

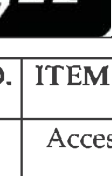
 TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)		
SR. NO.	ITEM	DESCRIPTION
1.11.5	Over range	150 % of maximum pressure.
1.11.6	Adjustments	(a) Internal Set Point.
		(b) Differential adjustment.
1.11.7	End Connection	½" NPT (M) bottom connected.
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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SR. NO.	ITEM	DESCRIPTION
		(d) 1/2" NPT 2 Valve SS-316 barstock manifold.
		(e) 1/2" 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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SR. NO.	ITEM	DESCRIPTION
		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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SR. NO.	ITEM	DESCRIPTION
		(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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SR. NO.	ITEM	DESCRIPTION
		alpha-numeric engraved for service and tag.
1.13.11	Preferred feature	Switch operating point marked on cage.
1.13.12	Mounting	On standpipe.
1.14	<u>CONDUCTIVITY TYPE LEVEL SWITCH</u>	
1.14.1	Type	Conductivity discrimination.
1.14.2	Application	Drain pots viz. on CRH line.
1.14.3	Mounting	Flanged – on external cage.
1.14.4	Probe MOC	Stainless steel with high purity ceramic.
1.14.5	Probe rating	> Maximum design pressure of vessel.
1.14.6	Input	Four independent channel with selectable switching threshold for water conductivity.
1.14.7	Relay Output	Four isolated output relays for Hi, Lo, Hi-Hi, Lo-Lo.
1.14.8	Contact type & rating	2 SPDT or 1 DPDT @ 5A 30V DC.
1.14.9	Local Display	Coloured LEDs for Hi, Lo, Hi-Hi, Lo-Lo, Power & fault.
1.14.10	Power supply	Dual 240V AC, 50 Hz, 1Ph.
1.14.11	Enclosure	IP-65, corrosion resistant & wall mounting type (Explosion proof for NEC Class-1, Division-1 area).

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SR. NO.	ITEM	DESCRIPTION
1.14.12	Accessories	(a) PTFE cable from probe to electronics. (b) Mounting accessories. (c) External cage. (d) Washer & gasket.
1.14.13	Test pressure	(e) Two times rated pressure.
1.14.14	Cable connection	(f) ½" NPT with cable gland.

8/24/2020  TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)		
SR. NO.	ITEM	DESCRIPTION
1.16	<u>ORIFICE PLATE</u>	

 TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)		
SR. NO.	ITEM	DESCRIPTION
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.

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SR. NO.	ITEM	DESCRIPTION
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

 TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)		
SR. NO.	ITEM	DESCRIPTION
		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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TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT
(TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)

SR. NO.	ITEM	DESCRIPTION
		power & air fail.
1.19.8	Repeatability	Better than 0.5% of full travel.
1.19.9	Hysteresis	Less than ±1% of full travel.
1.19.10	Operating Temp. limit	80 Deg. C (min.)

बीएसईएल  TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)		
SR. NO.	ITEM	DESCRIPTION
1.23	<u>OXYGEN ANALYZER</u>	
1.23.1	Type	In-situ, Zirconium sensor, micro-processor-based transmitter, field repairable.
1.23.2	Range	0.1-10% / 0.25-25% by volume.

 TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)		
SR. NO.	ITEM	DESCRIPTION
1.23.3	Output	4-20 mA DC linear.
1.23.4	Probe Length	1800 mm (approximate depending on duct size).
1.23.5	Process Temperature	850 °C approx.
1.23.6	Measurement Reference	Instrument Air.
1.23.7	Accuracy	±1% of F.S.
1.23.8	Response Time	Less than 5 (five) seconds.
1.23.9	Amplifier Housing	IP-65.
1.23.10	Calibration	Automatic periodic.
1.23.11	Calibration Frequency	Once every 24 hours.
1.23.12	Power Supply	240V, 50 Hz, 1 Phase.
1.23.13	Material for Gas Carrying Components	Stainless Steel.
1.23.14	Read Out	LED/LCD Local indicating meter.
1.23.15	Protection	Automatic cell protection against reducing atmosphere
1.23.16	Alarm Facility	1 HI and 1 LO independently adjustable over span. Contact rating 500 mA at 220 V DC (minimum).
1.23.17	Preferred Features	(a) HI and LO alarm LED visible from front.
		(b) Power Supply On/Failure LED visible from front.

बीएसईएल BS&E TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)		
SR. NO.	ITEM	DESCRIPTION
1.23.18	Accessories	(a) Mounting flanges, adaptor plate and protection shield.
		(b) Gasket, nuts and bolts.
		(c) Cable with conduit from cell to amplifier (as required) and other special cables. (if any)
		(d) Automatic calibration kit. (complete with all accessories and standard Gas Cylinders)
1.23.19	Application	(a) At each economizer outlet.
		(b) At each air preheater outlet.

 TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)		
SR. NO.	ITEM	DESCRIPTION
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.

 TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)		
SR. NO.	ITEM	DESCRIPTION
1.26.11	Antenna / Flange assembly	316 SS or Hestalloy. (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.

 TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)		
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"ET cable 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.

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SR. NO.	ITEM	DESCRIPTION
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.

 TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)		
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.

 TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)		
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.

 TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)		
SR. NO.	ITEM	DESCRIPTION
2.3.8	Colour of trends	Selectable.
2.3.9	Performance	
(a)	Accuracy	±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.

 TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)		
SR. NO.	ITEM	DESCRIPTION
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.

 TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)		
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	± 0.5% of span or better.
(b)	Ambient Temperature effect	± 0.3% of span for 10 °C variation or better.
(c)	Supply voltage variation effect	± 0.2% of span for 10% variation in supply voltage or better.
(d)	Frequency variation effect	± 0.1% of span for 2 Hz variation in frequency or better.
(e)	Operating Position effect	± 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%.

 TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)		
SR. NO.	ITEM	DESCRIPTION
(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.

 TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)		
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

 TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)		
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)

			TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)									
SR. NO.	ITEM	DESCRIPTION										
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 °C.										
2.8.9	Accessories	Engraved phenolic nameplate affixed to front flange to identify tag number and measured variable.										

 TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)		
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)

 TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)		
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.

 TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)		
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.

 TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)		
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.

		TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)	
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.	

 TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)		
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

 TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)		
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 VALVE BODY/END CONNECTIONS

- 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

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
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3.3 VALVE SIZE

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

- (a) The valves shall pass normal flow (MCR condition) with 60 to 70 percent opening for linear 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 VALVE TOP WORK

- 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 VALVE TRIM

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 (stellite 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

SR. NO.	SERVICE	MATERIAL
(a)	Non corrosive, non-flashing and non cavitating service for fluid temperature upto 275°C.	: SS 316 stellite
(b)	Non corrosive, non-flashing and non cavitating service for fluid	: SS 316 stellite

 TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)		
SR. NO.	SERVICE	MATERIAL
	temperature above 275°C.	
(c)	Severe flashing /cavitating services	: 440 C
(d)	Low flashing /cavitating services	: 17-4 PH SS
(e)	DM water application (condenser hotwell normal, emergency make up etc.)	: 17-4 PH SS
3.6	<u>NOISE LEVEL</u> The equivalent sound level measured at 1.5M above nearest floor level in elevation and 1 M horizontally from the control valve expressed in decibels to a reference of 0.0002 microbar shall not exceed 85 dB. If the calculated noise is more than the above limit, even with low noise trim design, diffusers shall be included. Diffusers shall be made of stainless steel and shall be integrally connected to the control valve with spool piece. The spool piece shall be in conformity with the main line piping specification.	
3.7	<u>VALVE ACTUATORS</u> Spring-diaphragm type actuators shall generally be used. Piston type actuators shall be offered in case of high shut-off pressure & quick response requirement.	
3.7.1	The actuator shall be designed for 150% thrust required for the valve (at shut-off pressure) at an air line supply pressure of 5.5 Kg/Sq. cm.	
3.7.2	Diaphragms shall be designed for 200% maximum operating pressure.	
3.7.3	Nylon reinforced neoprene is preferred as diaphragm material.	
3.7.4	Valve actuators shall be capable of operating at 80°C ambient, continuously.	
3.7.5	Entire actuator assembly shall be painted with corrosion inhibiting paint.	

	TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)
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.

	TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)
4.1 4.1.1 4.1.2 4.1.3 4.1.4 4.1.5 4.1.6 4.1.7 4.1.8	<u>CONTROL DESK</u> 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. 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. 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. 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. Desk shall be of modular, scalable and industrially ruggedized design and shall have Telephones and Intercom connections. Desk shall have concealed cable trays for wire dressing. Design shall include Earthing bolts. Back installed items shall be suitably concealed from front view.
4.2 4.2.1 4.2.2	<u>BACK UP PANEL</u> Construction shall be from sheet steel of thickness not less than 3 mm. 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.

	TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)	
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.
		: c. Total for a group - 6 mm.
(f)	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.

	TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)	
(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.
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.	

	TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)
	(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.

	TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)
	(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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5.16	<u>PLC GATEWAY</u>
5.16.1	Functional Description Interface between “Offsite PLC” networks and DCS system for remote information and monitoring of offsite plants data, shall be carried out by a dual hot redundant PLC gateway. Proposed Gateway shall operate as a node pair, one in operating and the other shall be in hot standby, serving as its redundant partner, with an exact up-to-date copy of the database and ready to take over full operation should the operating member of the pair fails or be taken out-of-service. The gateway shall provide the data conversion,

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	buffering, and sequencing to provide an efficient interchange of information between the DCS network and the programmable controllers. 5.16.2 Communication link in between the DCS and the Programmable logic controllers shall be dual and optical fiber based. 5.16.3 Data communication shall be in MODBUS or OPC as per requirement. 5.16.4 20 % tag handling capacity over the configured tags shall be kept as spare for future expansion. 5.16.5 Nodes shall be time synchronized with GPS master clock.

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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 °C.
(p)	Insulation at 20° C	: 100 MOhms/Km [Min].
(q)	Capacitance at 800 Hz	: 120 nf/km.

	TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)	
(r)	Cross talk	: 60 dB.
(s)	Attenuation	: 1.2 dB/Km
(t)	Codes & Standards	: IEC 332-1. ANSI MC 96.1. IS-8784-1987.
(u)	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 DEG C at 21 Oxy. Ind. (ASTM-D-2863) (iv) Smoke Density Rating : Max.60% (ASTM-D-2843). (v) Flammability Test : as per IEC 332 Part-I/IEEE-383 Swedish Chimney Test - SS-424-1475 F3. (vi) High voltage test Core to core- 1.5 kV for 1 min. Core to screen-1.0 kV for 1 min. (vii) Insulation Resistance 100 M Ohm/Km Min. (viii) Rodent & Termite repulsion test (Presence of lead shall be confirmed)



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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 MULTIPAIRED 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 Deg.C	: 100 MOhms/Km [Min]
(q)	Capacitance at 800 Hz	: 120 nf/km
(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)

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

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	Above 4 Pairs, 4 Pairs making a unit shall have indelible printed colour coded bands like Pink for 1st unit, Orange for 2nd unit and Violet for 3rd unit and so on. In addition band marking, for example single band for 1st. unit, double band for 2nd. unit and so on, shall be provided on each conductor for identification of unit. Band marking on individual core shall be provided at regular intervals not exceeding 50 mm. 10.6 Cables near high temperature zone shall be capable of withstanding high temperature and terminated in junction box / panel in normal temperature zone. Teflon insulated and sheathed thermocouple extension cables and copper conductor cables shall be used in high temperature zone. Conductor and sheath shall be extruded FEP (Teflon) as per VDE 0207 Part 6 and ASTM D 2116. These cables shall be pair, multipair, triad, multitriad and twisted & shielded. 10.7 <u>CONTROL & POWER CABLE</u> Bidder shall refer to Volume IVB of the electrical specification for detail. 11.0 <u>ERECTION HARDWARE</u> This section provides the general technical guidelines for the erection materials for instruments. All erection materials shall be of good quality and conform to the operating environment of the corresponding instrument. 11.1 <u>ELECTRICAL ACCESSORIES</u> Electrical conduit and associated materials shall conform to the requirements of the articles which follow: (a) Rigid Steel Conduit (i) Conduits up to and including 25 mm shall be of 16 SWG and conduits above 25 mm shall be of 14 SWG. Minimum size of conduits shall be 19 mm. (ii) Each piece of conduit shall be straight, free from blister and other defects and covered with capped bushing at both ends.



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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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	$\pm 15\%$ 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	: $\frac{1}{2}$ " 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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	(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.
11.2.9 Carbon Steel Globe Valve	(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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		Stem - Hardened Steel Plug - AISI 316 SS Seat- Stainless steel stellited
	(g) Packing	: Teflon as required
	(h) Yoke	: ASTM A182 F316
	(i) Handwheel	: Carbon steel
	(j) Design standard	: As per ANSI B 16.34
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 SPECIAL TOOLS & TACKLE AND TEST EQUIPMENT FOR DCS/PLC AND OTHER SYSTEMS

- 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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PLC SPECIFICATION

|

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1.0 OFF-SITE PLANTS CONTROL LOCATIONS AND DCS INTERFACE

SR. NO.	System Package	Control System	Local Control Panel (Control & Monitoring)	CCR (Control from Central Control room)	Interface with DCS	Control through HMI (Control, Monitoring & Programming)	Remarks
	All off-site plant systems						NOTES: All PLCs shall be ' hot standby redundant' and as per detailed specifications mentioned in Vol-V/ Sec-5 in this document. All PLC shall be of same make Laptops for PLC based systems shall be provided inline with requirements mentioned in Vol-V/ Sec-5 in this document. All monitors shall be 24" TFT only. (Sizes

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SR. NO.	System Package	Control System	Local Control Panel (Control & Monitoring)	CCR (Control from Central Control room)	Interface with DCS	Control through HMI (Control, Monitoring & Programming)	Remarks
							Soft communication shall be through dual redundant link.



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6.0 PROGRAMMABLE LOGIC CONTROLLER (PLC)

- 6.1 The following specification is applicable for for PLC related to main plant auxiliaries and off-site plants (like CHP,AHP,WTP etc.). In order to provide smooth and optimal maintenance, easy inter-changeability and optimal spare part management, the bidder should ensure that the PLC system offered for main plant auxiliaries and off-site plants are of the same make, series and family of hardware.
- 6.2 Programmable Logic Controller (PLC) based control system shall be high end version with latest configuration with 1:1 hot redundant Central Processing Units (CPUs). CPUs shall have word length of 32 bits minimum
- 6.3 Following components shall be redundant as well: communication processors, memory modules, rack power supply units, bulk IO power supply units, IO communication modules, data highway and high speed (100Mbps) data network connecting the operator stations.
- 6.4 Two CPUs shall operate on fault tolerant mode with continuous self and cross- monitoring. Failure of the active CPU shall not affect the operation of the plant. In the event of failure of active CPU, tasks shall be transferred to the standby CPU within fastest possible transfer time (< 5m sec.) without causing any relays to drop out during the transfer.
- 6.5 CPUs shall not be loaded to over 60% of their capacity even under worst data loading conditions. It shall be possible to make a manual transfer from the active to the back-up CPU from engineering station and as well as from the front panel of CPU module.
- 6.6 Modules shall have adequate status and diagnostic indication on the front panel.
- 6.7 System shall be of modular construction and expandable by adding hardware modules. Bidder shall provide at least 20% or a minimum of one off, spare channels as hot-on-rail spares in each configured cards / modules.

