TATA
		BST
		JINDAL
		SAIL
		PSL
		LALIT PROFILE
		SAMSHI PIPE INDUSTRIES
		S MUKUT PIPES
		MANN INDUSTRIES
		SURENDRA ENGINEERING
		PRATIBHA PIPES AND STRUCTURES PVT LTD
		JCO GAS PIPES
		NUKAT TANK AND VESSELS
		GOODLUCK TUBES
		ADVANCE STEEL TUBES
		BIHAR TUBES
		HITECH PIPES
		RATNAMANI
		MAHARASHTRA SEAMLESS
16	GI SHEETS FOR DUCTING	TISCO
		INDIAN IRON & STEEL CO
		RASHTRIYA ISPAT NIGAM LIMITED
		ESSAR
		ISPAT INDUSTRIES

		JSW
		LLOYDS
		Bhushan steels
		TATA
		SAIL
		JINDAL
17	GRILL/DIFFUSER/VOLUME CONTROL DAMPER	AIR FLOW
		TSC
		AIR MASTER
		CARRYAIRE
		RAVISTAR (SYSTEM AIR)
18	HUMID STAT	JHONSON CONTROL
		HONEYWELL AUTOMATION
		PENN
19	Y / POT STRAINER	MULTITEX
		GREAVES COTTON
		JAYPEE
		SANT VALVES
		OTOKLIN
		GRAND PRIX
		GUJARAT OTOLIFT
		DS ENGG
		SAROJINI ENTERPRISE
		BHATIA ENGINEERING
		FILTRATION ENGINEERS INDIA PVT LTD
		SUNGOV ENGINEERING

NOTES:

1. *Designed by Hyderabad Pollution Control / SK SYSTEM/ ADVANCE VENTILATION / DRAFT AIR/BLUE STAR/ VOLTAS/ STERLING WILSON/ROOTS COOLING SYSTEM/ C DOCTOR/ TAP/ Pack Plast/ Industrial projects and products & fabricated by their approved fabricator.

2. THE SUB VENDOR LIST ABOVE IS INDICATIVE ONLY AND IS SUBJECT TO BHEL AND CUSTOMER APPROVAL DURING DETAILED ENGINEERING STAGE WITHOUT ANY COMMERCIAL & DELIVERY IMPLICATION TO BHEL. BIDDER TO PROPOSE SUB VENDOR WITHIN 4 WEEKS OF PLACEMENT OF LOI. THEREAFTER NO REQUEST FOR ADDITIONAL SUB-VENDOR SHALL BE ENTERTAINED.

3. THE INSPECTION CATEGORY WILL BE INTIMATED AFTER AWARD OF CONTRACT BY BHEL/CUSTOMER. HOWEVER THE SAME WILL BE ADHERED BY THE BIDDER WITHOUT ANY COMMERCIAL AND DELIVERY IMPLICATION TO BHEL/ CUSTOMER.

	1x660MW BHUSAWAL TPS VENTILATION SYSTEM MANDATORY SPARE LIST	SPECIFICATION NO. PE-TS-415-554-A001	
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ANNEXURE-II
MANDATORY SPARE LIST
(REFER SUGGESTIVE PRICE FORMAT)



**1x660MW BHUSAWAL TPS
VENTILATION SYSTEM
PAINTING & COLOUR SCHEME**

SPECIFICATION No: PE-TS-415-554-A001

SECTION : I

SUB-SECTION : E

REV 00

SHEET 1 OF 1

SECTION-I

SUB SECTION E

ANNEXURE-III

**PAINTING & COLOUR SCHEME
(PLEASE REFER SECTION C2-C)**

	1x660MW BHUSAWAL TPS VENTILATION SYSTEM LIST OF TOOLS & TACKLES	SPECIFICATION No: PE-TS-415-554-A001	
		SECTION : I	
		SUB-SECTION : E	
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ANNEXURE-IV
LIST OF TOOLS & TACKLES
(REFER SUGGESTIVE PRICE FORMAT)



**1x660MW BHUSAWAL TPS
VENTILATION SYSTEM
DRAWINGS / DOCUMENTS SUBMISSION
PROCEDURE**

SPECIFICATION No: PE-TS-415-554-A001

SECTION : I

SUB-SECTION : E

REV 00

SHEET 1 OF 1

SECTION-I

SUB-SECTION-E

ANNEXURE-V

**DRAWINGS / DOCUMENTS SUBMISSION PROCEDURE
(COVERED UNDER SUB-SECTION C2-B)**

	1x660MW BHUSAWAL TPS VENTILATION SYSTEM MASTER DRAWING LIST WITH SCHEDULE OF SUBMISSION	SPECIFICATION No: PE-TS-415-554-A001	
		SECTION : I	
		SUB-SECTION : E	
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SECTION-I

SUB-SECTION-E

ANNEXURE-VI

**MASTER DRAWING LIST WITH SCHEDULE OF
SUBMISSION**

	1x660MW BHUSAWAL TPS VENTILATION SYSTEM MASTER DRAWING LIST WITH SCHEDULE OF SUBMISSION	SPECIFICATION No: PE-TS-415-554-A001	
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S. NO.	DRAWING NO	DRG./ DOC. TITLE	SCH. WEEK (FROM DATE OF LOI)
1	PE-V0-415-554-A001	INSPECTION CATEGORISATION PLAN CUM SUB VENDOR LIST FOR VENTILATION SYSTEM	4
2	PE-V0-415-554-A002	QUALITY PLAN OF AIR WASHER & UAF FOR VENTILATION SYSTEM	12
3	PE-V0-415-554-A003	QUALITY PLAN OF CENTRIFUGAL PUMPS FOR VENTILATION SYSTEM	12
4	PE-V0-415-554-A004	QUALITY PLAN OF CENTRIFUGAL FANS FOR VENTILATION SYSTEM	13
5	PE-V0-415-554-A005	QUALITY PLAN OF AXIAL FLOW FANS & RE UNITS FOR VENTILATION SYSTEM	14
6	PE-V0-415-554-A006	QUALITY PLAN OF MOTOR FOR VENTILATION SYSTEM	15
7	PE-V0-415-554-A008	VENTILATION FAN SCHEDULE.	22
8	PE-V0-415-554-A009	DATA SHEET & GA FOR AIR WASHER & UAF ALONGWITH FAN AND PUMP WITH FOUNDATION DETAILS FOR VENTILATION SYSTEM	12
9	PE-V0-415-554-A010	DATA SHEET & GA FOR ROOF EXTRACTOR, AXIAL EXHAUST AND SUPPLY AIR FANS WITH FIXING ARRANGEMENT FOR VENTILATION SYSTEM	12
10	PE-V0-415-554-A011	DATA SHEET & GA FOR VALVES AND STRAINER FOR VENTILATION SYSTEM	8
11	PE-V0-415-554-A012	DATA SHEET FOR INSULATION FOR VENTILATION SYSTEM	8
12	PE-V0-415-554-A013	DATA SHEET & GA FIRE DAMPER FOR VENTILATION SYSTEM	8
13	PE-V0-415-554-A014	DATA SHEET FOR INSTRUMENTS (PRESSURE GAUGE, TEMP GAUGE, LEVEL GAUGE, PRESSURE SWITCH, LEVEL SWITCH) FOR VENTILATION SYSTEM.	14
14	PE-V0-415-554-A015	DATA SHEET OF PIPE FOR VENTILATION SYSTEM	5
15	PE-V0-415-554-A016	DATA SHEET OF GI AND MS SHEET FOR VENTILATION SYSTEM	5
16	PE-V0-415-554-A017	DATA SHEET & GA FOR PRE AND FINE FILTERS FOR VENTILATION SYSTEM	8
17	PE-V0-415-554-A018	DATA SHEET FOR MOTORS (A/W Fan, A/W pumps, UAF Fan, UAF Pump, RE unit, Supply and Exhaust axial fan) FOR VENTILATION SYSTEM	15
18	PE-V0-415-554-A019	TYPICAL Details DUCT FABRICATION DRG / SUPPORT/EREC. FOR VENTILATION SYSTEM. INSULATION OF DUCT / PIPING &	7



**1x660MW BHUSAWAL TPS
VENTILATION SYSTEM
MASTER DRAWING LIST WITH SCHEDULE
OF SUBMISSION**

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S. NO.	DRAWING NO	DRG./ DOC. TITLE	SCH. WEEK (FROM DATE OF LOI)
		EQUIPMENTS PIPE ERECTION.	
19	PE-V0-415-554-020	GA OF PROPELLER FAN FOR VENTILATION SYSTEM	9
20	PE-V0-415-554-A021	PID & SCHEME FOR AIRWASHER AND UAF UNIT FOR VENTILATION SYSTEM	8
21	PE-V0-415-554-A022	AIR WASHER LAYOUT OUTSIDE "A ROW" SIDEALONGWITH FOUNDATION DETAILS - TG BUILDING	14
22	PE-V0-415-554-A023	AIR WASHER LAYOUT FOR "B-C BAY" SIDEALONGWITH FOUNDATION DETAILS - TG BUILDING	14
23	PE-V0-415-554-A024	UAF LAYOUT ALONGWITH FOUNDATION DETAILS - ESP BUILDING.	11
24	PE-V0-415-554-A025	VENTILATION DUCT LAYOUT FOR TG BUILDING - 'A' ROW SIDE	12
25	PE-V0-415-554-A026	VENTILATION DUCT LAYOUT FOR TG BUILDING - 'BC BAY' SIDE	12
26	PE-V0-415-554-A027	VENTILATION DUCT LAYOUT FOR ESP BUILDINGS	12
27	PE-V0-415-554-A028	LOCATION OF ROOF EXTRACTOR UNIT IN TG BUILDING ALONGWITH FIXING DETAILS FOR VENTILATION SYSTEM	12
28	PE-V0-415-554-A029	VENT. ARRANGEMENT FOR BATTERY ROOM.	13
29	PE-V0-415-554-A030	VENT. ARRANGEMENT FOR VARIOUS AUXILIARY BUILDING.	18
30	PE-V0-415-554-A031	ELECTRICAL FEEDER LIST FOR VENTILATION SYSTEM	18
31	PE-V0-415-554-A032	VENTILATION CABLE SCHEDULE	18
32	PE-V0-415-554-A033	P.G/ DEMONSTRATION TEST PROCEDURE FOR VENTILATION SYSTEM	12
33	PE-V0-415-554-A034	O & M MANUAL FOR VENTILATION SYSTEM	25
34	PE-V1-415-554-A200	MANUFACTURING QUALITY PLAN FOR MANUAL HOIST (CHAIN PULLEY BLOCK)	14
35	PE-V1-415-554-A201	GA DRAWING FOR CPB WITH DETAIL BOM WITH PAINTING DETAILS	16

Notes:

1. The above drawing list is tentative and shall be finalized with the successful bidder after placement of order. While some of the drawings indicated above may not be applicable, some additional drawings may also be required based on scope of work.

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2. Drawings shall be prepared in Auto-Cad latest edition. Required no. of hard and soft copies (editable) of the drawings shall be furnished as per requirement specified elsewhere in the specification.

3. Only manual calculation with authentic supporting literature (e.g. extracts of hand Book/ standard/codes) shall be acceptable. All design calculations and drawings shall be in SI system only.

4. All the drawings and documents including general arrangement drawing, data sheet, calculation etc. to be furnished to the customer during detailed engineering stage shall include / indicate the following details for clarity w.r.t. Inspection, construction, erection and maintenance etc.: -

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

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

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

d) All the drawings required to be furnished to customer during detailed engineering stage shall include technical parameters, details of paints and lubrication, hardness and BOQ / BOM in tabular form indicating all major components including bought out items and their quantity, material of construction indicating its applicable code / standard, weight, make etc.

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

f) Drawings and documents not covered above but required to check safety of machines/ system, shall be submitted during detailed engineering stage without any commercial implication.

g) All drawings shall include "B.O.M" and indicate quantity, material of construction, make along with IS/BS No., Technical parameters, dimensions, hardness, machining symbol and tolerance, requirement of radiography and hydraulic tests, painting details, elevation, side view, plan, skin section and blow-up view for clarity.

h) All drawings shall be prepared as per BHEL's title block and shall bear BHEL's drawing No.

i) Schedule of drawings submissions, comment incorporations & approval shall be as stipulated in the specifications. The successful bidder shall depute his design personnel to BHEL's/ Customer's/ Consultant's office for across the table resolution of issues and to get documents approved in the stipulated time.

j) Bidder to follow the following the drawing submission schedule:

k) 1st submission of drawings from date of LOI as per the submission schedule.

l) Every revised submission incorporating comments – within 7 days.

m) Bidder to submit revised drawings complete in all respects incorporating all comments. Any incomplete drawing submitted shall be treated as non-submission with delays attributable to bidder's account. For any clarification/ discussion required to complete the drawings, the bidder shall himself depute his personal to BHEL for across the table discussions/ finalizations/ submissions of drawings.



**1x660MW BHUSAWAL TPS
VENTILATION SYSTEM
FORMAT FOR OPERATION AND
MAINTENANCE MANUAL**

SPECIFICATION No: PE-TS-415-554-A001

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SECTION-I

SUB-SECTION-E

ANNEXURE-VII

**FORMAT FOR OPERATION AND MAINTENANCE
MANUAL**



**1x660MW BHUSAWAL TPS
VENTILATION SYSTEM
FORMAT FOR OPERATION AND
MAINTENANCE MANUAL**

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Project name :
Project number :
Package Name :
PO reference :
Document number :
Revision number :

Sl.no. & Sections	Description	Tick (√)if included in Manual			Remarks
		Yes	No	Not Applicable	
1.	COVER PAGE				
1.1	Project Name				
1.2	Customer/consultant Name				
1.3	Name of Package				
1.4	Supplier details with phone, FAX ,email address , Emergency Contact number				
1.5	Name and sign of prepared by , checked by & approved by				
1.6	Revision history with approval Details				
2.0	INDEX				
2.1	showing the sections & related page nos All the pages should be numbered section wise				
3.0	DESCRIPTION OF PLANT/SYSTEM				
3.1	Description /write up of operating principle of system equipment/ associated sub-systems & accessories/controls system , operating conditions, performance parameters under normal , start up and special cases				
3.2	Equipment list and basic parameter with Tag numbers				
3.3	Data sheets approved by Customer/for information and catalogues provided by original manufacturer				
3.4	Associated other packages and Interface /terminal points				
3.5	P&ID & Process Diagrams				
3.6	GA Layout drawings, As-built drawings , Actual photograph of items/system (Drawings of A2 &				