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	In addition to this, 10% or minimum of one off, extra assigned complete spare modules mounted on rails in racks for each type of I/O modules shall also to be provided. The spare channel and cards shall be fully wired and terminated. 6.8 Memory unit of the CPU shall be field expandable at least by 25%. Operating system/application program/sequence logic etc. shall be stored in nonvolatile memory for automatic re-booting. Dynamic memories shall be provided with battery back up at least for 360 hours. 6.9 Number of input/output points per card shall not exceed 16 (sixteen) for digital and 8 (eight) for analog/thermocouple/RTD signals. Individual input and Output channels shall have galvanic/optical isolation. Merely fusing of individual or a group of channels is not acceptable. 6.10 Data communication system of the PLC shall not be limited to the following: (a) Internal bus and external data network loading shall in no case be more than 60% of its capacity. (b) Disrupted message shall be automatically retransmitted when the system is restored. (c) Failure or physical removal of any module connected on the system bus shall not lead to any loss of communication. (d) Diagnostics message shall be issued on fault detection. (e) Bus change over from active bus to stand by bus, during failure of active bus, shall be performed automatically and bumpless. Such event shall be suitably logged or alarmed. (f) Noise immunized and reliable high speed dual fault tolerant optic fiber cable communication with standard communication protocol shall be provided between PLCs and remote or extended I/O modules.

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	(g) Main data network shall comply with the International Standard IEEE-802.3 (Ethernet) for data exchange and communication.
6.11	Operator workstation shall be complete with latest user friendly operating system, 24" colour TFT monitor, membrane or positive depression KB, mouse, colour laser printer and dot matrix printer. In addition, 3 no (three) laptop unit loaded with all PLC system software shall be furnished.
6.12	For PLC systems without OEWS (Operator cum Engineering work station), above mentioned Laptop shall be used.
6.13	Only licenced copy of programming software suitable for multi-user's use shall be provided.
6.14	PLC systems without OEWS (Operator cum Engineering work station) shall have panel mounted pushbuttons, lamps, hardware annunciation system and MIMIC for operation and control of the system from desk/panel.
6.15	The functions performed from the HMIs shall not be limited to the following: (a) Selection of Auto/Manual, Open/Close, Sequence Auto, Start/ Stop operation. (b) Dynamic Mimic display depicting the process. (c) Alarm monitoring, report & log generation, printing of trends etc. (d) On line/historical trending, historical storage and retrieval of data.
6.16	Software (a) Necessary software for implementation of the control logics, operational displays & logs, data storage, retrieval and other functional requirements, shall be provided. (b) Licensed version of required software including operating system, configuration and HMI software suitable for multi-user's use shall be provided.

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	(c) Detail documentation on the programming softwares as part of the O&M manual.
6.17	<u>POWER SUPPLY</u>
6.17.1	Power supply to the each PLC system shall be provided from separate redundant solid-state 240V AC $\pm$ 1% packaged UPS (Uninterruptible Power Supply) units to be placed local to the control systems. UPS system shall be complete with Plante type battery & battery chargers. UPS shall have adequate capacity to cater 100% load without overloading. UPS system shall be adequate to provide back up power for not less than 60 minutes. (General guide lines as per section-10). UPS for PLC of CHP shall be provided with redundant battery. But for other PLC (AHP, WTP etc.) one battery for UPS is sufficient. 24V DC interrogation supply for off-site plant should be derived from the dual redundant ac-dc converters.
6.17.2	UPS shall be complete with AC Distribution board. Two feeders shall be extended from ACDB to PLC.
6.17.3	Bulk power supply units for interrogation, relay and solenoid voltage shall be separate from system power supply units and shall be redundant.
6.17.4	System shall have MTBF better than 99.7% and shall be hot maintainable. System hardware shall be designed to be 'fault avoidant' by selecting high-grade components of proven quality and properly thermally de-rated design. The network shall have extensive fault monitoring, self-surveillance & on-line self-diagnostic capability so that failure is immediately detected.
6.17.5	System shall automatically check and correct gain & drift for ADCs on-line.
6.17.6	Data exchange in a bus shall be fully monitored and checked for validity.
6.17.7	Response time consisting of IO scan time, data communication time, processing time etc. shall be equal to or less than the following :
(a)	OLCS & sequence control inputs : 100 ms.
(b)	CLCS inputs : 250 ms.

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	(c) Monitoring analog parameters : 500 ms. (d) Monitoring digital parameters : 100 ms.
6.17.8	Following operations will be performed on I/Os, as required: (a) Square root extraction (b) Pressure & temperature compensation (c) Reasonability check of all inputs, validation and quality tagging like good, bad, suspect etc. (d) Channel wise engineering unit conversion (e) Contact bounce filtering with adjustable time constant.
6.17.9	The PLC controllers shall be time synchronized to GPS master clock via IRIG-B or Ethernet port. Software capability shall be provided to implement closed loop control functions as follows: (a) PID control and their variations. (b) On-off control (c) Cascade control (d) Ratio and bias control
6.17.10	Features for Open Loop Control shall not be limited to following: (a) Logic functions like AND/ OR/ NOT gates, timers (on-delay, off-delay), shift registers, counters, latches, flip-flops, mono-shots etc. (b) Automatic sequence control for start up and shutdown of auxiliaries /auxiliaries/equipment in functional groups initiated by command from operator's console. A sequence shall be made of steps executed in predetermined order according to logic criteria. For each



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step there shall be a provision for 'waiting time' and 'monitoring time'. System shall have the capability to bypass a step, if desired, from the operator's station. Such action however shall be registered as an exception.

- (c) Inputs for protection system shall be of high priority. In the event of either loss of control power or control signal input to the drive, the drive shall remain in its last position unless specifically required otherwise. The system shall be designed such that no upset occurs either to process or to the drive when the power is restored.

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

Each IO rack shall have 10% spare rack space for future upgradation.

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

6.17.13 Updating time and reaction time shall be as follows:

- | | | | |
|-----|---|---|------------------|
| (a) | Calling up a mimic | : | 2 sec or better |
| (b) | Updating status signal in mimic | : | 1 sec or better |
| (c) | Updating variables in a mimic | : | 1 sec. or better |
| (d) | Issuance of command to output (without considering process lag) | : | 1 sec. or better |

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6.17.14	Displays shall be classified into overview display, group display, point display and trend display.
6.17.15	Printing of logs shall be initiated automatically at prescribed time intervals, or initiated on demand by the occurrence of predefined events.
6.17.16	System shall permit the operator to specify minimum of 5 summary logs each with minimum of 25 points to be printed on demand.
6.17.17	Salient features of the PLC system for I/O handling shall be as follows.
	(a) Input filters to attenuate noise.
	(b) Isolation of 1500V AC for the input & output module.
	(c) Common mode noise rejection for analog inputs of 120 db at 50 Hz.
	(d) Normal mode noise rejection for analog inputs of 60 db at 50 Hz.
	(e) LED indicators on each card to show status of input.
	(f) All the outputs shall be with individual fuse.
	(g) J/ K type thermocouple mV input where applicable.
	(h) Pt-100 three/four wire resistance thermometer input where applicable.
	(i) 24 V DC power supply to field mounted two wires transmitters.
6.17.18	Salient hardware/software features of the CPUs shall be as follows:
	(a) Watch dog timer : Periodical reset. Alarm and interruption, if not reset within stipulated time.
	(b) Max. scan time for inputs : 1 second max.