	1x660MW BHUSAWAL TPS VENTILATION SYSTEM FORMAT FOR OPERATION AND MAINTENANCE MANUAL	SPECIFICATION No: PE-TS-415-554-A001			
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Sl.no. & Sections	Description	Tick (√)if included in Manual			Remarks
		Yes	No	Not Applicable	
	bigger sizes are to be attached in the last)				
3.7	Single line/wiring diagrams				
3.8	Control philosophy /control write-ups				
4.0	COMMISSIONING ACTIVITIES (IF NOT COVERED IN SEPARATE DOCUMENT I.E. ERECTION MANUAL, COMMISSIONING MANUAL)				
4.1	Pre-Commissioning Checks				
4.2	handling of items at site				
4.3	Storage at site				
4.4	Unpacking & Installation procedure				
5.0	OPERATION GUIDELINES FOR PLANT PERSONAL/USER/OPERATOR				
5.1	Interlock & Protection logic along with the limiting values of protection settings for the equipment along with brief philosophy behind the logic, drawings etc. to be provided.				
5.2	Start up, normal operation and shut down procedure for equipments along with the associated systems in step by step mode. Valve sequence chart, step list, interlocks etc. with Equipment isolating procedures to be mentioned.				
5.3	Do's & Don't of the equipments.				
5.4	Safety precautions to be taken during normal operation. Safety symbols, Emergency instructions on total power failure condition/lubrication failure/any other condition				
5.5	Parameters to be monitored with normal values and limiting values				
5.6	Trouble shooting with causes and remedial measures				
5.7	Routine operational checks, recommended logs & records				
5.8	Changeover schedule if more than one auxiliary for the same purpose is given				
5.9	Painting requirement and schedule				
5.10	Inspection, repair , Testing and calibration procedures				

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Sl.no. & Sections	Description	Tick (√)if included in Manual			Remarks
		Yes	No	Not Applicable	
6.0	MAINTENANCE GUIDELINES FOR PLANT PERSONAL				
6.1	List of Special Tools and Tackles required for Overhaul/Trouble shooting including special testing equipment required for calibration etc.				
6.2	Stepwise dismantling and re-assembly procedure clearly specifying the tools to be used, checks to be made, records to be maintained, clearances etc. to be mentioned. Tolerances for fitment of various components to be given.				
6.3	Preventive Maintenance & Overhauling schedules linked with running hours/calendar period along with checks to be given				
6.4	Long term maintenance schedules especially for structural, foundations etc.				
6.5	Consumable list along with the estimated quantity required during commissioning, normal running and during maintenance like Preventive Maintenances and Overhaul. Storage/handling requirement of consumables/self-life.				
6.6	List of lubricants with their Indian equivalent, Lubrication Schedule, Quantity required for each equipment for complete replacement is to be given				
6.7	List of vendors & Sub-vendors with their latest addresses, service centres ,Telephone Nos., Fax Nos., Mobile Nos., e-mail IDs etc.				
6.8	List of mandatory and recommended spare parts list				
6.9	Tentative Lead time required for ordering of spares from the equipment supplier				
6.10	Guarantee and warranty clauses				
7.0	Statutory and other specific requirements considerations.				
8.0	List of reference documents				
9.0	Binding as per requirement				



**1x660MW BHUSAWAL TPS
VENTILATION SYSTEM
SITE STORAGE AND PRESERVATION**

SPECIFICATION No: PE-TS-415-554-A001

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**SECTION-I
SUB-SECTION-E
ANNEXURE-VIII
SITE STORAGE AND PRESERVATION**

SITE STORAGE AND PRESERVATION GUIDELINES

FOR

MECHANICAL BOPs

(Doc No: PE-DC-SSG-A001 REV.00)



PROJECT ENGINEERING MANAGEMENT, POWER SECTOR
BHARAT HEAVY ELECTRICALS LIMITED-NOIDA

CONTENT

- 1 SCOPE OF THE DOCUMENT
- 2 PURPOSE OF STORAGE & PRESERVATION
- 3 MEASURES TO BE TAKEN FOR STORAGE AND PRESERVATION
 - a) GENERAL STORAGE REQUIREMENTS
 - b) GENERAL PRESERVATION REQUIREMENTS
 - c) GENERAL INSPECTION REQUIREMENTS
- 4 TYPE OF STORAGE FOR VARIOUS EQUIPMENT
5. CONCLUSION
6. STACKING ARRANGEMENT FOR PLATES AND STRUCTURAL STEEL

1. SCOPE OF THE DOCUMENT

This guideline is prepared in intent to provide proper site storage and preservation of the Mechanical, Electrical and C & I items / equipment supplied under various bought out packages/items. This storage procedure shall be followed at different power plant sites by concerned agency for storage and preservation from the date of equipment received at site until the same are erected and handed over to the customer.

2. PURPOSE OF STORAGE & PRESERVATION

Many of the items may be required to be kept in stores for long period. It shall therefore be essential that proper methods of storage and preservation be applied so that items do not deteriorate, loose some of their properties and become unusable due to atmospheric conditions and biological elements.

3. MEASURES TO BE TAKEN FOR STORAGE, HANDLING & PRESERVATION

a) GENERAL STORAGE REQUIREMENTS

1. To the extent feasible, materials should be stored near the point of erection. The storage areas should have adequate unloading and handling facilities with adequate passage space for movement of material handling equipment such as cranes, fork lift trucks, etc. The storage of materials shall be properly planned to minimise time loss during retrieval of items required for erection.
2. The outdoor storage areas as well as semi-closed stores shall be provided with adequate drainage facilities to prevent water logging. Adequacy of these facilities shall be checked prior to monsoon.
3. The storage sheds shall be built in conformity with fire safety requirements. The stores shall be provided with adequate lights and fire extinguishers. 'No smoking' signs shall be placed at strategic locations. Safety precautions shall be strictly enforced.
4. Adequate lighting facility shall be provided in storage areas and storage sheds and security personnel positioned to ensure enforcement of security measures to prevent theft and loss of materials.
5. Adequate number of competent stores personnel and security staff shall be deployed to efficiently store and maintain the equipment / material.
7. The equipment shall be stored in an orderly manner, preserving their identification slips, tags and instruction booklets, etc., required during erection. The storage of materials shall be equipment-wise. Loose parts shall be stored in sheds on racks,

preserving the identification marks and tags in good condition. The group codes shall be displayed on the racks

6. At no time shall any materials be stored directly on ground. All materials shall be stored minimum 200 mm above the ground preferably on wooden sleepers

b) GENERAL PRESERVATION REQUIREMENTS

1. All special measures to prevent corrosion shall be taken like keeping material in dry condition, avoiding the equipment coming in contact with corrosive fluid like water, acid etc.
2. Materials which carry protective coating shall not be wrapped in paper, cloth, etc., as these are liable to absorb and retain moisture. The material shall be inspected and in case of signs of wear or damages to protective coating, that portion shall be cleaned with approved solution and coated with an approved protective paint. Complete record of all such observations and protective measures taken shall be maintained.
3. Generally equipment supplied at site are properly greased or rust protective oil is applied on machined/ fabricated components. However periodic inspection shall be carried out to ensure that protection offered is intact.
4. While handling the equipment, no dragging on the ground is permitted. Avoid using wire rope for lifting coated components. Use polyester slings (if possible) otherwise protective material (e.g. clothes, wood block etc.) should be used while handling the components with rope / slings
5. For Equipment supplied with finished paint, touch paint shall be done in case any surface paint gets peeled off during handling. Otherwise such surfaces shall necessarily be wrapped with polythene to avoid any corrosion. Further for equipment wherein finish coat is to be applied at site, site to ensure that equipment is received with primer coat applied.
6. It shall be ensured by periodic inspection that plastic inserts are intact in tapped holes, wherever applicable.
7. Pipes shall be blown with air periodically and it shall be ensured that there is no obstruction.
8. Silica gel or approved equivalent moisture absorbing material in small cotton bags shall be placed and tied at various points on the equipment, wherever necessary.
9. Heavy rotating parts in assembled conditions shall be periodically rotated to prevent corrosion/jamming due to prolonged storage.

10. All the electrical equipment such as motors, generators, etc. shall be tested for insulation resistance at least once in three months and a record of such measured insulation values shall be maintained.
11. Following preservatives/preservation methods can be used depending upon type of equipment
 - a. Rust preventive fluid (RPF)
 - b. Rust protective paints
 - c. Tarpaulin covers, in case of outdoor storage
 - d. De-oxy aluminate for weld-ments

c) GENERAL INSPECTION REQUIREMENTS

1. Period inspection of materials with specific reference to –
 - Ingress of moisture and corrosion damages.
 - Damage to protective coating.
 - Open ends in pipes, vessels and equipment -
 - In case any open ends are noticed, same shall be capped.
2. Any damages to equipment / materials.
 - In case of any damages, these shall be promptly notified and in all cases, the repairs / rectification shall be carried out.
 - Any items found damaged or not suitable as per project requirements shall be removed from site. If required to store temporarily, they shall be clearly marked and stored separately to prevent any inadvertent use.

4. TYPE OF STORAGE FOR VARIOUS EQUIPMENT

The types of storage are broadly classified under the following heads:

i **Closed storage with dry and dust free atmosphere. (C)**

The closed shed can be constructed by using cold-rolled / tubular components for structure and corrugated asbestos sheets / galvanised iron sheets for roofing. Brick walls / asbestos sheets can be used to cover all the sides. The floor of the shed can be finished with plain cement concrete suitably glazed. The shed shall be provided with proper ventilation and illumination.



ii **Semi-closed storage. (S)**

The semi closed shed can be constructed by using cold-rolled / tubular components for structure and corrugated / asbestos sheets for roofing. The floor shall be brick paved. If required a small portion of sides can be covered to protect components from rainwater splashing onto the components.





iii Open storage (O)

The open yard shall be levelled, well consolidated to achieve raised ground with the provision of feeder roads for crane approach along with access roads running all sides. One part of the open yard shall be stone pitched, levelled and consolidated with raised ground suitable for storing / stacking heavier and critical components with due space to handle them by cranes etc . Adequate number of sleepers, concrete block etc. to be provided to make raised platforms to stack critical materials.

A separate yard to be identified as “scrap yard” slightly away from main open yard to store wooden/steel scraps, which are to be disposed off. This is required to avoid mix up with regular components as well as to avoid fire hazard.

Some of the components, which are having both machined & un-machined surfaces and are bulky, shall be stored in open storage area on a raised ground and suitably covered with water proof / fire retardant tarpaulin.



The equipment listed below shall be stored and inspected as per requirement mentioned in the table below.

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
Raw material /mechanical items like pipes, plates, structure sections etc.)				
1.	Steel pipes (lined/unlined)	S	Damage , paint, corrosion, rubber lining peeling	Provide end cap
2.	MS Plates	S	Damage, paint, corrosion	
3.	SS Plates	S	Damage	
4.	Non-metallic pipes	S	Damage, cracks	Provide end cap
5.	Stainless steel pipes	S	Damage ,	Provide end cap
6.	MS sections, beams	S	Damage, paint, corrosion	
7.	Cable trays	S	Damage, condition of preservations	
8.	Insulation sheets	S	Damage	
9.	Insulation	C	Damage, packing	
10.	Hangers Rods	S	Damage, paint, packing	
11.	Tubes	S	Damage, paint , packing	Provide end cap
12.	Hume pipes	O	Damage	
13.	Castings	O	Damage, paint, corrosion	
Fabricated mechanical items (pressure vessels, tanks etc.)				
14.	Pressure vessels (unlined)	O	Damage, paint, corrosion,	Covered nozzles
15.	Atmospheric storage tanks (unlined)	O	Damage, paint, corrosion	Covered nozzles

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
16.	Pressure vessels (lined)	S	Damage, paint, corrosion, rubber lining	
17.	Atmospheric storage tanks(lined)	S	Damage, paint, corrosion, rubber lining	
18.	Support structures	O	Damage , paint, corrosion	
19.	Flanges	C	Damage , paint, corrosion	
20.	Fabricated pipes	S	Damage , paint, corrosion	Provide end cap
21.	Vessels internals	C	Damage , paint, corrosion ,packing	
22.	Grills	S	Damage , paint, corrosion	
23.	Angles	S	Damage , paint, corrosion	
24.	Bridge mechanism/clarifier mechanism	O	Damage , paint, corrosion	
25.	Cranes, rails	S	Damage , paint, corrosion	
26.	Stair cases	O	Damage , paint, corrosion	
27.	Ladders/handrails	O	Damage , paint, corrosion	
28.	Fabricated ducts	S	Damage , paint, corrosion	
29.	Isolation Gates	O	Damage , paint, corrosion	
30.	Fabricated boxes/panels	S	Damage , paint, corrosion	
Mechanical components like valves, fittings, cables glands, spares etc.)				
31.	Valves	S	Damage , packing	

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
32.	Fittings	S	Damage , packing	Provide end cap
33.	Cable glands	C	Damage , packing	
34.	Tools & tackles	C	Damage , packing	
35.	Nut , bolts, washers,	C	Damage , packing	
36.	Gasket & Packings	C	Damage , packing	
37.	Copper tubes	C	Damage , packing, corrosion	Provide end cap
38.	SS tubing	C	Damage , packing	Provide end cap
Rotating assemblies (pumps, blowers, stirrers, fans, compressors etc.)				
39.	Pumps	S	Damage , packing, corrosion	Shaft rotation
40.	Blowers/Compressors	S	Damage , packing, corrosion	Shaft rotation
41.	Agitators/stirrers/radial launders	C	Damage , packing, corrosion	Shaft rotation
42.	Rollers for chlorine tonner mounting	C	Damage , packing, corrosion	
43.	Centrifuge	S	Damage , packing,	
44.	Gear box	C	Damage , packing, corrosion	
45.	Bearings	C	Damage , packing, corrosion	
46.	Fans	S	Damage , packing, corrosion	
47.	Dosing skids	S	Damage , packing, corrosion	
48.	Pump assemblies	S	Damage , packing, corrosion	
49.	Air washers(INTERNALS)	S	Damage , packing	
50.	Air conditioners (split)	C	Damage , packing	

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
51.	Elevators(CONTAINERIZED)	O	Damage , packing, corrosion	
52.	Chillers/VA machines	S	Damage , packing	
53.	Air handling Unit/Package unit	S	Damage , packing	
54.	Chlorinators & Evaporators	C	Damage , packing	
55.	Ejectors	C	Damage , packing	
56.	Electrolyser	C	Damage , packing	
Miscellaneous items like chain pulley blocks, hoists etc.				
57.	Chain pulley blocks	S	Damage, Packing	
58.	Electric hoists	S	Damage, Packing	
59.	Fire extinguishers	C	Damage, expiry date	
60.	Fork Lift Truck	S	Damage, Packing	
61.	Hydraulic Mobile Crane	O	Damage, Packing	
62.	Mobile Pick Up & Carry Crane	O	Damage, Packing	
63.	Motor boats	O	Damage, Packing	
64.	Safety showers	S	Damage, Packing	
65.	Diffusers/dampers	S	Damage, Packing	
Chemicals and consumables (acid, alkali, paints, oils, reagents and special chemicals)				
66.	Hydro Chloric Acid (HCl)	Store in canes/ storage tank in dyke area	Date of production/ leakage/fumes	hazardous chemical
67.	Sulphuric acid (H ₂ SO ₄)	Store in canes/ storage tank in dyke area	Date of production/ leakage/fumes	hazardous chemical

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
68.	Sodium hydroxide (NaOH)	Store in canes/ storage tank in dyke area	Date of production/ leakage/ fumes/ breather	hazardous chemical ,breather to be checked for air ingress
69.	Sodium hypo chlorite	To be stored under shed	Date of production/ leakage/ fumes	hazardous chemical ,self-life normally 15-30 days after which strength of chemical decays
70.	Ammonia	S	Date of production/ leakage/ fumes	Store in closed storage tanks, hazardous chemical
71.	CW treatment chemicals	S	Date of production , Self-life	Store in closed canes
72.	RO/UF cleaning chemicals	S	Date of production , Self-life	Store in closed canes
73.	Lime	C	Damage to packing , seepage	Prevent moisture, rain
74.	Alum bricks	C	Damage to packing	Prevent moisture, rain
75.	Poly electrolyte	S		Store in closed storage tanks
76.	Laboratory chemicals(powder)	C	Damage, Packing self-life	
77.	Laboratory chemicals(liquid)	C	Damage, Packing self-life	
78.	Lubrication oils	C	Leakage	
79.	Paints	S	Leakage ,air tightness	
80.	Sand	O	Damage of packing	No hooks
81.	Salt (NaCl)	C	Damage of packing, water ingress	Prevent moisture, rain
82.	Anthracite	S	Damage of packing	
83.	Activated carbon	S	Damage of packing	

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
84.	Thermal insulation	S	Damage of packing	
85.	Cement	C	Damage of packing	Prevent moisture, rain
86.	Gravels	O	Damage of packing	
87.	ION exchange resins	C	Damage , packing	Refer manufacturer guidelines
88.	RO membranes	C	Damage , packing	Refer manufacturer guidelines
89.	UF membranes	C	Damage , packing	Refer manufacturer guidelines
90.	Cleaning chemicals	C	Damage , packing	Refer manufacturer guidelines
91.	Chemicals for analysers/calibration	C	Damage , packing	Refer manufacturer guidelines
Electrical and C & I items (motors, cables etc.)				
92.	Motors	C	Damage , packing	
93.	Cable drums	O	Damage	
94.	Control Panel /control desk, UPS ,JB	S	Damage, Packing	
95.	Instruments(gauges/analysers)	C	Damage	
Special items		As per Manufacturer's item, like Hydrogen cylinders, Ozonator, Analyser, Chlorine dioxide generators etc.		