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- (c) Maximum Scan Rate : 1 ms (Per K Word) or better
- (d) Memory capacity : 25% spare capacity after full utilization.
Expandable in multiples of 16 K.
- (e) Comm. processor : Separate
- (f) Battery back up for RAM : 360 hrs continuous operations.
- (g) Diagnostic feature : Periodic, automatic self- diagnostic.

6.17.19 Salient features of the Input/Output modules are as follows.

- (a) All modules
 - (i) Surge withstand capability : IEC-255.4
- (b) Digital General
 - (i) No. of channels/module : 16
 - (ii) Interrogation voltage : 24V DC or 48 V DC
 - (iii) Status indicator : LED type.
 - (iv) Isolation : Optical
- (c) Digital Input Module
 - (i) Contact bounce filtering : Adjustable time constant of 15 millisecond.
 - (ii) Diagnostic : Module fault

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	(d) Digital Output Module (i) Output protection : Short circuit Proof & Individual fuse protection (ii) Diagnostic : Module fault (e) Analog General (i) No. of channels / module : 8 (ii) Isolation : Galvanic/ Optical (f) Hi-level Analog Input Module (i) Type of input : 4-20 mA DC / 1-5V DC (ii) A/D Converter : 11 bits + Sign (or better) (iii) Accuracy : 0.1% or better (iv) Diagnostic : Module fault (v) Powering of transmitter : 24 V DC 2 W type (g) Low Level Analog Input Module (i) Type of input : PT-100; T/C (As required) (ii) C-J-C : On Module (iii) Accuracy : 0.1% or better (iv) A/D converter : 15 bits + Sign (or better) (v) Diagnostic : Module fault

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(h)	Analog Output Module (i) Type of output : 4-20 mA DC (ii) Accuracy : $\pm 0.1\%$ or better (iii) A/D Converter : 11 bits + Sign (or better) (iv) Load : 600 Ohms (v) Diagnostic : Module fault
6.17.20	Bidder shall provide control/work station as below
(a)	Operator's Station / Engineering Station (PC Based) (i) Processor : 2 nd generation core i5 or better (ii) Mother Board : Intel Original (iii) Configuration : Tower/Flat (iv) Internal clock : 2.0 GHz or better (v) Architecture : 32 bit (vi) Video Card : On Board (vii) System Memory : 4 GB or better. (viii) Hard drive : 500 GB or higher (ix) Cache : 6 Mb or better (x) Floppy drive : 3½" (xi) DVD Drive : DVD Read & Write with Dual Layer for both EWS & OWS (xii) Audio controller : 16-bit



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|----------------------------|---|---|
| (xiii) Operating system | : | Window NT or Better |
| (xiv) Graphic accelerator | : | 2 GB or better |
| (xv) Communication ports | : | 04 nos. (min.) with serial port & 04 nos. (min.) with parallel port (USB) |
| (b) Monitor | | |
| (i) Type | : | TFT colour monitor |
| (ii) Screen diagonal | : | 24" flat |
| (iii) Display | : | XGA or better |
| (iv) Resolution | : | 1024 X 768 or better |
| (v) Degree of protection | : | IP-30 |
| (vi) External Controls | : | Brightness, contrast, Horizontal / Vertical amplification & shift |
| (vii) Power supply | : | 240 V, 50 Hz, 1 phase |
| (viii) Ambient temperature | : | 0-50 °C |
| (ix) Humidity | : | 95% non-condensing. |
| (x) Version | : | To suit industrial application. |
| (c) Key Board | | |
| (i) Type | : | Flat spill proof membrane type or Positive depression type. |
| (ii) Different keys | : | – Soft and user defined function keys for software/programming including text correction, scan rate alteration, |



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zooming/flashing colour selection etc.

- Panel select keys for alarm summary, control loop display, overview, trend, graphic, operator guide message etc.
- Standard Alphanumeric keys
- Alarm acknowledge keys
- Cursor keys
- Mode/loop status switching keys
- Setting change keys
- Print-out command keys
- Other keys as required to operate the system

(iii) Key lock : Lockable type push button mounted on keyboard

(iv) Life Expectancy : 50 million cycles per key

(v) Version : To suit industrial application

6.18 OPTICAL FIBER CABLE

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

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6.18.2 6.18.3 6.18.4 6.18.5 6.18.6 6.18.7	Fiber Optic Cables shall be installed on cable tray, duct bank, cable trench, as necessary. For outdoor applications the cable shall be armoured with Poly Ethylene sheathing. Cable shall be routed through suitable grade permanently lubricated HDPE protection pipe as per IS 4984, IS 12235 & TEC.G/CDS-08/01 of suitable size @ 53% fill factor. The Optical Fiber core shall be of ultra pure fused silica glass coated with UV-cured acrylate suitable to withstand temperature of about 80°C (continuous). Fiber optic cable shall be of loose tube design. Typically, fibers shall be housed in-groups of 6 (minimum) within gel-filled buffer tubes to protect against ingress of moisture and vibration. The tubes shall be manufactured with industry standard material like Poly-Butelene Terathylate (PBT). They shall be colour for easy identification. Buffer tubes shall be approachable with industry standard tools and practices. The buffer tubes shall be stranded around the Central Strength Member utilizing Reverse Oscillating Lay (ROL). Blank fillers shall be used as necessary to maintain circular cable structure. Cable shall withstand water penetration when tested with a one meter static head or equivalent continuous pressure applied at one end of a one meter length of filled cable for one hour. No water shall leak through the open cable end. The central strength member of the cable shall be Fiberglass Reinforced Plastic (FRP) or other material with equivalent mechanical strength to provide both tensile and anti buckling strength to the cable. In addition to central strength member, additional strengthening substance like aramid yarns shall be helically applied over the cable core to provide additional tensile strength to the cable. The cable shall be of dual jacket & armoured. Inner sheath consists of a medium density polyethylene (MDPE) jacket extruded over the cable core. Two highly visible ripcords are placed under the jacket to aid in sheath removal. A co-polymer coated steel tape is corrugated and wrapped around the inner jacket to provide additional cable compression strength and rodent protection. The armour is covered with an outer black FRLS MDPE