5. CONCLUSION

Concerned storage agency at site should make sure that loss in equipment performance and wear & tear are minimised through proper storage and preservation. The above are broad guidelines and cover major equipment / materials. However specific storage practices shall be followed as per manufacturer recommendation. All the necessary measures even in addition to the ones mentioned above, if found necessary, should be taken to achieve the objective.

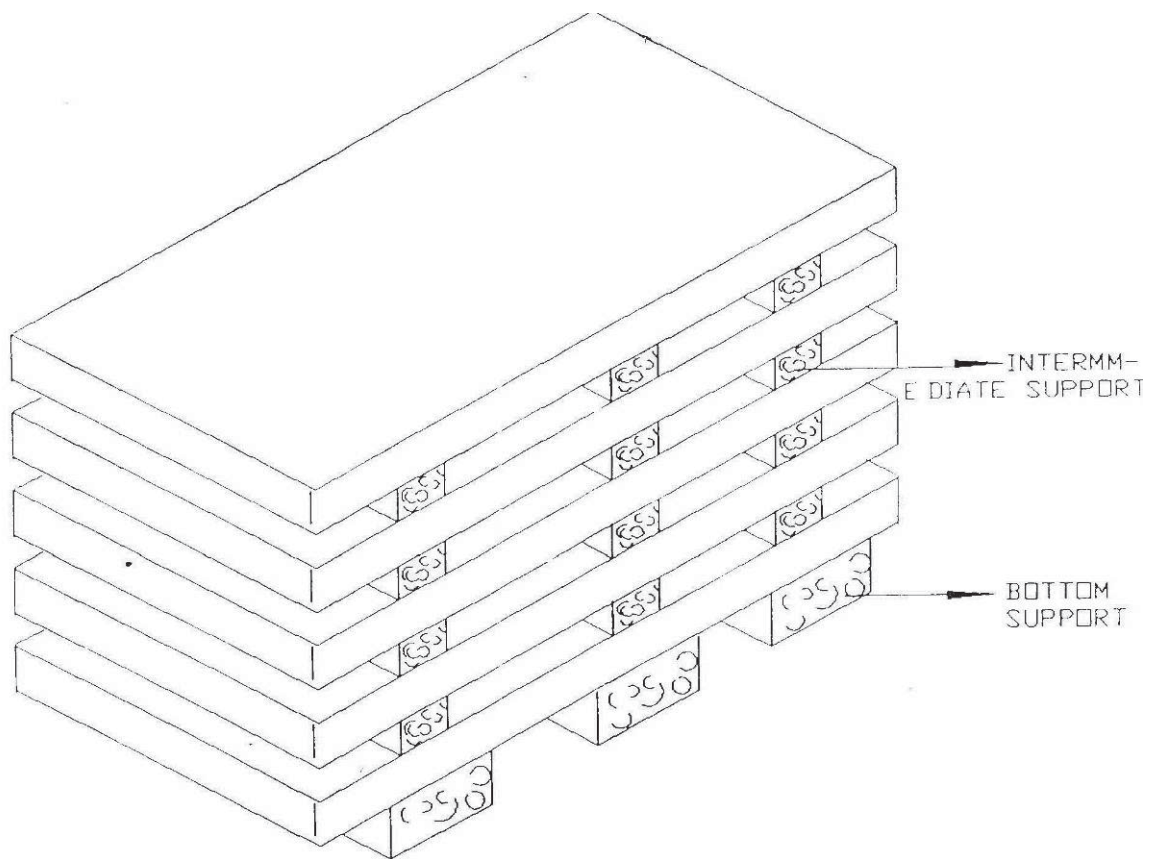


Figure – 1 – PLATE STACKING ARRANGEMENT

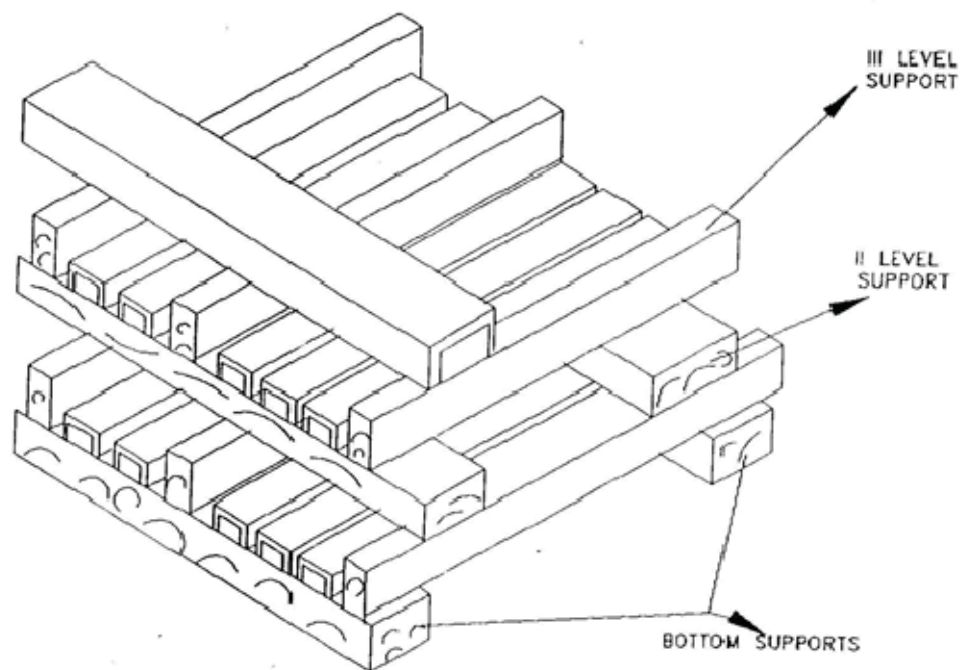


Figure – 2 – STRUCTURAL STEEL STACKING ARRANGEMENT



**1x660MW BHUSAWAL TPS
VENTILATION SYSTEM**

SPECIFICATION No: PE-TS-415-554-A001

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SECTION-I

SUB-SECTION-E

ANNEXURE-IX

PACKING PROCEDURE

(REFER SUB-SECTION C2-B)



**1x660MW BHUSAWAL TPS
VENTILATION SYSTEM**

SPECIFICATION No: PE-TS-415-554-A001

SECTION: II

REV. 00

SECTION II



**1x660MW BHUSAWAL TPS
VENTILATION SYSTEM
INSPECTION AND TESTING**

SPECIFICATION No: PE-TS-415-554-A001

SECTION : II

SUB-SECTION : 1

REV 00

SHEET 1 OF 4

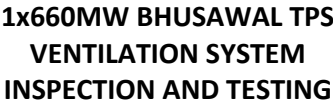
SECTION-II

SUB-SECTION-1

INSPECTION AND TESTING

	1x660MW BHUSAWAL TPS VENTILATION SYSTEM INSPECTION AND TESTING	SPECIFICATION No: PE-TS-415-554-A001	
		SECTION : II	
		SUB-SECTION : 1	
		REV 00	
		SHEET 2 OF 4	
1.01.00	Inspection and Tests during Manufacture.		
1.01.01	The method and techniques to be used by the Bidder for the control of quality during manufacture of all plant and equipment shall be agreed with the Owner.		
1.01.02	The Owner’s general requirements with respect to quality control and the required shop tests are set out elsewhere in this specification.		
1.01.03	Before any item of plant or equipment leaves its place of manufacture the Owner shall be given the option of witnessing inspections and tests for compliance with the specification and related standards.		
1.01.04	Advance notice shall be given to the Owner as agreed in the Contract, prior to the stage of manufacture being reached, and the piece of plant must be held at this stage until the Owner has inspected the piece, or has advised in writing that inspection is waived. If having consulted the Owner and given reasonable notice in writing of the date on which the piece of plant will be available for inspection, the Owner does not attend the Bidder may proceed with manufacture having forwarded to the Owner duly certified copies of his own inspection and test results.		
	The owner’s representative shall have at all reasonable times access to bidder’s or his sub-vendor’s premises and shall have power to inspect/ examine materials and workmanship or equipment under manufacture.		
	The Bidder shall forthwith forward to the engineer duly certified copies of the Test Certificates in six copies (one to the Purchaser and five to the Consulting Engineer) for approval. Further nine (9) copies of Shop Test Certificates shall be bound with Instruction Manuals referred to elsewhere.		
	For electrical equipment, routine tests as per relevant IS spec are to be carried out on all equipment. Type tests are also to be carried out on selected equipment as detailed in the specs of concerned electrical equipment.		
1.01.05	Under no circumstances any repair or welding of castings be carried out without the consent of the Engineer. Proof of the effectiveness of each repair by radiographic and/or other non-destructive testing technique, shall be provided to the Engineer.		
1.01.06	All the individual and assembled rotating parts shall be statically and dynamically balanced in the works. Where accurate alignment is necessary for component parts of machinery normally assembled on site, the Bidder shall allow for trial assembly prior to dispatch from place of manufacture.		
1.01.07	All materials used for the manufacture of equipment covered under this specification shall be of tested quality. Relevant test certificates shall be made available to the		

	1x660MW BHUSAWAL TPS VENTILATION SYSTEM INSPECTION AND TESTING	SPECIFICATION No: PE-TS-415-554-A001	
		SECTION : II	
		SUB-SECTION : 1	
		REV 00	
		SHEET 3 OF 4	
Purchaser. The certificates shall include tests for mechanical properties and chemical analysis of representative material. Equipment or parts coming under any statutory Regulations shall be certified by a Competent Authority under the regulations in the specified format.			
1.01.08	All pressure parts connected to pumping main shall be subjected to hydraulic testing at a pressure of 150% of shut-off head for a period not less than one hour. Other parts shall be tested for one and half times the maximum operating pressure, for a period not less than one hour.		
1.01.09	All necessary non-destructive examinations shall be performed to meet the applicable code requirements.		
1.01.10	All welding procedures adopted for performing welding work shall be qualified in accordance with the requirements of Section-IX of ASME code or IBR as applicable. All welded joints for pressure parts shall be tested by liquid penetrant examination according to the method outlined in ASME Boiler and Pressure Vessel code. Radiography, magnetic particle examination magnuflux and ultrasonic testing shall be employed wherever necessary/ recommended by the applicable code. At least 10% of all major but welding joints shall be radiographed unless otherwise stipulated.		
Statutory payments in respect of IBR approvals including inspection shall be made by the bidder. Bidder's scope shall include to preparation of all necessary documents, co-ordination and follow-up for above approval. Owner shall only forward assistance/endorsement of documents /design /drawings /reports/records to be submitted for approval as stipulated/ required by Statutory Authorities till registration of the unit and clearance for commercial operation.			
1.02.00	Performance Tests at Site		
1.02.01	The full requirements for testing the system shall be agreed between the Owner and the Bidder prior to Award of Contract. The completely erected System shall be tested by the Bidder on site under normal operating conditions. The Bidder shall also ensure the correct performance of the System under abnormal conditions, i.e. the correct working of the various emergency and safety devices, interlocks, etc.		
1.02.02	The Bidder shall provide complete details of his normal procedures for testing, for the quality of erection and for the performance of the erected plant. These tests shall include site pressure test on all erected pipe work to demonstrate the quality of the piping and the adequacy of joints made at site.		
1.02.03	The Bidder shall furnish the quality procedures to be adopted for assuring quality from the receipt of material at site, during storage, erection, pre-commissioning to tests on completion and commissioning of the complete system/equipment.		
1.03.00	For details of specific tests required on individual equipment refer to respective section of this specification.		



SECTION : II

SUB-SECTION : 1

REV 00

SHEET 4 OF 4

All Statutory testing / clearance is in Bidder's scope including payment of all fees, etc. as required

QAP FORMAT

BHARAT HEAVY ELECTRICALS LIMITED

CORPORATE QUALITY ASSURANCE

PROJECT:

SYSTEM :

VENDOR :

ITEM :

[illegible]

Legend:	1. BHEL	2. Vendor	3. Sub-Vendor
---------	---------	-----------	---------------

[illegible]

	MANUFACTURER'S NAME & ADDRESS:	MANUFACTURING QUALITY PLAN ITEM: Chain Pulley Block QP No.: REV.:0, Date.: , PAGE: 1 OF 4	PROJECT: 1X660 MW BHUSAWAL TPS UNIT-6 PACKAGE: CHAIN PULLEY BLOCK

Sr. No.	COMPONENT / OPERATION	CHARACTERISTICS	CLAS S	TYPE OF CHECK	QUANTU M OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
					M	C/N				M	C	N	
					6.					10.			
1.	2.	3.	4.	5.			7.	8.	9.				11.

1	RAW MATERIAL & B/OUT ITEMS:												
1.1	HOOKS	CHEMICAL & MECH MARK & IDENTIFICATION INTERNAL DEFECTS PROOF LOAD TEST NDT AFTER PROOF LOAD TEST	MA MA MA MA MA	LAB ANALYSIS VISUAL UT REVIEW DPT	ONE SAMPLE PER HEAT 100% 100% 100% 100%	MATERIAL SPECIFICATION AS PER APPROVED DRAWINGS. HOOK TC FROM COMPETENT AUTHORITY ASTM A-388 (REFER NOTE I) IS 15560 ASTM E-165		MTC. TC IR TC TC	✓ ✓ ✓ ✓ ✓	P P P P P	V V V V V	V V V V V	ON SHANK PORTION
1.2	LOAD CHAIN	- DIMENSIONS - BREAKING STR & % ELONGATION - PROOF LOAD -HEAT TREATMENT -GRADE	MA MA MA MA MA	MEASUREMENT -TENSILE TEST -TENSILE TEST REVIEW REVIEW	100% 1/LOT 100% 100% 1/BATCH	APPD. DRGS -DO- -DO- -DO- -DO-	APPD. DRGS. -DO- -DO- -DO- -DO-	IR MTC MTC HT CHRT MTC	✓ ✓ ✓ ✓ ✓ ✓	P P P P P P	V V V V V V	V V V V V V	

MANUFACTURER / CONTRACTOR	LEGEND: ** M : MANUFACTURER / SUB-SUPPLIER C : BHEL / NOMINATED INSPECTION AGENCY. N : CUSTOMER/ NOMINATED INSPECTION AGENCY. INDICATE "P" PERFORM "W" WITNESS AND "V" VERIFICATION	FOR CUSTOMER USE	
SUB-CONTRACTOR		REVIEWED BY	NAME & SIGN OF APPROVING AUTHORITY & SEAL
SIGNATURE			

	MANUFACTURER'S NAME & ADDRESS:	MANUFACTURING QUALITY PLAN ITEM: Chain Pulley Block QP No.: REV.:0, Date.: , PAGE: 2 OF 4	PROJECT: 1X660 MW BHUSAWAL TPS UNIT-6 PACKAGE: CHAIN PULLEY BLOCK

Sr. No.	COMPONENT / OPERATION	CHARACTERISTICS	CLAS S	TYPE OF CHECK	QUANTU M OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
					M	C/N				M	C	N	
					6.					10.			
1.	2.	3.	4.	5.			7.	8.	9.				11.

1.3	RAW MATL. (BAR /FORGING) FOR GEAR BLANKS/SHAFTS/ PINIONS/AXLE/ RATCHET PAWL / RATCHET WHEEL & PLATES FOR FABRICATION ETC	CHEMICAL COMPOSITION MECHANICAL INTERNAL DEFECTS NDT AFTER MACHINING	MA MA MA MA	Review Review UT DPT	ONE SAMPLE PER HEAT 100% 100%	Material specification as per approved drawings. ASTM A-388 REFER NOTE 1 ASTM E-165 NO RELEVANT INDICATION		MFR' S TC IR TC	✓ ✓ ✓ ✓	P P P P	V V V V	V V V V	TC or inspection report for components shall be given. For rounds ≥50mm and plates ≥25 mm.
1.4.	LOAD CHAIN WHEELS	- CHEMICAL & MECHANICAL PROPERTIES	MA	CHEMICAL MECHANICAL PROPERTIES	ONE SAMPLE PER LOT	APPD. DRG.	APPD. DRG.	MTC	✓	P	V	V	
1.5	BEARINGS	MAKE, TYPE, CATALOUGE NO.	MA	VISUAL	RANDOM	APP DRG / MFR"S CATALOGUE	APP DRG / MFR"S CATALOGUE	IR	✓	P	V	V	
1.6	HAND CHAIN WHEEL	CHEMICAL MECHANICAL PROPERTIES	MA	CHEMICAL MECHANICAL PROPERTIES	ONE SAMPLE PER LOT	AS PER DRAWING	AS PER DRAWING	MTC	✓	P	V	V	
1.7	HAND CHAIN	GRADE/ DIMENSION	MA	GRADE DIMENSION	100%	AS PER DRAWING	AS PER DRAWING	MTC	✓	P	V	V	

	LEGEND:	FOR CUSTOMER USE	
MANUFACTURER / CONTRACTOR	** M : MANUFACTURER / SUB-SUPPLIER C : BHEL / NOMINATED INSPECTION AGENCY. N : CUSTOMER/ NOMINATED INSPECTION AGENCY. INDICATE "P" PERFORM "W" WITNESS AND "V" VERIFICATION		
SUB-CONTRACTOR		REVIEWED BY	NAME & SIGN OF APPROVING AUTHORITY & SEAL
SIGNATURE			

	MANUFACTURER'S NAME & ADDRESS:	MANUFACTURING QUALITY PLAN ITEM: Chain Pulley Block QP No.: REV.:0, Date.: , PAGE: 3 OF 4	PROJECT: 1X660 MW BHUSAWAL TPS UNIT-6 PACKAGE: CHAIN PULLEY BLOCK

Sr. No.	COMPONENT / OPERATION	CHARACTERISTICS	CLAS S	TYPE OF CHECK	QUANTU M OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
					M	C/N				M	C	N	
					6.					10.			
1.	2.	3.	4.	5.			7.	8.	9.				11.

1.8	TROLLEY GEARS, PINION, WHEELS, AXLE	CHEMICAL & MECHANICAL	MA	LAB ANALYSIS,	100%	APPVD DRGS	APPVD DRGS	IR/TC	✓	P	V	V	
2	IN PROCESS												
2.1	RATCHET PAWL / RATCHET WHEEL	-HARDNESS -SURFACE CRACK	MA MA	HARDNESS DPT	100% 100 %	IS:3832/ APPD DRG. ASTM E165	IS:3832/ APPD. DRG. NO DEFECT	IR IR	✓ ✓	P P	V V	V V	
2.2	COMPONENTS AFTER HARDFACING & MACHINING	HEAT TREATMENT SURFACE HARDNESS SURFACE CRACK DIMENSION	MA MA MA MA	HT CHART HARDNESS DPT FOR SURFACE CRACK MEASURE	100% 10% 100% 10%	IS 1875/IS 4367/IS 3832 --DO-- ASTM E 165	NO DEFECT	IR IR IR IR	✓ ✓ ✓ ✓	P P P P	V V V V	V V V V	
3.0	FINAL INSPECTION												
3.1	COMPLETE ASSEMBLY	OVERALL DIMENSION ENDURANCE TYPE TEST OPERATIONAL PROOF LOAD & LIGHT LOAD TEST, EFFORT. HEIGHT OF LIFT	CR MA CR MA	MEASUREMENT TYPE TEST LOAD TEST VISUAL	100 % 1 PER SIZE 100% 100 %	IS:3832 /APPD DRG IS 3832 -DO- -DO-	IS:3832 /APPD DRG IS 3832 -DO- -DO-	IR TC IR IR	✓ ✓ ✓ ✓	P P P P	W V W W	V V V V	

MANUFACTURER / CONTRACTOR	LEGEND: ** M : MANUFACTURER / SUB-SUPPLIER C : BHEL / NOMINATED INSPECTION AGENCY. N : CUSTOMER/ NOMINATED INSPECTION AGENCY. INDICATE "P" PERFORM "W" WITNESS AND "V" VERIFICATION	FOR CUSTOMER USE	
SUB-CONTRACTOR		REVIEWED BY	NAME & SIGN OF APPROVING AUTHORITY & SEAL
SIGNATURE			

	MANUFACTURER'S NAME & ADDRESS:	MANUFACTURING QUALITY PLAN ITEM: Chain Pulley Block QP No.: REV.:0, Date.: , PAGE: 4 OF 4	PROJECT: 1X660 MW BHUSAWAL TPS UNIT-6 PACKAGE: CHAIN PULLEY BLOCK

Sr. No.	COMPONENT / OPERATION	CHARACTERISTICS	CLAS S	TYPE OF CHECK	QUANTU M OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
					M	C/N				M	C	N	
1.	2.	3.	4.	5.	6.		7.	8.	9.				11.

		SWIVELING OF HOOK	MA	VISUAL	100%	APPROVED DRG	APPROVED DRG	IR	✓	P	W	V	
		EFFORT	MA	PULL ON CHAIN	100%	-DO-	-DO-	IR	✓	P	W	V	
3.2	PAINTING	-CLEANING - SHADE & DFT OF PAINT	MA MI	VISUAL VISUAL	AT RANDOM AT RANDOM	APPROVED DRAWING/ SPECIFICATI ON	APPROVED DRAWING/ SPECIFICATI ON	IR IR		P p	--- W	--- ---	
3.3	NAME PLATE	VERIFICATION	MA	VISUAL	100%			IR		P	V	---	
3.4	PACKING	-VERIFICATION	MI	VISUAL	100%	SPECS.	SPECS.	IR		P	---	---	
3.5	REVIEW OF QA DOCUMENTATION	VERIFICATION	MA	VISUAL	100%	APPD. QP	APPD. QP		✓	V	V	V	
CR – CRITICAL, MA – MAJOR , MI – MINOR													

NOTE 1: WHEN BACK WALL ECHO (BWE) IS SET AT 100% OF FULL SCREEN HEIGHT (FSH) IN DEFECT FREE AREA THEN

(A) DEFECT ECHO SHALL NOT EXCEED 20% OF FSH &

(B) BWE SHOULD BE MINIMUM 80% OF FSH IN ANY AREA.

NOTE 2: RECORDS IDENTIFIED WITH TICK SHALL BE ESSENTIALLY INLCUDED IN QA DOCUMENTATION.

	LEGEND: ** M : MANUFACTURER / SUB-SUPPLIER C : BHEL / NOMINATED INSPECTION AGENCY. N : CUSTOMER/ NOMINATED INSPECTION AGENCY. INDICATE “P” PERFORM “W” WITNESS AND “V” VERIFICATION	FOR CUSTOMER USE	
MANUFACTURER / CONTRACTOR			
SUB-CONTRACTOR			
SIGNATURE		REVIEWED BY	NAME & SIGN OF APPROVING AUTHORITY & SEAL

		MANUFACTURERS NAME & ADDRESS		MANUFACTURING QUALITY PLAN				PROJECT		1X660 MW BHUSAWAL TPS UNIT-6			
		AS PER APPROVED VENDOR LIST		ITEM:	ELECTRIC WIRE ROPE	QP NO		PACKAGE		ELECTRIC WIRE ROPE HOIST			
						REV	0	CONTRACT No					
						DATE		CONTRACTOR		BHEL-FEM			
						PAGE	1 of 4						
Sl.No	COMPONENT & OPERATIONS	CHARACTERISTICS	CATEGORY	TYPE OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
									D*	M	C	N	
1	2	3	4	5	6	7	8	9		**	10		11
1.0	RAW-MATERIALS												
1.1	a) STRUCTURAL MATERIAL b) RAW MATERIAL FOR HOIST AND GEAR BOX HOUSING, TROLLEY PLATE, ROPE DRUM IF FABRICATED ETC	CHEM & MECH PROPS	MA	Lab analysis	1 SAMPLE PER LOT%	IS 2062 /APPD. DRG./ DATA SHEET	MTC/IR	√	P/V	V	V		Test shall be carried out in absense of mill TC or non-correlation of TC with material.BHEL to identify Samples for testing. Test to be carried out at NABL accredited Lab. Reports to be submitted for verification during inspection.
		NDT	MA	UT	100%	ASTM A388-2004	NOTE 1	IR	√	P	V	V	For dia / plate thickness above 25 mm
1.1 A	SEAMLESS PIPE FOR ROPE DRUM	CHEMICAL , MECHANICAL	MA	Lab analysis	1 SAMPLE /pipe	Approved drg/	ASTM A 106 Grade A or B	MTC/IR	√	P/V	V	V	Test shall be carried out in absense of mill TC or non-correlation of TC with material.BHEL to identify Samples for testing. Test to be carried out at NABL accredited Lab. Reports to be submitted for verification during inspection
		Flattening & Acid Etching test	MA	PHYSICAL & METALLOGRAPHY	1 SAMPLE /pipe	No cracks, pitting, rusting , damage etc		IR	√	P	V	V	
		SURFACE DEFECTS	MA	Visual	100%								
1.2	FORGINGS FOR GEARS BLANKS ,PINIONS, SHAFT/AXLES, WHEELS , STEEL CASTINGS	MECH , CHEM. PROPS	MA	Lab analysis	100%	APPD. DRG./ DATA SHEET	APPD. DRG./ DATA SHEET / IS:3938	LAB. REPORT / MANUFACTURER'S TEST CERTIFICATE	√	P	V	V	
		NDT	CR	UT	100%	ASTM A 388	NOTE 1	INSPN. REPORT	√	P	V	V	IF DIA or THK > 50mm
		Hardness , surface defects after hardfacing and machining/grinding	MA	DPT/MPI	100%	ASTM E -165 /E-709, No linear indication		MTC	√	P	V	V	
1.3	WIRE ROPE	Dimensional, type, constrction ,	MI	measurement	100%	APPD. DRG./ DATA SHEET	APPD. DRG./ DATA SHEET	MFRS' TEST CERT.	√	P	V	V	
		EXAMINATION OF REPORT OF BREAKING LOAD CAPACITY	CR	Review of TC	100%	IS: 2266		MFRS' TEST CERT.	√	P	V	V	
1.4	HOOKS	MECH , CHEM. PROPS.	MA	Lab analysis	100%	APPROVED DRG/DATA SHEET IS:15560		MFRS' TEST CERT.	√	P	V	V	
		U.T IF SHANK DIA > 50mm	CR	NDT	100%	ASTM A 388	NOTE 1	INSPN. REPORT	√	P	V/W	V	SHANK PORTION ONLY
		Dimension & PROOF LOAD TESTING	CR	Measurment , PROOF LOAD TEST	100%	APPROVED DRG/DATA SHEET / IS:3938 / IS:15560		QCR	√	P	V/W	V	IF REQUIRED BY END CUSTOMER.
		DPT AFTER PROOF LOAD	CR	NDT	100%	ASTM E-165	NO CRACKS	INSPN. REPORT	√	P	V/W	V	
1.5	SHEAVES	MECH	MA	Tensile & hardness	1/lot	Approved drgs		MTC/IR	√	P	V	V	