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	jacket. A ripcord is also placed underneath the armour for easy outer jacket removal.		
6.18.8	Minimum bending radius shall be equal or more to 15 D. A continuous strength member shall be provided for the entire length of the cables. Every tube and fiber shall be colour coded to provide easy identification. The outer sheath shall be marked to show fiber type and cable classification at suitable intervals.		
6.18.9	Entire length of the cable shall be marked with the following at regular intervals:		
	(a) Manufacturer's Name		
	(b) Month and year of manufacturer		
	(c) Coded description of the cable based on Telcordia's (Bellcore) SR-2014 Suggested Optical Cable Code (SOCC).		
	(d) Sheath Identification Number		
	(e) Sequential Length Marking in meter		
	(f) A Telephone Handset symbol to distinguish communication from power cable as per NESC section -35 G.		
6.18.10	Fiber optic cable shall provide a long life expectancy of minimum 25 years and shall meet the industrial standard of continuous operation at temperature of 55 °C and humidity to 100% without degradation to optical or mechanical performance.		
6.19	<u>OPTICAL FIBER USED IN THE PLANT SHALL GENERALLY CONFORM TO THE FOLLOWING SPECIFICATION.</u>		
	SPECIFICATION FOR G.652 MONOMODE FIBER		
	<table> <tr> <th data-bbox="466 1684 986 1765">ATTRIBUTES</th><th data-bbox="992 1684 1374 1765">VALUE</th></tr> </table>	ATTRIBUTES	VALUE
ATTRIBUTES	VALUE		
(a)	<table> <tr> <td data-bbox="466 1774 986 1812">Cladding Diameter</td><td data-bbox="992 1774 1374 1812">125 m 1.0 m</td></tr> </table>	Cladding Diameter	125 m 1.0 m
Cladding Diameter	125 m 1.0 m		



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

6.20 CABLE ASSEMBLY

6.20.1 Optical Fiber Environmental Splice Enclosure

Optical fiber environmental splice joint enclosures shall be re-enterable and rack/wall mountable. The interior splice case shall be equipped to mechanically accommodate single-mode optical fibers connected by the fusion method. Splice case shall be equipped to organize the splice trays and the required service loops of buffered incoming optical fibers and outgoing 'pigtailed' in such a way that allows each completed splice and associated optical fiber to be maintained in an unstrained configuration. Splice enclosure shall be dust and weather proof.

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6.20.2	Fiber Optic Distribution Patch Panel
	Fiber optic distribution panels shall be provided as required. Fiber optic distribution panels shall be of a standard wall mounted sheet metal enclosure type. Fiber optic distribution panels shall be equipped to secure optical fiber patch cables and pigtails to prevent damage during all operation and maintenance functions. In general splice enclosure are envisaged. However, if no optical fiber splice enclosures are implemented, than the fiber optic distribution panels shall be equipped with splice trays for storage and protection of fusion splice connections of single-mode fiber optic cable and pigtails. Each fiber optic distribution panel shall be fully equipped with 'S' type bulkhead connector sleeves or equivalent. Unused sleeve ports shall be equipped with reusable caps to prevent the intrusion of dust.
6.20.3	Pigtail and Patch Cord
	All pigtails shall be factory SC-connectorized, and satisfy specified performance for optical links. All unused pigtails (including spares) shall be terminated with the connector to a bulkhead connector sleeve, protected by a reusable cap on the opposite sleeve port, to prevent the intrusion of foreign material or dust. All necessary connector pigtails shall be provided in the lengths required.
6.21	<u>FIBER OPTIC TOOL KIT</u>
6.21.1	Optical Time Domain Reflectometer
	(a) A recording optical time domain reflecto meter (OTDR) will be utilized to test for end-to-end continuity and attenuation of each optical fiber. The OTDR shall be equipped with data storage, printer, help feature, compare trace features and OTDR software. The data storage unit must include a built-in floppy disk drive capable of storing a minimum of 100 test traces. (b) Data traces saved to disk shall include the following labels: (i) Fiber Identification (ID) with a minimum of 10 characters



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- (ii) Cable ID with a minimum of 10 characters
- (iii) OTDR location with a minimum of 20 characters
- (iv) Far End location with a minimum of 20 characters
- (v) Test Operator initials with a minimum of 3 characters
- (c) The printer shall preferably be internal. The printer shall be able to print data traces within 30 seconds or less. The machine settings used to repeat tests at a later time shall include: index, range, wavelength, average time, pulse width and scale settings. The test results (on printout) shall provide information including: loss, distance, reflectance, date and time.
- (d) The requirements for the compare trace feature include the ability to recall two historical traces from a diskette and display them simultaneously for analysis and printing. The compare trace must compute and display a single graph representing any differences between two traces. The compare trace must be able to recall historical traces from a diskette and perform the same tests on connected live fibers. The compare trace shall perform a two point loss measurement test for any two particular fibers in a comparison analysis. The losses between the two points on each fiber shall be displayed, and the differences between the two readings clearly shown.
- (e) The OTDR must be equipped with software to support all of the required functions. The software shall provide for printing of whole set of traces (batch print) with minimal commands eliminating the time spent for printing traces individually.
- (f) Contractor shall provide all mounting accessories, cables and connectors required to establish data communication.

6.21.2 Fiber Optic Splicer, Terminator And Tool Kit Box

Bidder shall provide new unused tools comprise of Splicer and Fusion Joiner and tool kit comprise of cutter, stripper, polishing tool, handheld



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microscope, heat shrinkable sleeve, scissor, knife etc. as required for maintenance and commissioning.

6.22 **TESTS**

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

- (a) Attenuation And Dispersion Characteristics Tests
- (b) Proof Tests
- (c) Macro-Bend Resistance Test
- (d) Mechanical Tests
- (e) Low And High Temperature Cable Bend Test
- (f) Impact Resistance Test
- (g) Compressive Strength Test
- (h) Tensile Strength Test
- (i) Cable Twist Test
- (j) Cable Cyclic Flexing Test
- (k) Environmental Characteristics Test
- (l) Temperature Cycling Test
- (m) Colour Permanence Test
- (n) Cable Aging Test
- (o) Water Penetration Test
- (p) Lightning Test

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(q) Routine Test/Sample Test (r) Site Test (Like Continuity & Attenuation)	

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UPS SPECIFICATION	

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1.0	<u>SCOPE OF WORK</u>
1.1	<u>SCOPE OF SUPPLY</u>
	The scope of supply shall include Uninterruptible Power Supply (UPS) System as required for main plant.
(a)	UPS System shall comprise the following :
(a)	100% Static inverter banks : 2.
(b)	100% Converter AC to suitable DC : 2.
(c)	100% Static switches : 2.
(d)	Manual bypass switch/breaker : 2.
(e)	100% UPS System battery banks : 2.
(f)	100% Float-cum-boost charger : 2.
(g)	Step-down transformer with associated Switchgear : 1.
(h)	Voltage stabilizer and back up power source and synchronizing circuit : 1.
(i)	UPS A.C. Power Distribution Board : 2.
(b)	One (1) set of special tools and tackle.
(c)	All inter-connecting cables including those required for inter-connection within UPS equipment as mentioned above. All power cables from UPS AC power distribution board to loads.
(d)	Mandatory Spare parts.
(e)	List of recommended spare parts for three (3) years satisfactory and trouble-free operation of the equipment for Purchaser's consideration.

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	(f) All relevant drawings, data and instruction manuals.
2.0	<u>GENERAL REQUIREMENTS</u>
2.1	<u>CODES AND STANDARDS</u>
	(a) All equipment and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) except where modified and/or supplemented by this specification.
	(b) Equipment and materials conforming to any other standard which ensures equal or better quality may be accepted. In such case, copies of the English version of the standard adopted shall be submitted along with the bid.
	(c) The electrical installation shall meet the requirements of Indian Electricity Rules as amended up to date and relevant IS Codes of Practice. In addition, other rules or regulations applicable to the work shall be followed. In case of any discrepancy, the more restrictive rule shall be binding.
2.2	<u>ANNEXURES</u>
2.2.1	All annexure appended to this specification shall form part of this specification and supplement the requirements specified herein.
2.2.2	This specification shall be read and construed in conjunction with the drawings and annexures to determine the scope of work and terminal points.
2.3	<u>COMPLETENESS OF SUPPLY</u>
2.3.1	It is not the intent to specify completely herein all details of the equipment. Nevertheless, the equipment shall be complete and operative in all aspects and shall conform to the highest standard of engineering, design and workmanship.
2.3.2	Any material or accessory which may not have been specifically mentioned but which is necessary or usual for satisfactory and trouble free operation and maintenance of the equipment shall be furnished.