		MANUFACTURERS NAME & ADDRESS		MANUFACTURING QUALITY PLAN				PROJECT		1X660 MW BHUSAWAL TPS UNIT-6				
		AS PER APPROVED VENDOR LIST		ITEM:	ELECTRIC WIRE ROPE	QP NO		PACKAGE		ELECTRIC WIRE ROPE HOIST				
						REV	0	CONTRACT No						
						DATE		CONTRACTOR		BHEL-PEM				
						PAGE	1 of 4							
Sl.No	COMPONENT & OPERATIONS	CHARACTERISTICS	CATEGORY	TYPE OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY		REMARKS		
									D*	M	C	N		
1	2	3	4	5	6	7	8	9			10		11	
1.6	CASTING FOR BEARING PLATED, ROPE GUIDES, PULLEYS ETC	CHEMICAL & MECHANICAL	MAJOR	LAB ANALYSIS	1/LOT	APPROVED DRG/MFG STANDARD	APPROVED DRG/MFG STANDARD	LAB REPORT	√	P	V	V		
2.0	IN-PROCESS													
2.1	Welding process capability and welder skill	WPS,PQR & WPQ	MA	Welding procedure approval and Welder performance qualification in accordance with ASME Section IX	100%	ASME Section IX		WPS,PQR & WPQ		P	V	V	In case approved WPS/PQR/WPQ from BHEL/NTPC/EIL/LLOYDS/TPL available, then documents/records to be submitted for verification during inspection, else, Vendor shall get the approval of Welding Procedure / Welder from the identified agency prior to carrying out welding at the	
2.2	Welding of trolley, rope drum etc	Fillet weld	MA	DPT	10%	ASTM E165 or Eq/ No cracks or linear indication		INSPN. REPORT	√	P	V	V		
		Butt welds	MA	RT, DPT	100%	ASME SEC VIII, DIV 1, UW 51/52		RT FILM & REPORT	√	P	V	V	100% RT for butt weld in tension and 10 % in compression. 100% RT on butt weld of rope drum	
		DPT AFTER STRESS RELIEVING OF ROPE DRUM	MA	NDT	100%	ASTM E-165	NO CRACKS	INSPN. REPORT	√	P	V	V		
2.3	NDT OF LOAD BEARING BUTT WELDS (IF ANY)	WELD QUALITY OF BUTT WELDS IN TENSION	CR	PT & RT	100%	ASME SEC. VIII DIV. 1	ASME SEC. VIII DIV. 4 . CLUW-51 FOR RT APPENDIX -8 FOR PT	INSPN. REPORT ND FILM	√	P	W	V/ W	FILMS TO BE REVIEWED BY BHEL & END CUSTOMER/THIRD PARTY. DPT SHALL BE CHP .	
2.4	GEAR BOXES													
	COMPLETE ASSEMBLY	OVERALL DIMENSIONS. LEAK TEST, REDUCTION RATIO, BACK LASH AND CONTACT PATTERN,	MA	MEAS./VISUAL	100%	MFG. DRG./KERSON E TEST	MFG. DRG./NO LEAKAGE WHEN FILLED	INSPN. REPORT	√	P	V			
	NO LOAD RUN TEST FOR 4 HRS	CHECK FOR OIL LEAKAGE, VIBRATION, NOISE ,TEMP. RISE. REDUCTION RATIO, BACKLASH , CONTACT PATTERN	MA	PERFORMANCE	100%	APPROVED DRGS /No leakage,Noise 85dbA maxat 1 mtrs, vibration 75 microns max, oil temp rise 20 deg above ambient max		- DO -	√	P	V	V		
3.0	ELECTRICALS													
1	MOTORS & CABLES	Make, type , rating	MA	Visual /measurment	100%	Apprvd drg	IS 325 / IS:3938	IR, MTC	√	P	V	V	For motor refer Note: 2	
		ROUTINE TESTS												
3	LIMIT SWITCHES,SFU, ISOLATOR/ O/L RELAY, MCB, FUSES,PUSH BUTTONS,CONTACTOR, INDICATING LAMPS etc	Make , type , rating, functional, Continuity	MA	Review of TC	100%	Approved drgs		IR	√	P	V	V		
4	BRAKES	Make , type , rating, HV/IR, Functional test	MA	Review of TC	100%	Approved drgs		IR, MTC	√	P	V	V		
5	DSL	Make , type , rating, dimension	MA	Review of TC	100%	Approved drgs		IR	√	P	V	V		
6	Control transformer	Make , type , rating, input/output	MA	Review of TC	100%	Approved drgs		IR	√	P	V	V		
	CONTROL PANEL, PENDANT SWITCH	* FIXING OF COMPONENTS WIRING MARKING CONTINUITY * FUNCTIONAL TEST * IR & H.V. TEST * IP - PROTECTION TEST * PAINT SHADE, THICKNESS, SHEET THICKNESS, ADHESION TEST * DIMENSION	MA	VISUAL/MEASUR	100%	APPD.DRG. WIRING DIAGRAM,	APPD. DRG. WIRING DIAGRAM,	IR	√	P	V	V		
8	VVVF DRIVES (IF APPLICABLE)	MAKE , TYPE , RATING , ROUTINE TESTS	MA	VISUAL/ VERIFY	100%	APPROVED DRAWINGS	APPROVED DRAWINGS	MTC	√	P	V	V		
4.0	FINAL INSPECTION													

		MANUFACTURERS NAME & ADDRESS		MANUFACTURING QUALITY PLAN				PROJECT		1X660 MW BHUSAWAL TPS UNIT-6			
		AS PER APPROVED VENDOR LIST		ITEM:	ELECTRIC WIRE ROPE	QP NO		PACKAGE	ELECTRIC WIRE ROPE HOIST				
						REV	0	CONTRACT No					
						DATE		CONTRACTOR	BHEL-PEM				
						PAGE	1 of 4						
SI.No	COMPONENT & OPERATIONS	CHARACTERISTICS	CATEGORY	TYPE OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY				REMARKS
									D*	M	C	V	
1	2	3	4	5	6	7	8	9		**	10	11	
4.1	COMPLETELY ASSEMBLED HOIST	1. COMPLETENESS, CORRECTNESS, WELD QUALITY, OVERALL DIMENSIONS.	MA	VISUAL, MEAS	100%	APPD. DRG.	APPD. DRG.	MNFRS' TEST CERT.	√	P	W	V	CHP
4.2	ASSEMBLED HOIST PERFORMANCE WITH ACTUAL CONTROL PANEL, AND PENDENT PUSH BUTTON	1. LOAD TEST	CR	LOAD TEST at SWL	100%	IS:6547 / IS:3938	IS:6547 / IS:3938	MNFRS' TEST CERT.	√	P	W	V	CHP
		2. HOISTING & LOWERING SPEED, PERFORMANCE OF CONTROLLERS SWITCHES CONTACTORS, RELAYS AND OTHER CONTROL DEVICES CORRELATIONS OF CIRCUITS AND INTERLOCKS AND SEQUENCES OF OPERATION, CURRENT MEASUREMENT, LIMIT SWITCH OPERATION.	CR	MEAS & VISUAL	100%	IS:3938, TECH SPEC.	TECH SPEC.	MNFRS' TEST CERT.	√	P	W	V	CHP
		3. OPERATION OF ALL PROTECTIVE DEVICES	CR	VISUAL	100%	TECH SPEC	TECH SPEC.	MNFRS' TEST CERT.	√	P	W	V	CHP
4.3	OVER LOAD TEST	OVER LOAD TEST INCLUDING HOLDING CAPACITY OF BRAKES, LIFTING LOAD FROM MID AIR, SOUNDNESS OF WELD AFTER OVERLOAD	CR	TEST AT 125 % OF-SWL	100%	IS:3938	IS:3938	INSPN. REPORT	√	P	W	V	CHP
5	PAINING												
5.1	PRIMER & FINISHING AND SHADE	Examination - Shade, DOP by paper insertion method	MI	visual	100%	DRG. & DATA SHEET & RELV. IS SPEC.		MNFRS' TEST CERT.		P	V		
		DFT	MA	measurement	Sample					P	V		
6	PACKING	STURDINESS, PROTECTION MARKING	MA	VISUAL	100%	MFG STD	MFG STD			P			
	NOTE:												
1	When back wall echo is set to 100% in sound area then a) defect echo shall not exceed 20% b) Back echo shall be minimum 80% in any area.												
2	Less than 30 KW. Acceptance of motor less than 30 KW is based on COC of the manufacturer & the contractor confirming as follows : It is hereby confirmed that the above mentioned motor/motors was/were manufactured taking care of specific requirement regarding ambient temp, voltage & frequency variation, hot start, pull out torque, starting KVA/KW, temp rise, distance between center of stud and gland plate and tested in accordance with approved drawing/data sheet.												
LEGENDS													
		* RECORDS IDENTIFIED WITH 'TICK' SHALL BE ESSENTIALLY INCLUDED BY MANUFACTURER IN QA DOCUMENTATION.											
		** M: MANUFACTURER/SUBCONTRACTOR											
		C: BHEL/BHEL NOMINATED THIRD PARTY INSPECTION AGENCY											
MANUFACTURER/ SUB CONTRACTOR		N: CUSTOMER/CUSTOMER'S CONSULTANT/CUSTOMER'S APPOINTED THIRD PARTY											
		"P"- PERFORM", "W"- WITNESS AND "V"- VERIFICATION											
SIGNATURE		"CHP" CUSTOMER HOLD POINT											
						REVIEWED BY	NAME & SIGN OF APPROVING AUTHORITY & SEAL						

	1x660MW BHUSAWAL TPS VENTILATION SYSTEM LIST OF DOCUMENTS TO BE SUBMITTED WITH BID	SPECIFICATION No: PE-TS-415-554-A001	
		SECTION : II	
		SUB-SECTION : 2	
		REV: 00	
		SHEET 1 OF 1	

BIDDER SHOULD SUBMIT THE SIGNED AND STAMPED COPY OF THE FOLLOWING DOCUMENTS:

1. Compliance cum confirmation certificate
2. Guaranteed power consumption
3. Un priced format
4. Deviation schedule /No deviation certificate in attached format 'Deviation sheet (Cost of withdrawal)'.
5. Pre bid clarification schedule (as applicable)



**1x660MW BHUSAVAL TPS
VENTILATION SYSTEM
COMPLIANCE CUM CONFIRMATION
CERTIFICATE**

SPECIFICATION No: PE-TS-415-554-A001

SECTION : II

SUB-SECTION : 3

REV. NO. 00

SHEET: 1 OF 2

COMPLIANCE CUM CONFIRMATION CERTIFICATE

The bidder shall confirm compliance with following by signing / stamping this compliance certificate (every sheet) and furnish same with the offer.

- a) The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusions, other than those mentioned under "exclusion and those resolved as per 'Schedule of Deviations', with regard to same.
- b) There are no other deviations w.r.t. specifications other than those furnished in the 'Schedule of Deviations'. Any other deviation, stated or implied, taken elsewhere in the offer stands withdrawn unless specifically brought out in the 'Schedule of Deviations'
- c) Bidder shall submit QP in the event of order based on the guidelines given in the specification & QP enclosed therein. QP will be subject to BHEL / CUSTOMER approval & customer hold points for inspection / testing shall be marked in the QP at the contract stage. Inspection / testing shall be witnessed as per same apart from review of various test certificates/ Inspection records etc. This is within the contracted price without any extra implications to BHEL after award of the contract.
- d) All drawings/ data-sheets / calculations etc. submitted along with the offer shall not be taken cognizance off.
- e) The offered materials shall be either equivalent or superior to those specified in the specification & shall meet the specified / intended duty requirements. In case the material specified in the specifications is not compatible for intended duty requirements then same shall be resolved by the bidder with BHEL during the pre-bid discussions, otherwise BHEL / Customer's decision shall be binding on the bidder whenever the deficiency is pointed out.

For components where materials are not specified, same shall be suitable for intended duty, all materials shall be subject to approval in the event of order.

- f) The commissioning spares shall be supplied on 'As Required Basis' & prices for same included in the base price itself.
- g) All sub vendors shall be subject to BHEL / CUSTOMER approval in the event of order.
- h) Guarantee for plant/equipment shall be as per relevant clause of GCC / SCC / Other Commercial Terms & Conditions
- i) In the event of order, all the material required for completing the job at site shall be supplied by the bidder within the ordered price even if the same are additional to approved billing break up, approved drawing or approved Bill of quantities within the scope of work as tender specification. This clause will apply in case during site

	1x660MW BHUSAWAL TPS VENTILATION SYSTEM COMPLIANCE CUM CONFIRMATION CERTIFICATE	SPECIFICATION No: PE-TS-415-554-A001	
		SECTION : II	
		SUB-SECTION : 3	
		REV. NO. 00	
		SHEET: 2 OF 2	
commissioning, additional requirements emerges due to customer and / or consultant's comments. No extra claims shall be put on this account j) Schedule of drawings submissions, comment incorporations & approval shall be as stipulated in the specifications. The successful bidder shall depute his design personnel to BHEL's / Customer's / Consultant's office for across the table resolution of issues and to get documents approved in the stipulated time. k) As built drawings shall be submitted as and when required during the project execution. l) The bidder has not tempered with this compliance cum confirmation certificate and if at any stage any tempering in the signed copy of this document is noticed then same shall be treated as breach of contract and suitable actions shall be taken against the bidder. m) Successful bidder shall furnish detailed erection manual for each of the equipment supplied under this contract at least 3 months before the scheduled erection of the concerned equipment / component or along with supply of concerned equipment / component whichever is earlier. n) Document approval by customer under Approval category or information category shall not absolve the vendor of their contractual obligations of completing the work as per specification requirement. Any deviation from specified requirement shall be reported by the vendor in writing and require written approval. Unless any change in specified requirement has been brought out by the vendor during detail engineering in writing while submitting the document to customer for approval, approved document (with implicit deviation) will not be cited as a reason for not following the specification requirement. o) In case vendor submits revised drawing after approval of the corresponding drawing, any delay in approval of revised drawing shall be to vendor's account and shall not be used as a reason for extension in contract completion.			



**1x660MW BHUSAWAL TPS
VENTILATION SYSTEM
PRE-BID CLARIFICATION SCHEDULE**

SPECIFICATION No: PE-TS-415-554-A001

SECTION : II

SUB-SECTION : 4

REV. NO. 00

SHEET: 1 OF 1

PRE-BID CLARIFICATION SCHEDULE

S. NO.	SECTION/CLAUSE/PAGE NO.	STATEMENT OF THE REFERRED CLAUSE	CLARIFICATION REQUIRED

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

Signature: _____

Name: _____

Designation: _____

Company: _____

Date: _____

Company Seal

	1x660MW BHUSAWAL TPS VENTILATION SYSTEM DEVIATION SHEET (COST OF WITHDRAWAL)	SPECIFICATION No: PE-TS-415-554-A001	
		SECTION : II	
		SUB-SECTION : 5	
		REV: 00	
DEVIATION SHEET (COST OF WITHDRAWAL) (Refer GCC and unpriced schedule for cost of withdrawal format)			

	1x660MW BHUSAWAL TPS VENTILATION SYSTEM GUARANTEED POWER CONSUMPTION	SPECIFICATION No: PE-TS-415-554-A001	
		SECTION : II	
		SUB-SECTION : 6	
		REV: 00	

GUARANTEED POWER CONSUMPTION

Guaranteed Power Consumption For Ventilation System (ANNEXURE I)							
NAME OF PROJECT:			1X660 MW BHUSAWAL TPS				
NAME OF PACKAGE:			VENTILATION SYSTEM				
TECHNICAL SPECIFICATION No:			PE-TS-415-554-A001_Rev 00				
S.NO.	DESCRIPTION OF EQUIPMENT	NO OF EQUIPMENT		TOTAL GUARANTEED POWER CONSUMPTION FOR EACH EQUIPMENT AT MOTOR INPUT TERMINAL AND CONTROL PANEL (IN KW)	DUTY FACTOR		TOTAL KW
		WORKING	STANDBY				
		3A	3B	4	5		6=3Ax4x5
1	VENTILATION SYSTEM FOR TG BUILDING & ESP BUILDING						
1.1	Centrifugal Fan of cap. 1,25,000 CMH at min. 75 mmwc static pr for air washers.	8	0		1		
1.2	Pumps for circulation of water in spray chamber of above air washer	4	4		1		
1.3	RE Units 50,000 cmh at 15mmwc	13	0		1		
1.4	Centrifugal Fan of cap. 40,000 CMH at min. 65 mmwc static pr for UAF.	2	2		1		
1.5	Pump for above UAF.	1	3		1		
2	VENTILATION SYSTEM FOR FGD SCOPE						
2.1	Cable vault of FGD control room (6 nos. axial flow supply fan each of capacity 10000 CMH at	6	0		1		
2.2	Switchgear room of FGD control room (9 nos. axial flow supply fan each of capacity 10000 CMH at 30 MWC)	9	0		1		
2.3	Battery room of FGD control room (1 no. axial flow exhaust fan of capacity 7500 CMH at 15 MWC)	1	0		1		
2.4	Wet ball mill building (9 nos. axial flow exhaust fan of capacity 15000 CMH at 10 MWC)	9	0		1		
2.5	Gypsum dewatering building (21 nos. axial flow exhaust fan of capacity 15000 CMH at 10 MWC)	21	0		1		
2.6	Oxidation blower and RC pump house (7 nos. axial flow exhaust fan of capacity 15000 CMH at 10 MWC)	7	0		1		
				TOTAL (KW)			
Note:	Estimated power consumption (EPC) figure for the system (for working drives only) has been considered as 581 KW. So long bidder's quoted guaranteed power consumption (GPC) above remains within this EPC, there will be no technical loading of bid on power consumption for evaluation. However, if bidder's quoted GPC exceeds EPC, there shall be technical loading of bid for evaluation @ Rs 4,50,000/- per KW of additional power over EPC. Bidder's guaranteed power consumption at motor input terminals (not shaft power) as furnished in relevant schedule shall be demonstrated by the successful bidder during performance testing at works/ site. In case power consumption is noted higher than EPC / bidder's quoted GPC whichever is higher, during inspection/ PG test, penalty @ Rs 4,50,000/- per KW shall be levied on vendor.						
Particulars of bidder / authorised representative							
Name	Designation	Signature	DATE	Company Seal			

Guaranteed Power Consumption For Ventilation System (ANNEXURE II)							
NAME OF PROJECT:			1X660 MW BHUSAWAL TPS				
NAME OF PACKAGE:			VENTILATION SYSTEM				
TECHNICAL SPECIFICATION No:			PE-TS-415-554-A001_Rev 00				
S.NO.	DESCRIPTION OF EQUIPMENT	NO OF EQUIPMENT		TOTAL GUARANTEED POWER CONSUMPTION FOR EACH EQUIPMENT AT MOTOR INPUT TERMINAL AND CONTROL PANEL (IN KW)	DUTY FACTOR		TOTAL KW
		WORKING	STANDBY				
		3A	3B	4	5		6=3Ax4x5
A	VENTILATION SYSTEM FOR AUXILIARY BUILDING						
1	Compressor house (6 nos. axial flow supply fan of capacity 10000 CMH at 20 MWC)	6	0		1		
2	Compressor house cable vault (2 nos. axial flow supply fan of capacity 6000 CMH at 30 MWC)	2	0		1		
3	Compressor house MCC room (2 nos. axial flow supply fan of capacity 7500 CMH at 30 MWC)	2	0		1		
4	Gas cylinder room at 0 M, A row grid 5-6 (1 no. axial flow exhaust fan of capacity 7500 CMH at 15 MWC)	1	0		1		
5	Inert gas room at 0 M,DE bay (2 no. axial flow exhaust fan of capacity 15000 CMH at 15 MWC)	2	0		1		
6	MCC room at 0 M DE bay of power house (2 nos. axial flow supply fan of capacity 7500 CMH at 30 MWC)	2	0		1		
7	cable vault at 0 M DE bay of power house (1 no. axial flow supply fan of capacity 10000 CMH at 30 MWC)	1	0		1		
8	AC plant room at 0 M of power house (6 nos. axial flow supply fan of capacity 10000 CMH at 20 MWC)	6	0		1		
9	Non AC area of SWAS room at 0 M BC bay of power house (1 no. axial flow supply fan of capacity 6000 CMH at 30 MWC)	1	0		1		
10	24 V BATTERY ROOM AT EL. 8.5 M TG Bldg. GRID 1-3-EF (6 no. axial flow exhaust fan of capacity 15000 CMH at 15 MWC)	3	3		1		
11	220 V BATTERY ROOM AT EL. 8.5 M TG Bldg. GRID 1-2-CDE (10 no. axial flow exhaust fan of capacity 10000 CMH at 15 MWC)	5	5		1		
12	Non AC area of Excitation panel room at 17 m A row side, grid 4-6 (1 no. axial flow supply fan of capacity 7500 CMH at 30 MWC)	1	0		1		

13	Mill bunker tripper floor along grid Mr-Nr (6 no. RE unit fan of capacity 40000 CMH at 15 MWC)	6	0		1		
14	Mill bunker tripper floor along grid MI-NI (6 no. RE unit fan of capacity 40000 CMH at 15 MWC)	6	0		1		
15	DG building (14 nos. axial flow supply fan of capacity 10000 CMH at 20 MWC)	14	0		1		
16	Clarified water pump house (3 nos. axial flow supply fan of capacity 10000 CMH at 20 MWC)	3	0		1		
17	Electrical Annexe MCC of Clarified water pump house (5 nos. axial flow supply fan of capacity 10000 CMH at 30 MWC)	5	0		1		
18	CW pump house (12 nos. axial flow supply fan of capacity 10000 CMH at 20 MWC)	12	0		1		
19	Electrical Annexe MCC of CW pump house (2 nos. axial flow supply fan of capacity 7500 CMH at 30 MWC)	2	0		1		
20	Electrical Annexe cable vault of Clarified water pump house (1 nos. axial flow supply fan of capacity 7500 CMH at 30 MWC)	1	0		1		
21	Electrical room of Chemical LAB (1 nos. axial flow supply fan of capacity 4000 CMH at 30 MWC)	1	0		1		
22	Water analysis of Chemical LAB (2 no. axial flow exhaust fan of capacity 7500 CMH at 15 MWC)	2	0		1		
23	Instrumentation room of chemical lab (1 no. axial flow exhaust fan of capacity 7500 CMH at 15 MWC)	1	0		1		
24	Gen. LAB equipment of chemical lab (1 no. axial flow exhaust fan of capacity 10000 CMH at 15 MWC)	1	0		1		
25	Environmental of chemical lab (1 no. axial flow exhaust fan of capacity 10000 CMH at 15 MWC)	1	0		1		
26	Coal fuel / oil testing lab of chemical lab (1 no. axial flow exhaust fan of capacity 15000 CMH at 15 MWC)	1	0		1		
27	FOPH unloading pump house (3 no. axial flow exhaust fan of capacity 10000 CMH at 15 MWC)	3	0		1		
28	FOPH pressurising and heating pump house (4 no. axial flow exhaust fan of capacity 15000 CMH at 15 MWC)	4	0		1		
29	Electrical annexe of FOPH MCC room (3 nos. axial flow supply fan of capacity 10000 CMH at 30 MWC)	3	0		1		
30	Electrical annexe of FOPH cable vault (2 nos. axial flow supply fan of capacity 10000 CMH at 30 MWC)	2	0		1		

31	Service building AC PLANT ROOM (3 nos. axial flow supply fan of capacity 10000 CMH at 20 MWC)	3	0		1		
32	Service building MCC ROOM (2 nos. axial flow supply fan of capacity 10000 CMH at 30 MWC)	2	0		1		
33	Foam pump house (2 nos. axial flow supply fan of capacity 10000 CMH at 20 MWC)	2	0		1		
34	Store I (14 no. axial flow exhaust fan of capacity 10000 CMH at 10 MWC)	14	0		1		
35	Store II (14 no. axial flow exhaust fan of capacity 10000 CMH at 10 MWC)	14	0		1		
36	Fire water booster pump house (1 nos. axial flow supply fan of capacity 7500 CMH at 20 MWC)	1	0		1		
37	CPU regeneration building (8 no. axial flow exhaust fan of capacity 15000 CMH at 15 MWC)	8	0		1		
38	Battery room of CPU regeneration building (2 no. axial flow exhaust fan of capacity 7500 CMH at 15 MWC)	2	0		1		
39	Electrical Annexe MCC of CPU regeneration building (2 nos. axial flow supply fan of capacity 7500 CMH at 30 MWC)	2	0		1		
40	Electrical Annexe cable vault of CPU regeneration building (1 no. axial flow supply fan of capacity 7500 CMH at 30 MWC)	1	0		1		
41	Empty storage cylinder area of Gas cylinder storage area (2 no. axial flow exhaust fan of capacity 10000 CMH at 15 MWC)	2	0		1		
42	Full storage cylinder area of Gas cylinder storage area (3 no. axial flow exhaust fan of capacity 10000 CMH at 15 MWC)	3	0		1		
43	Raw and fire water pump house (10 nos. axial flow supply fan of capacity 10000 CMH at 20 MWC)	10	0		1		
44	MCC room of Raw and fire water pump house (3 nos. axial flow supply fan of capacity 6000 CMH at 30 MWC)	3	0		1		
45	Cable vault of Raw and fire water pump house (3 nos. axial flow supply fan of capacity 6000 CMH at 30 MWC)	2	0		1		
46	CST pump house (4 nos. axial flow supply fan of capacity 10000 CMH at 20 MWC)	4	0		1		
47	compressor house area of Amonia unloading and storage area of SCR (2 no. axial flow exhaust fan of capacity 10000 CMH at 15 MWC)	2	0		1		
48	Main area Ozonation plant-air dryer area (2 no. axial flow exhaust fan of capacity 10000 CMH at 15 MWC)	2	0		1		

49	Main area Ozonation plant-Ozone generator area (5 no. axial flow exhaust fan of capacity 15000 CMH at 15 MWC)	5	0		1		
50	MCC room of Ozone building (2 nos. axial flow supply fan of capacity 7500 CMH at 30 MWC)	2	0		1		
51	Battery room of Ozone building (2 no. axial flow exhaust fan of capacity 7500 CMH at 15 MWC)	1	1		1		
52	UF-RO-MB Building (7 no. axial flow exhaust fan of capacity 15000 CMH at 15 MWC)	7	0		1		
53	MCC Room of UF-RO-MB Building (3 nos. axial flow supply fan of capacity 7500 CMH at 30 MWC)	3	0		1		
54	Chemical store room in UF-RO-MB Building (1 no. axial flow exhaust fan of capacity 4000 CMH at 15 MWC)	1	0		1		
55	Laboratry in UF-RO-MB Building (1 no. axial flow exhaust fan of capacity 2000 CMH at 15 MWC)	1	0		1		
56	UF area clear height 10.0M in UF-RO-MB Building (7 no. axial flow exhaust fan of capacity 10000 CMH at 10 MWC)	7	0		1		
57	MB area clear height 7.5M in UF-RO-MB Building (5 no. axial flow exhaust fan of capacity 10000 CMH at 10 MWC)	5	0		1		
58	Battery room in UF-RO-MB Building (2 no. axial flow exhaust fan of capacity 4000 CMH at 15 MWC)	1	1		1		
59	Exhaust fan for AMT Building (1 no. axial flow exhaust fan of capacity 15000 CMH at 15 MWC)	1	0		1		
60	PT Plant Chemical house ground floor-Lime stone room (2 no. axial flow exhaust fan of capacity 10000 CMH at 15 MWC)	2	0		1		
61	PT Plant Chemical house ground floor-Alum stone room (2 no. axial flow exhaust fan of capacity 10000 CMH at 15 MWC)	2	0		1		
62	PT Plant Chemical house ground floor- MCC room (2 nos. axial flow supply fan of capacity 7500 CMH at 30 MWC)	2	0		1		

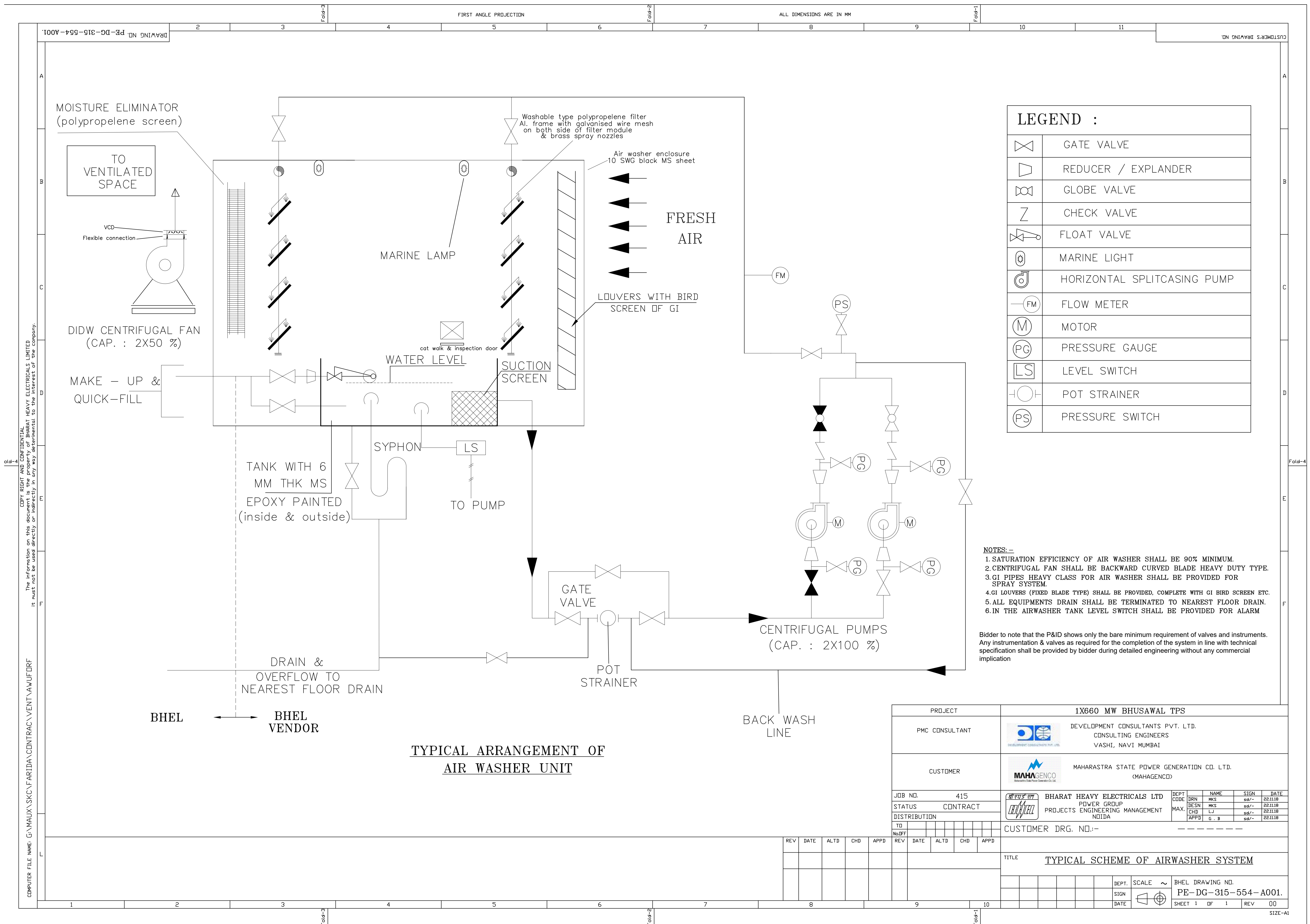
63	PT Plant Chemical house ground floor- Battery room (2 no. axial flow exhaust fan of capacity 4000 CMH at 15 MWC)	1	1		1		
64	PT Plant Chemical house first floor area (6 no. axial flow exhaust fan of capacity 15000 CMH at 15 MWC)	6	0		1		
65	Ozonation & CW Treatment plant-Chemical house (1 no. axial flow exhaust fan of capacity 4000 CMH at 15 MWC)	1	0		1		
66	MCC Room of Ozonation & CW treatment (2 nos. axial flow supply fan of capacity 7500 CMH at 30 MWC)	2	0		1		
67	Battery room in Ozonation & CW treatment Building (2 no. axial flow exhaust fan of capacity 4000 CMH at 15 MWC)	1	1		1		
68	STP area-Skid area (2 no. axial flow exhaust fan of capacity 7500 CMH at 15 MWC)	2	0		1		
69	ETP area- ETP Chemical store room (1 no. axial flow exhaust fan of capacity 4000 CMH at 15 MWC)	1	0		1		
70	ETP area-Skid area (1 no. axial flow exhaust fan of capacity 7500 CMH at 15 MWC)	1	0		1		
71	ETP area- MCC room (1 no. axial flow supply fan of capacity 7500 CMH at 30 MWC)	1	0		1		
72	DM Transfer Pump house (2 no. axial flow supply fan of capacity 7500 CMH at 20 MWC)	2	0		1		
				TOTAL (KW)			