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2.3.3	The Tenderer shall supply all brand new equipment and accessories as specified herein.
2.4	<u>GUARANTEED PERFORMANCE</u>
2.4.1	The proposal data sheets given in another volume of this package specification shall be filled in without any ambiguity by typing in appropriate place on each page.
2.5	<u>DRAWING APPROVAL</u>
2.5.1	Before starting manufacture of any equipment, the contractor shall have to take approval of relevant drawings and data from Owner/Consultant in writing.
2.5.2	Any manufacture done prior to the approval of drawings/data shall be rectified in accordance with the approved drawings/data by the Tenderer at his own cost and the equipment shall be supplied within the stipulated period.
2.6	<u>DESIGN CRITERIA</u>
2.6.1	Design Basis
(a)	UPS System provides a regulated and uninterrupted single phase A.C. power, within specified tolerances, to critical station loads during normal and emergency operation.
(b)	The UPS system excluding its battery shall be installed indoors in A.C. environment.
(c)	UPS system shall be compatible for satisfactory and well-coordinated operation with other related equipment as well as with input and output systems.
(d)	Energizing or de-energizing any portion of the system serviced by the UPS shall not cause output changes which will affect the operation or integrity of the remaining portions of the system in any way.

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	(e) The equipment shall be self-protecting against all A.C. and D.C. transients, voltage surges, and steady state abnormal voltages and currents. (f) The circuit protection shall be coordinated with UPS short circuit capacity and protective device characteristics so that a fault on any circuit shall result in minimum loss of function. (g) All non-interrupting components of UPS system shall be capable of withstanding the prevailing short circuit current without damage. (h) All circuit interrupting components shall be capable of withstanding and interrupting the prevailing short circuit currents without damage. (i) For continuous operation at specified ratings, temperature rise of the various components of UPS system shall be limited to the permissible values stipulated in the relevant standards and/or this specification. (j) For selecting Battery capacity following data to be considered : (i) Maximum temperature : 50 deg. C (ii) Minimum temperature : 5 deg. C (iii) Design margin : 15%. (iv) Ageing compensation factor : 1.25. (v) Reference for Battery Sizing calculation : As per IEEE Standard. (vi) UPS Capacity : Selected UPS rating (not actual load on UPS) (k) UPS shall have automatic on line battery health checking facility as indicated in Clause No. 3.6 (section – 10, part – B) It shall

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	have connectivity with the plant DCS status monitoring. (l) The chargers, inverters, static switches, regulating transformers and voltage stabilizers should be arranged in such a way that any equipment will be fully isolated for maintenance without affecting in any way the operation of other panels/components. (m) In the A.C. Distribution Board, the Bidder shall provide 10% or minimum one (1) no. Spare feeder of each size and type of the outgoing feeders. (n) UPS shall be sized by the bidder to cater to power the bidder furnished loads and to provide for at least 10% spare capacity to cater to changed load requirements during detailed engineering stage over and above 10% design margin.
2.6.2	System Concept (a) A D.C. power source and an A.C. power source are available to the UPS system. The system is so designed that its load shall be served without interruption as long as one of the above power sources is available within specified limit of voltage and/or frequency. The UPS will consist of two physically separate sets of equipment streams each consisting of the following : (i) One set of converter to convert incoming 240V, 1 Ph, 50 Hz A.C. power to suitable D.C. (ii) One set of suitable Battery Bank to get charged by the above referred converter and to feed the inverter described below. (iii) One set of inverter to take D.C. input from above referred converter - Battery assembly output and to produce high quality 240V, 1 Ph, 50 Hz A.C. output power. (iv) One UPS A.C. Power distribution board with suitable number of output feeders.

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	(v) One no. static switch. (vi) One no. manual bypass switch. (vii) One no. static switch isolator. In addition to above a common bypass stream power supply consisting of suitable transformer, voltage stabilizer etc and synchronizing circuit to parallel it with the inverter output is to provided. One set of synchronizing equipment and high performance static switch will parallel the above two streams and common output will be taken to loads which can accept only single non- redundant power input source. For equipment requiring dual redundant input power source, separate cables will be taken from the individual UPS Power Distribution Boards of the above-mentioned two UPS streams. The system will ensure highest system availability around 99%. (b) Each of the two UPS streams will be of 100% capacity and will normally work, each sharing 50% load. On failure of any stream, its load gets automatically transferred to the other inverter through static transfer switch. (c) If one UPS stream is out of service for any reason then the second UPS stream will be working with 100% UPS load.
2.6.3	Layout Criteria (a) The UPS system will be located indoor in Power House operating floor. The inverter, static switches, chargers and distribution panels shall be located in the UPS room. The batteries shall be located in a separate battery room.



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

The equipment of the two UPS streams shall be physically isolated with reasonable space between two installations.

- (b) Battery room ventilation shall be under the scope of the Contractor.
- (c) Sufficient clear space shall be provided for comfortable attending and removal of individual cells.
- (d) If both streams fail, its load get automatically transferred to the standby source through static transfer switch.

3.0 SPECIFIC REQUIREMENTS

3.1 STATIC INVERTER

- (a) The static inverters shall be static type consisting of IGBT PWM type inverter, static filters, integrated control modules including necessary oscillators, voltage regulators, current limiting and surge suppression.
- (b) The inverter equipment shall include all necessary circuitry and devices to conform requirements like voltage regulation, soft start, transient recovery, protection, automatic synchronization, wave shaping etc. as specified herein.
- (c) Upon transfer of full load, the inverter output voltage shall not drop below 80% of nominal voltage during the first half cycle after transfer and 90% of nominal voltage in the next half cycle. The recovery to within $\pm 2\%$ of voltage shall be in less than 50 milliseconds.
- (d) On occurrence of a fault in branch circuit, the inverter shall be capable of clearing the highest rated branch circuit fuse in 4 milliseconds or less.



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- (e) The inverter shall be protected against overload, short circuit, 100% loss of load, as well as excursions, loss or restoration of D.C. Input voltage and synchronizing voltage. The overload capacity shall be 125% for 10 minutes, 150% for 60 seconds and 300% for 4 milliseconds.
- (f) The D.C. input current shall never exceed twice the full load current except for a short circuit within the inverter.
- (g) For any value of the load and load power factor drawn by the equipment served, the inverter shall not impose on D.C. Source any voltage oscillations in excess of 5 volts (RMS total all frequencies) or any current oscillations in excess of 3 percent (RMS total all frequencies) of the D.C. current at full load.
- (h) The inverter will be self protecting against A.C. and D.C. Transients, voltage surges and steady state abnormal voltage and currents likely to be encountered in the plant.