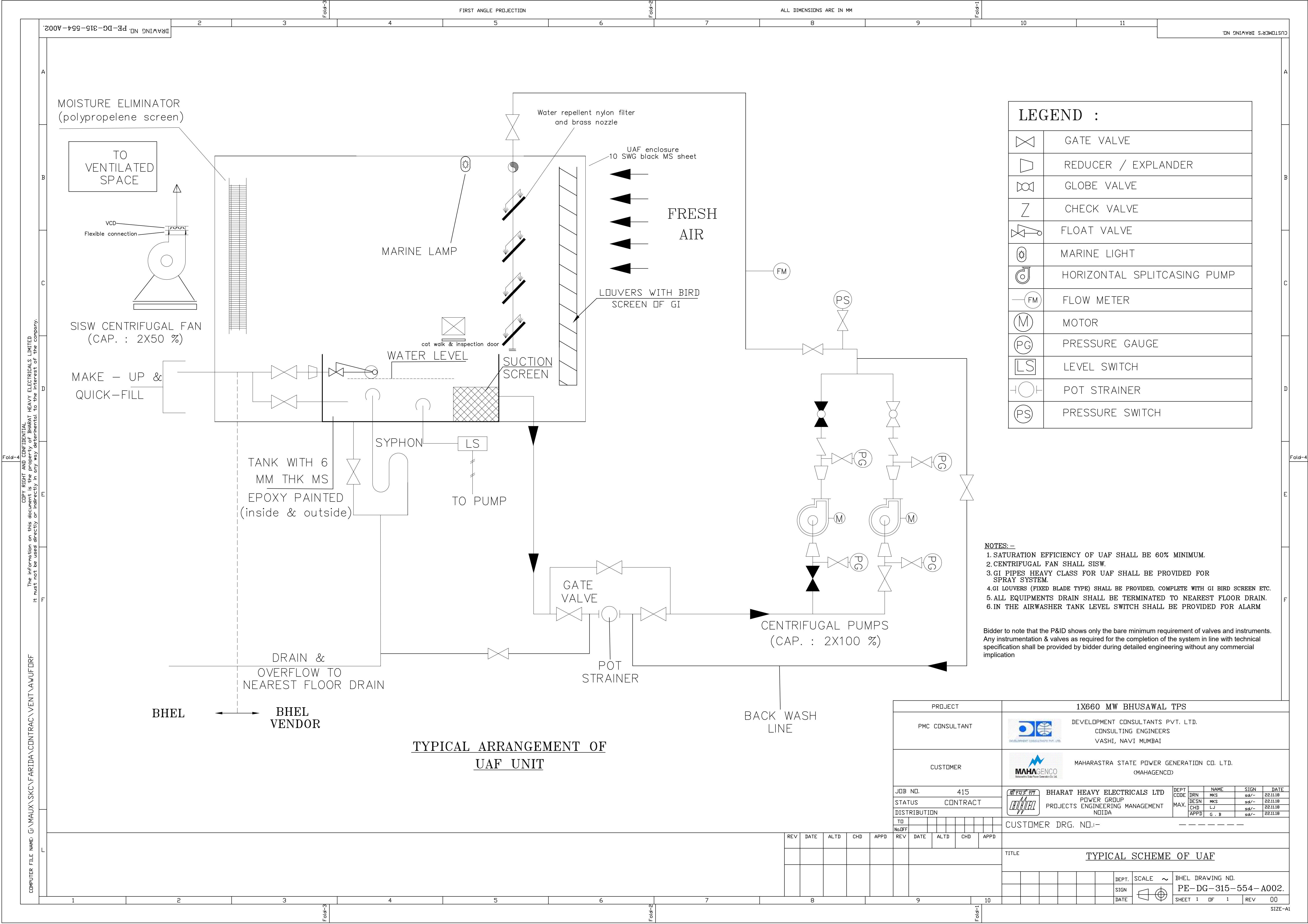
Note:	Estimated power consumption (EPC) figure for the system (for working drives only) has been considered as 300 KW. So long bidder's quoted guaranteed power consumption (GPC) above remains within this EPC, there will be no technical loading of bid on power consumption for evaluation. However, if bidder's quoted GPC exceeds EPC, there shall be technical loading of bid for evaluation @ Rs 4,50,000/- per KW of additional power over EPC. Bidder's guaranteed power consumption at motor input terminals (not shaft power) as furnished in relevant schedule shall be demonstrated by the successful bidder during performance testing at works/ site. In case power consumption is noted higher than EPC / bidder's quoted GPC whichever is higher, during inspection/ PG test, penalty @ Rs 4,50,000/- per KW shall be levied on vendor.
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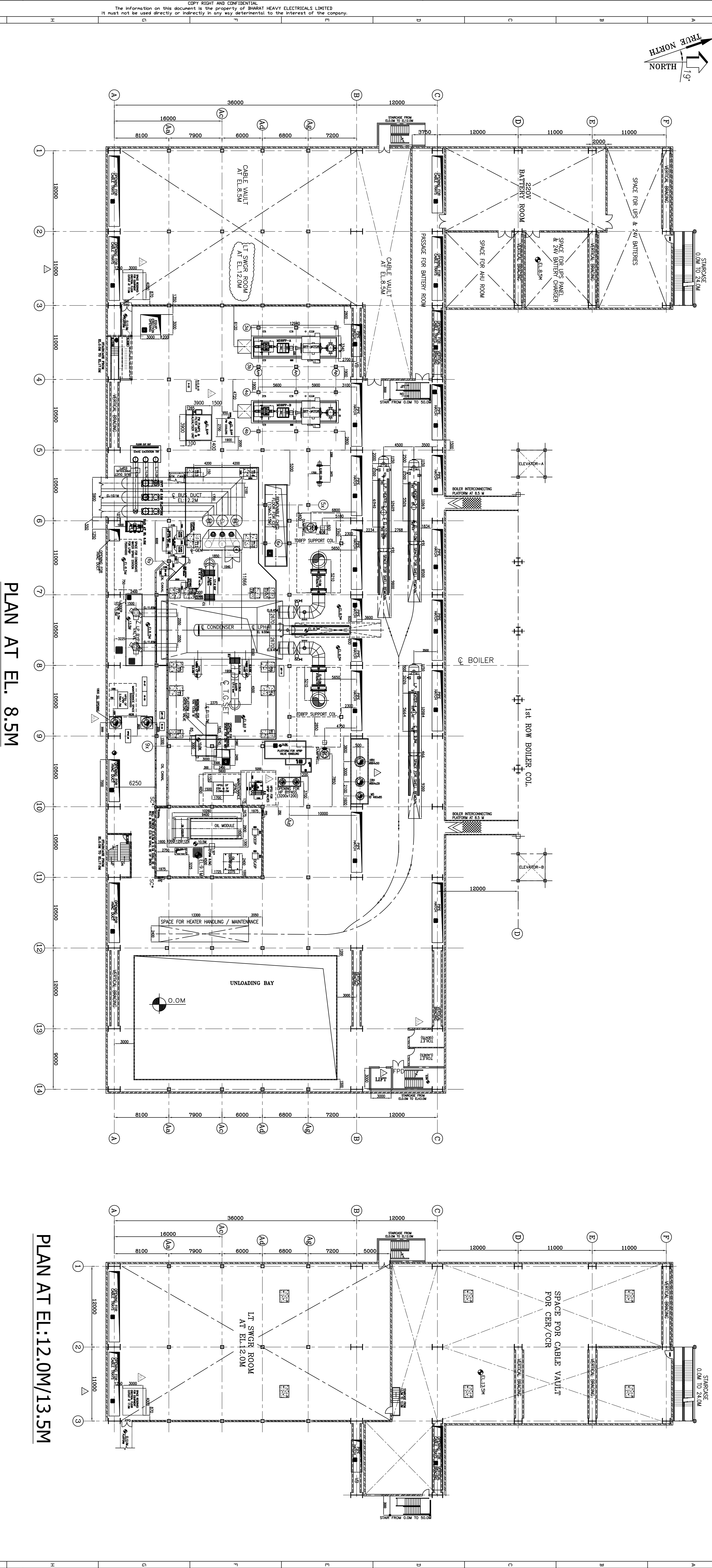
Particulars of bidder / authorised representative					
Name	Designation	Signature	DATE	Company Seal	

	1x660MW BHUSAWAL TPS VENTILATION SYSTEM DRAWINGS	SPECIFICATION No: PE-TS-415-554-A001	
		SECTION : II	
		SUB-SECTION : 7	
		REV: 00	

DRAWINGS







The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED
 It must not be used directly or indirectly in any way detrimental to the interest of the company.

LEGEND:

-  CHECKERED PLATE FLOORING
-  REMOVABLE CHECKERED PLATE
-  GRADED FLOORING
-  REMOVABLE GRATING
-  CONCRETE BLOCK
-  HAND RAILING
-  PAPERET WALL
-  GLASS PARTITION
-  OUT OUTS
-  BRICK WALL

REFERENCE DRAWING:

1. TG EQUIPMENT LAYOUT AT GROUND FLOOR (1.0M)
 2. TG EQUIPMENT LAYOUT AT OPERATING FLOOR (17.0M)
 3. TG EQUIPMENT LAYOUT AT MISC. FLOORS ABOVE OPERATING FLOOR (17.0M)
 4. CROSS SECTION OF MAIN PLANT
 5. GENERAL ARRANGEMENT OF MAIN PLANT
 6. GENERAL ARRANGEMENT OF NO. BPP SET
 7. GENERATOR OUTLINE
 8. GENERAL ARRANGEMENT OF LP HEATER No.1
 9. FOUNDATION DETAILS OF GEN. AUXILIARY EQUIPMENTS
 10. GENERAL ARRANGEMENT OF LP HEATER No.2
 11. OIL ROOM ARRANGEMENT
 12. GENERAL ARRANGEMENT OF LP HEATER No.3
 13. GENERAL ARRANGEMENT OF LP HEATER No.4
 14. GENERAL ARRANGEMENT OF LP HEATER No.5
 15. LIST OF JUNCTION BOX
 16. LIST OF TURBINE-GENERATOR W/ AIR CONTROL CABINET

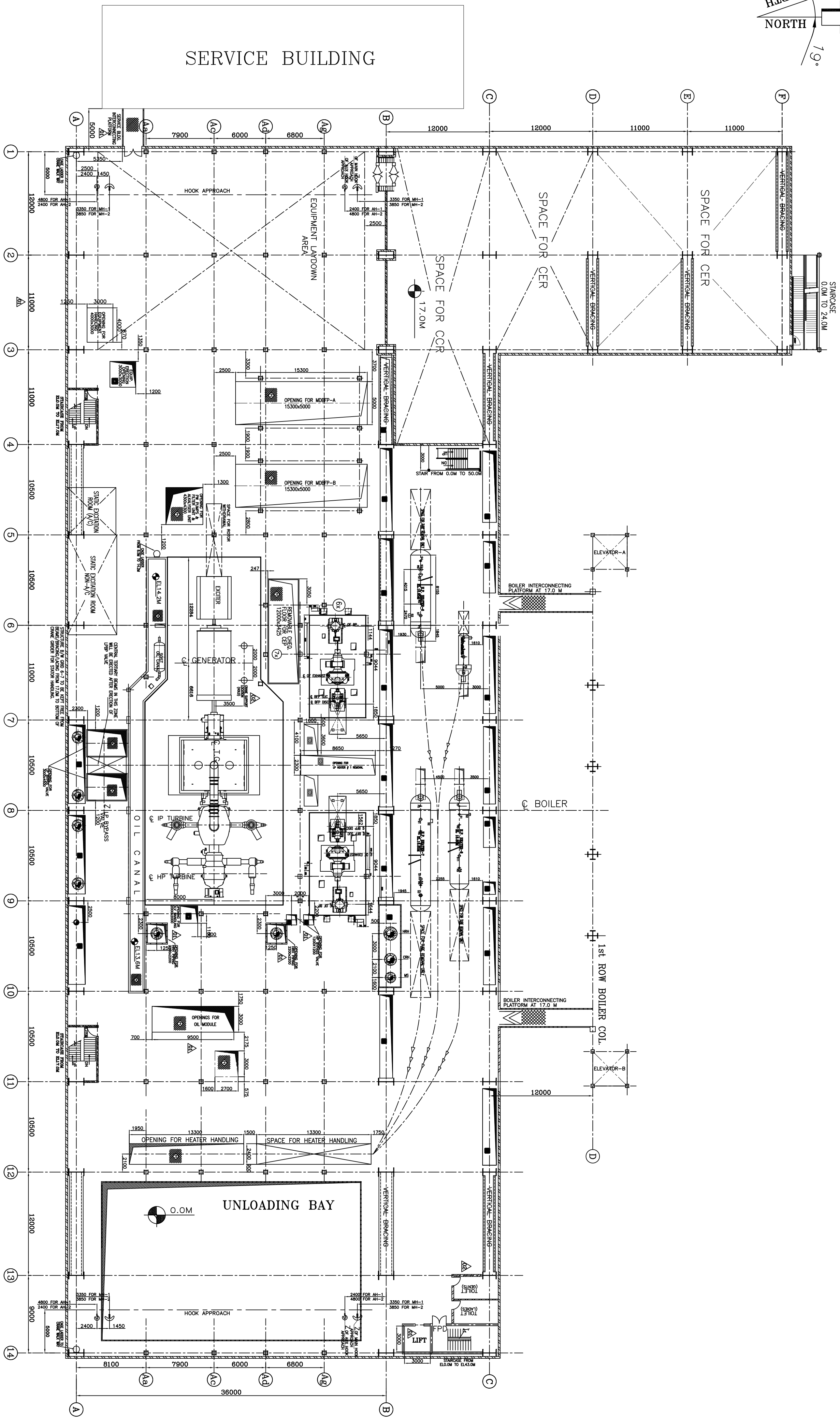
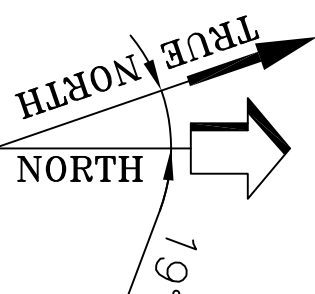
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NOTES:

1. ALL DIMENSIONS ARE IN MM'S AND LEVELS ARE IN METRES.
2. ALL ELEVATIONS INDICATED IN THE DRG. ARE W.R.T. POWER HOUSE GROUND FLOOR
3. GROUND FLOOR ELEVATION AS 0.00M. EL 0.00M CORRESPONDS TO RL(+209.0M).