3.2 AUTOMATIC SYNCHRONIZATION

- (a) Inverter equipment shall include stable solid-state oscillator devices designed to automatically maintain the inverter output in phase and in synchronism with the stand-by A.C. source.
- (b) Facility shall be provided for automatic transfer to internal oscillator operation when the stand-by source frequency is beyond specified limits and the frequency shall be automatically controlled within 50 Hz plus or minus 0.5 Hz when the inverter operates in this mode.
- (c) Retransfer to stand-by A.C. Source for synchronization shall be automatic after the stand-by source frequency is restored to permissible limits and remains within this limit for an adjustable time delay period (up to 5 seconds).
- (d) Provision shall be made for stepless adjustment of synch-disconnects frequency range from 50 Hz $\pm$ 0.5 Hz to 50 Hz $\pm$ 2 Hz.
- (e) Automatic adjustment of phase relationship between inverter output



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and stand-by A.C. source shall be gradual at a controlled slow rate, which shall not exceed one hertz per second.

3.3 STATIC TRANSFER SWITCH

- (a) The static transfer switch shall be solid-state type using SCR for automatic/manual transfer of load from "inverter" to "stand-by" source and vice-versa.
- (b) Stand-by source can be either of the inverter or A.C. source depending on whether both the inverters are supplying 50% load each or one of the inverter is carrying 100% load.
- (c) The transfer time including sensing shall be less than 4 milliseconds. Further the transition shall be make- before-break in both directions.
- (d) The capacity of static transfer switch shall be equal to the continuous full-load capacity of the inverter. The switch shall be provided with protective devices in both normal and alternate power source.
- (e) Static transfer switch shall be furnished with contact to alarm failure of the alternate source or opening of any fuse protecting the static switch.
- (f) Static transfer switch shall include all necessary circuitry and devices to meet the functional requirements of transfer initiation, transfer inhibit and re-transfer back to normal as detailed below :
- (g) **Transfer Initiation**
 - (i) The transfer of static switch from normal 'Inverter' position to 'stand-by' position shall be initiated by one of the following causes.
 - a. Inverter failure and UPS system trouble.
 - b. Inverter output voltage failure.
 - c. Manual push button operation.

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	(ii) The UPS bus shall be monitored by two voltage detectors. One fast acting circuit shall be used for detecting a complete and instantaneous voltage loss while the other slower acting averaging circuit with adjustable trip level shall be employed to detect voltage deviation beyond selected limits. Both voltage detector circuits shall automatically initiate operation of transfer switch. (iii) The static switch shall automatic transfer the load from inverter to stand-by source when the maximum I²t capability of the inverter is reached and when the inverter output drops below 90%. (h) Transfer Inhibit Automatic or manual transfer from inverter to stand-by A.C. source vice versa shall be inhibited when the inverter frequency is not synchronized to the alternate source. (i) Retransfer to Normal (i) The return to inverter mode shall be manual in all cases. (ii) Manual transfer shall be initiated by push button actuation. 3.4 <u>MANUAL BY-PASS SWITCH</u> (a) Manual by-pass switch is used to isolate any static transfer switch for maintenance or repair without interruption to the UPS load. (b) The switch has also the facility of by-passing both the static transfer switches during start-up at the option of the operator. (c) Switch contact shall be make-before-break type. (d) The switch shall have current rating equal to the full load inverter current and necessary short time load carrying and interrupting capacity to meet the requirement of UPS system.

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	(e) Breakers may be used instead of By-pass switch maintaining the same philosophy of operation.
3.5	<u>BATTERY</u>
	Battery shall be Lead -Acid Plante type. Construction details of the batteries shall be as follows:
3.5.1	Lead -Acid Plante Battery
	(a) Equipments.
	(i) DC Batteries shall be stationary lead acid Plante positive plate type conforming to IS: 1652. The battery shall be high discharge performance type. For the purpose of design an ambient temperature of 50°C and relative humidity of 85% shall be considered.
	(ii) DC Batteries shall be suitable for standby duty. The Batteries shall normally be permanently connected to the load in parallel with a charger and shall supply the load during emergency conditions when AC supplies are lost. Batteries shall be suitable for a long life under continuous float operations and occasional discharges. The batteries shall be boost charged at about 2.75 volts per cell maximum and float charged at about 2.2 V/cell.
	(b) Construction Features
	(i) Containers
	Containers shall be made of transparent glass, hard rubber, suitable robust, heat resistance, leak proof, non absorbent, acid resistant, non- bulging type and free from flaws, such as wrinkles, cracks, blisters, pin holes etc. Electrolyte level lines shall be marked on container in case of transparent containers. Float type level indicator shall be provided in case of opaque containers. The stem portion of the float should be long enough to prevent falling of the float inside the container even



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if there is no electrolyte in the container. The marking for the electrolyte level should be for the upper and lower limits. The material of level indicator shall be acid proof and oxidation proof. Container shall be closed/sealed lid type. Lid and sealing compound shall be non-cracking type. The container made of hard rubber and plastics shall be type tested as per IS:1146. All type tests shall be carried out for sealing compound as per IS: 3116.

The pole sealing arrangement should be such that no acid particle get entrapped due to acid creep as a result of capillary action and it should be possible to remove and refix the sealing to carry out the maintenance.

(ii) Vent Plugs

Vent plugs shall be provided in each cells. They shall be anti-splash type, having more than one exit hole shall allow the gases to escape freely but shall prevent acid from coming out. The design shall be such that the water loss due to evaporation is kept to minimum. In addition the ventilator shall be easily removed for topping up the cells and of such dimensions that the syringe type hydrometer can be inserted into the vent to take electrolyte sample.

(iii) Plate

The plates shall be designed for maximum durability during all service conditions including high rate of discharge and rapid fluctuations of load. The construction of plates shall conform to latest revisions of IS: 1652 as applicable.

The separators shall maintain the electrical insulation between the plates and shall allow the electrolyte to flow freely. Separators should be suitable for continuous immersion in the electrolyte without distortion. The positive and negative post shall be clearly marked.



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(iv) Sediment Space

Sufficient sediment space shall be provided so that cells will not have to be cleaned during normal life and prevent shorts within the cells.

(v) Cell Insulator

Each cell shall be separately supported on PVC/porcelain/hard rubber insulators fixed on the racks with adequate clearance between adjacent cells. Minimum distance between adjacent cells shall be more than the bulge allowed for two cells in accordance with IS:1146.

(vi) Electrolyte

The electrolyte shall be prepared from battery grade sulphuric acid conforming to IS:266 and distilled water conforming to IS:1069. The cells shall be shipped dry uncharged. The electrolyte shall be supplied separately.

(vii) Connectors and fasteners

Lead or Lead coated copper connectors shall be used for connecting up adjacent cells and rows. Bolts, nuts and washers shall be effectively lead coated to prevent corrosion. The thickness of lead-coating of connectors should not be less than 0.025 mm. The lead coating thickness shall be measured in accordance with IS: 6848 (latest edition). All the terminals and cells inter-connectors shall be fully insulated or have insulation shrouds. End take off connections from positive and negative poles of batteries shall be made by single core cables having stranded aluminium conductors and XLPE insulation. Necessary supports and lugs for termination of these cables on batteries shall also be supplied by the contractor. All connectors and lugs shall be capable of continuously carrying the 30 minutes discharge current of the respective Batteries and through fault short circuit current which the battery can produce and withstand for the period



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declared.

(viii) Battery racks

Wooden racks/Steel Racks with anti-corrosive epoxy paint for all the batteries shall be provided. These racks shall be made of good quality first class seasoned teak. They shall be free standing type mounted on porcelain/hard rubber/PVC pads insulators. Batteries shall preferably be located in the single tier arrangement. However, batteries having a complete cell weight of lower than 50 Kg could be located in the double tier arrangement. The batteries rack and wooden support for cable termination shall be coated with three (3) coats of anti-acid paint of approved shade. Numbering tags, resistant to acid, for each cell shall be attached on to the necessary racks. The bottom tier of the stand shall not be less than 150 mm above the floor. Wherever racks are transported in dismantled condition, suitable match markings shall be provided to facilitate easy assembly.