REV	DATE	ALTD	CHD	A
02	22.01.19	AK	AMT	PM
1.	DRAWING REVISED AS PER CUST COMMENTS DTD: 15.09.2018 & DCS COMMENTS 19.11.2018			
2.	DRAWING REVISED AS MARKED 			

[illegible]



PLAN AT EL. 17.0M

DETAIL OF LAY-OWN SPACE FOR THE COMPONENTS (HMD)			
ITEM	DESCRIPTION	WT IN KG	AREA IN M ²
01	HP WATER COOLING SYSTEM UNIT	20000	3.4 X 3.3
02	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
03	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
04	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
05	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
06	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
07	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
08	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
09	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
10	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
11	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
12	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
13	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
14	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
15	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
16	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
17	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
18	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
19	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
20	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
21	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
22	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
23	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
24	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
25	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
26	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
27	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
28	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
29	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
30	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
31	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
32	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
33	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
34	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
35	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
36	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
37	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
38	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
39	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
40	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
41	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
42	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
43	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
44	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
45	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
46	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
47	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
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49	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
50	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
51	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
52	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
53	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
54	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
55	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
56	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
57	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
58	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
59	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
60	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
61	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
62	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
63	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
64	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
65	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
66	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
67	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
68	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
69	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
70	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
71	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
72	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
73	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
74	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
75	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
76	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
77	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
78	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
79	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
80	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
81	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
82	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
83	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
84	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
85	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
86	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
87	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
88	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
89	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
90	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
91	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
92	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
93	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
94	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
95	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
96	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
97	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
98	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
99	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3
100	HP WATER COOLING SYSTEM UNIT	17000	3.4 X 3.3

EQUIPMENT LAYDOWN DETAIL

NOTES:

1. ALL DIMENSIONS ARE IN MM'S AND LEVELS ARE IN METRES.
2. ALL ELEVATIONS INDICATED IN THE DRG. ARE MSL POWER HOUSE GROUND FLOOR ELEVATION AS 0.00M. EL. 0.00M CORRESPONDS TO RL (+209.0M).

REFERENCE DRAWING:

1. TO EQUIPMENT LAYOUT AT GROUND FLOOR (0.0M)
2. TO EQUIPMENT LAYOUT AT MEZZANINE FLOOR (8.5M)
3. TO EQUIPMENT LAYOUT AT MISC. FLOORS ABOVE OPERATING
4. CROSS SECTION OF MAIN PLANT
5. GENERAL ARRANGEMENT OF MD BFP SET
6. FOUNDATION ARR. OF MD BFP SET
7. GENERAL ARRANGEMENT OF TO BFP SET
8. GENERAL ARRANGEMENT OF HP HEATER No. 6
9. GENERAL ARRANGEMENT OF HP HEATER No. 7
10. GENERAL ARRANGEMENT OF HP HEATER No. 8
11. GENERAL ARRANGEMENT OF DESUPER HEATER
12. GA OF SV DISCHARGE F/T
13. OIL CANAL DETAIL
14. LANDOWN SPACE FOR GENERATOR COMPONENTS
15. LANDOWN SPACE FOR STEAM TURBINE COMPONENTS
16. OIL ROOM ARRANGEMENT

(HOLD)

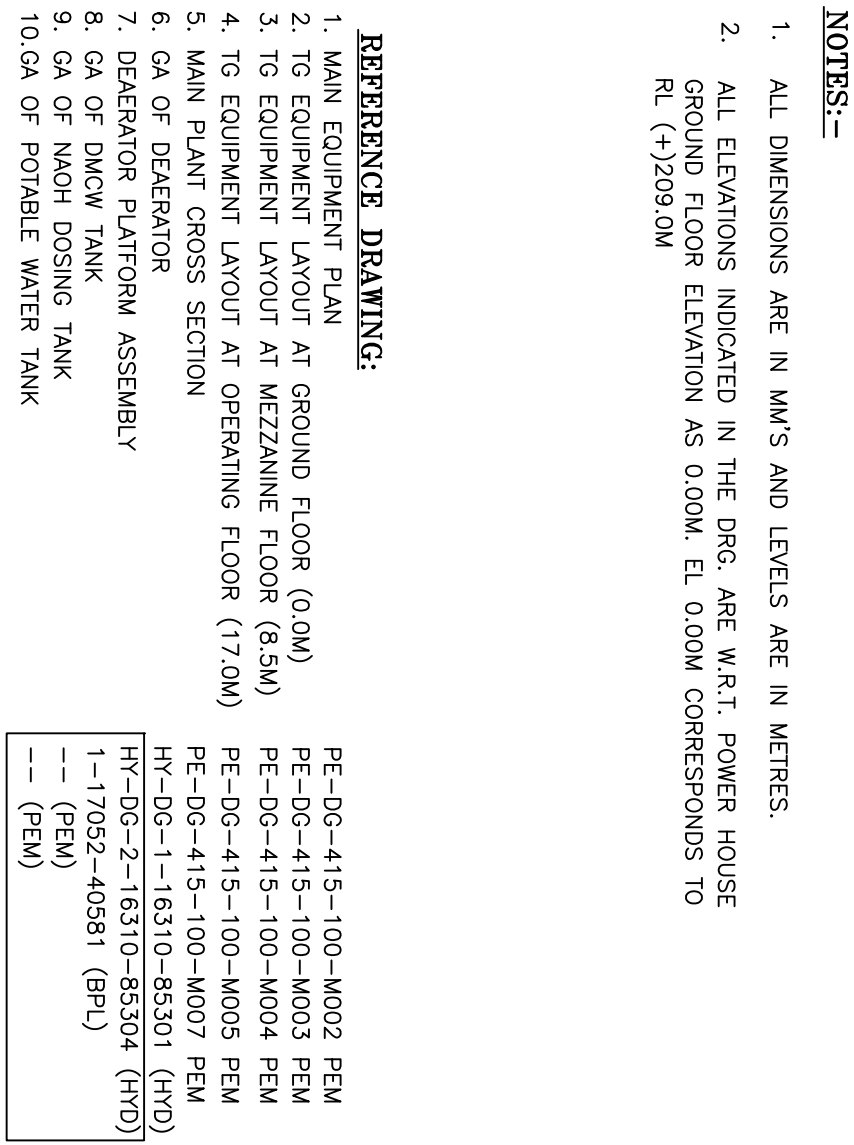
LEGEND:

- CHECKERED PLATE FLOORING
- REMOVEABLE CHECKERED PLATE
- GRADED FLOORING
- REMOVEABLE GRATING
- CONCRETE BLOCK
- CUT OUTS
- PIPE HATCH
- BRACING
- HAND RAILING
- PARAPET WALL
- GLASS PARTITION
- BRICK WALL

MAHARASHTRA STATE POWER GENERATION CO. LTD.
DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS
VASHI, NAVI MUMBAI

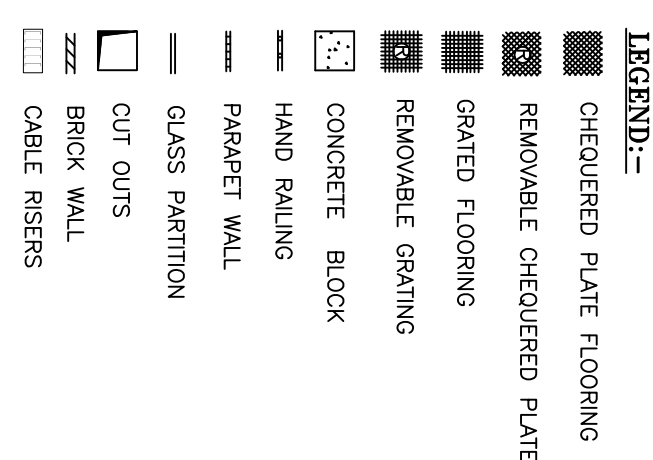
1x660 MW BHUSAWAL TPS UNIT-6
BHARAT HEAVY ELECTRICALS LTD
PROJECT ENGINEERING MANAGEMENT
INDIA

1x660 MW BHUSAWAL TPS UNIT-6
BHARAT HEAVY ELECTRICALS LTD
PROJECT ENGINEERING MANAGEMENT
INDIA
SCALE 1:150
PE-DG-415-100-M005
SHEET 1 OF 1
SIZE-A4

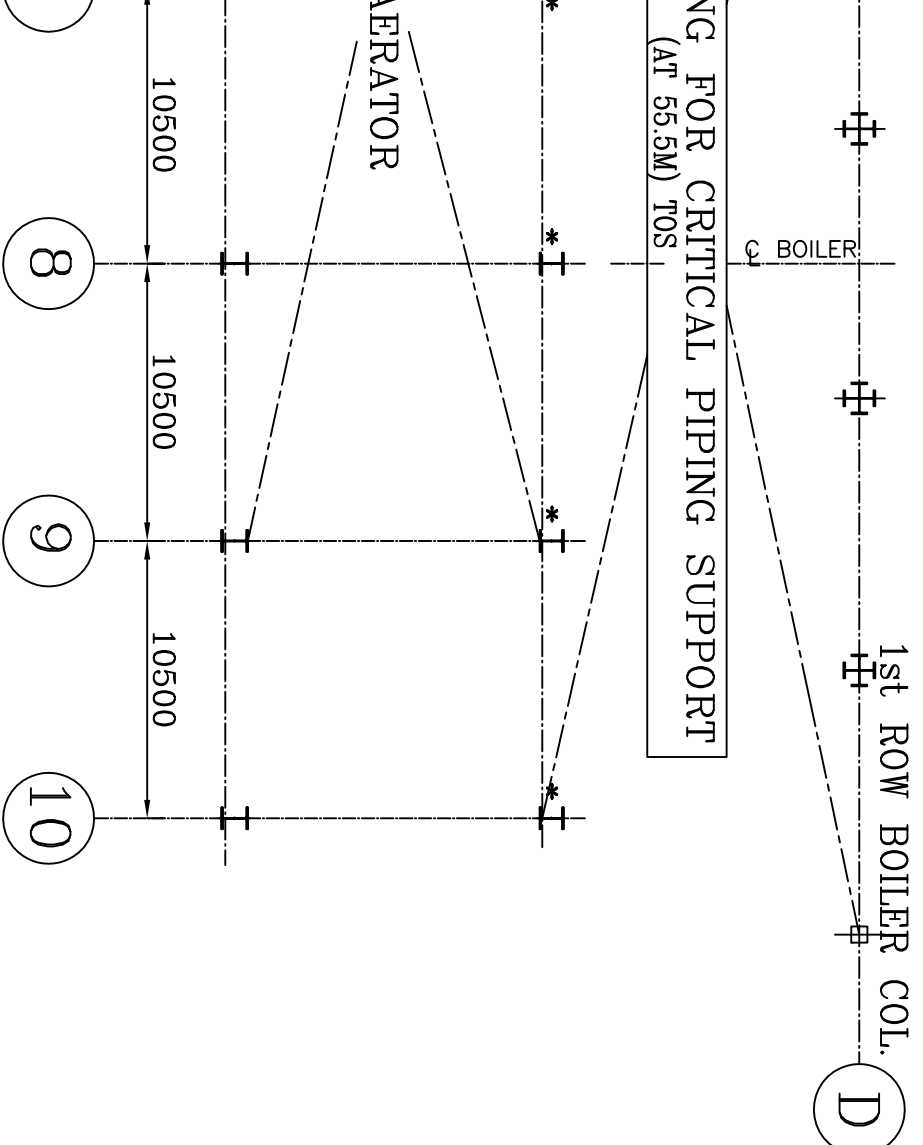


REFERENCE DRAWING:	
1. MAIN EQUIPMENT PLAN	PE-DG-415-100-N002 PEM
2. TG EQUIPMENT LAYOUT AT GROUND FLOOR (0.0M)	PE-DG-415-100-N003 PEM
3. TG EQUIPMENT LAYOUT AT MEZZANINE FLOOR (8.5M)	PE-DG-415-100-N004 PEM
4. TG EQUIPMENT LAYOUT AT OPERATING FLOOR (17.0M)	PE-DG-415-100-N005 PEM
5. MAIN PLANT CROSS SECTION	PE-DG-415-100-N007 PEM
6. CA OF DEAFERATOR	HY-DG-2-16310-85304 (HYD)
7. DEAFERATOR PLATFORM ASSEMBLY	HY-DG-2-16310-85304 (HYD)
8. CA OF DRYOW TANK	1-170502-40488 (BPT)
9. CA OF MOH DOWING TANK	--- (PEM)
10. CA OF PORTABLE WATER TANK	--- (PEM)

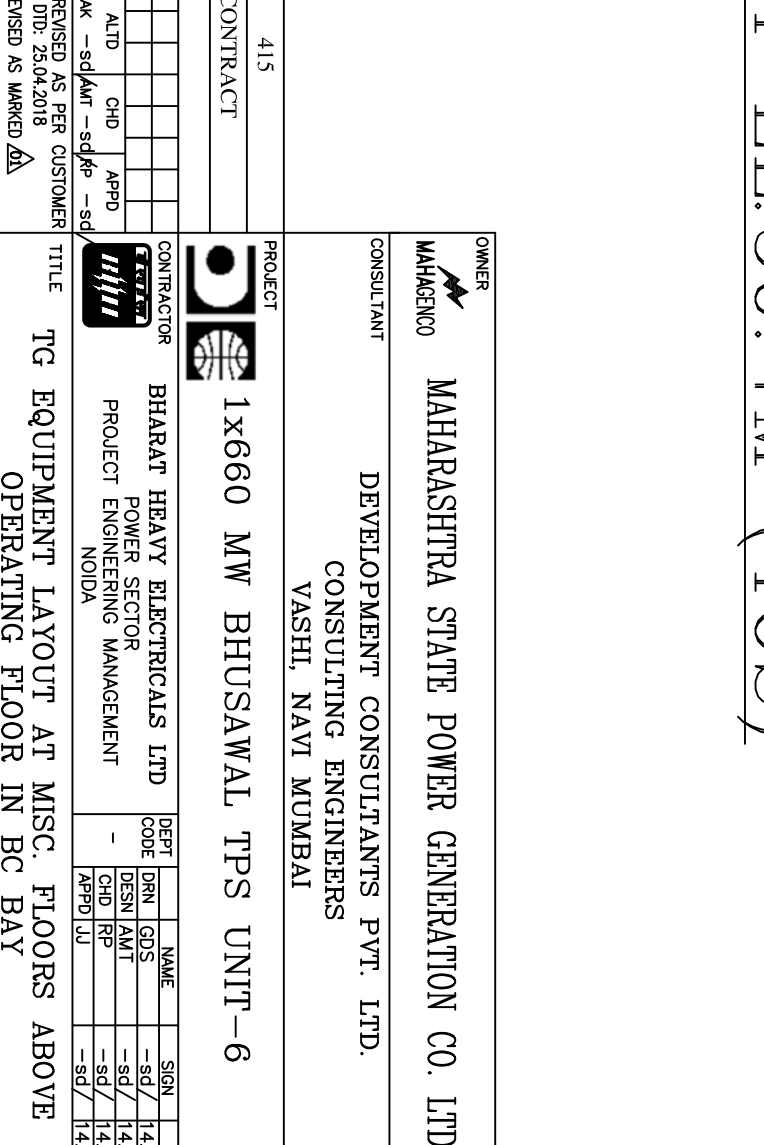
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1st ROW BOILER COL. D



T EL.50.4M (TOS)



TITLE TG EQUIPMENT LAYOUT AT MISC. FLOORS ABOVE OPERATING FLOOR IN BC BAY	SCALE 1:200	DRAWING NO.
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