(ix) Manufacturer's Identification systems

The following information shall be indelibly marked on outside of each cell:

- a. Manufacturer's name and trade marks.
- b. Country and year of manufacture.
- c. Manufacturer type designation.
- d. AH capacity at 10 hour discharge rate.
- e. Serial number.

Bidder shall be considered, if in case, Indian standards are not available for any equipment, standards issued by IEC/BS/VDE/IEEE/NEMA or equivalent shall be applicable.

	TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)
3.6	<u>FLOAT-CUM-BOOST CHARGER</u>
3.6.1	Refer Section-10, Part-B, 24V DC Battery & Battery Charger specification.
3.7	<u>STEP-DOWN TRANSFORMER AND VOLTAGE STABILIZER</u>
	(a) A three phase to single phase transformer along with associated voltage stabilizer shall be furnished with the UPS system. (b) The transformer and stabilizer shall be sized for 100 per cent UPS load and shall coordinate with the largest branch circuit protection device for feeder short circuit current without sacrificing voltage regulation. (c) The voltage stabilizer shall employ silicon solid state circuitry and shall maintain the specified output voltage for 0 to 100% load with maximum input voltage variation as indicated in the annexure. The make and rating shall be subject to Purchaser's approval.
3.8	<u>A.C. DISTRIBUTION BOARDS</u>
	(a) The distribution boards shall be fixed type, of modular design in freestanding gasketed sheet steel enclosure conforming to IP-54. Sheet steel thickness shall be 2 mm minimum. 100% redundant AC distributed boards shall be provided for each UPS. (b) Each module shall be housed in a separate compartment complete with individual front access door. Working height shall be limited to 1800 mm from floor level. (c) A full height vertical cable alley shall be provided in each panel to facilitate module wiring. The alley shall be liberally sized and shall have removable cover at the front. Removable back covers shall be provided at the back of the panels. (d) Switches shall be double pole, air break, heavy duty type, capable of safely making and breaking the full load current of associate circuit.

	TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)
	(e) Switch handle shall have position indicator and provision of padlocking in ON & OFF positions. Further it shall be interlocked with access door for safety. (f) Fuses shall be HRC, preferably link type, design to permit easy & safe replacement. Visible indication shall be provided for indication of fuse.
3.9	<u>UPS CABINETS/ENCLOSURES</u>
	(a) The UPS system components shall be housed in a sheet steel freestanding IP-52 enclosure with all access from the front. Sheet steel thickness shall be 2 mm minimum. (b) The enclosure shall consist of vertical cabinets housing modules in rack type sub-assemblies, connected mechanically and electrically to form a rigid, self-supporting, metal enclosed structure. (c) The modular units shall be mounted in pull out and/or swing trays. Each module shall be capable of being easily removed to provide for the ready inspection of major solid-state devices. (d) Vertical wiring trough shall be provided for the entire height of the UPS cabinet. Cable entry shall be from bottom only. (e) Adequate ventilating louvers and screens shall be provided. The top of the panel shall be protected by a suitable drip cover to prevent entrance of falling liquid and foreign material. (f) If the equipment supplied requires forced air cooling, the cooling system furnished shall meet the following requirement : (i) Two (2) nos. 100% cooling fans shall be provided for each vertical panel. (ii) Completely independent duplicate protection, control and wiring systems shall be provided for the cooling fans for redundancy.

	TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)
	(iii) The cooling fans shall be powered from the output of the associated inverter. Normally one fan will be running while the other is on stand-by. (iv) Each cooling fan shall be equipped with an airflow switch having an alarm contact that closes upon failure of airflow.
3.10	<u>ALARMS</u> (a) Solid state audio-visual annunciation system shall be provided for inverters, static transfer switch, and battery charger. (b) Alarm fascia shall be provided on each charger and inverter panel, complete with proper actuating devices, circuitry and legends. (c) The arrangement shall be such that on occurrence of a fault the corresponding window will light up and stays lighted until the fault is cleared and reset button pressed. (d) Each time a window lights up a master relay will get energized to provide group alarm signals for remote DCS alarm system. (e) The requirements of indication/metering/alarm are given in the datasheet-A. (f) Alarm contacts shall be rated 0.5 A at 220 V DC and 5A at 240 V A.C. (g) Electrically independent, potential free alarm contacts for each of the points mentioned in the datasheet-A shall be wired up to the terminal block for Purchaser's use.
3.11	<u>LAMP/SPACE HEATERS/RECEPTACLES</u> (a) The panels shall be provided with : (i) Internal illumination lamp with door switch. (ii) Space heater with thermostat control.

	TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)
	(iii) 3-pin 6A receptacle with plug. (b) Lamp, heater and receptacle circuits shall have individual switch fuse units.
3.12	<u>WIRING/CABLING</u>
	(a) The panels shall be completely wired up. All wiring shall be done with flexible, 1100V grade, PVC insulated wires with stranded 2.5 Sq.mm copper conductors and routed through wiring troughs. Each wire shall be ferruled by plastic tube with indelible ink print at both end having terminal block No., terminal number as per approved wiring diagram. (b) Panels shall have removable gland plate for cable entry. All incoming/outgoing cables shall be terminated in suitable terminal block. (c) Control terminal blocks shall be box-clamp type, minimum 10 Sq.mm. 20% spare terminals shall be furnished.
3.13	<u>NAMEPLATE</u>
	(a) Engraved nameplates shall be provided for each panel and for each equipment/device mounted on it. (b) The material shall be anodized aluminium/lamicoid, 3 mm thick, with white letters on black background. (c) Nameplates shall be held by self-tapping screws. The size of nameplates shall be approximately 20 mm x 75 mm for equipment and 40 mm x 150 mm for panels. (d) Nameplates for panels shall be provided both on the front and rear. (e) Control and meter selection switches shall have integral nameplates. Nameplates for all other devices shall be located below the respective devices.

	TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)
	(f) Instruments and devices mounted on the face of the panels shall also be identified on the rear with the instrument/device number. The number may be painted on or adjacent to the instrument or device case. (g) Caution notice on suitable metal plate shall be affixed at the back of each panel.
3.14	<u>GROUNDING</u> (a) Normal 3-phase A.C power supply will be grounded at the source. For grounding other than this, isolation transformer shall be furnished with the U.P.S. (b) The inverter D.C. Input and A.C. Output shall be electrically isolated from each other and from cabinet ground. (c) Panels shall have fully rated ground bus with two ground terminals, one at each end. (d) Each terminal shall comprise two-bolt drilling M10 G.I. bolts and nuts to receive Purchaser's ground connection of 50 x 6 mm G.S. flat. (e) Separate electronic grounding shall be provided for UPS system.
3.15	<u>TROPICAL PROTECTION</u> (a) All equipment accessories and wiring shall have fungus protection, involving special treatment of insulation and metal against fungus insects and corrosion. (b) Screens of corrosion resistant material shall be furnished on all ventilating louvers to prevent the entrance of insects.
3.16	<u>PAINTING</u> (a) The external and internal colour of the panels shall be RAL 7032 and Brilliant white respectively. The panels shall have a matt finish to prevent any glare from surface due to illumination.



TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT
(TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)

4.0 TESTS

4.1 All equipment and components thereof shall be subject to shop tests as per relevant IEC/BIS Standards. The tests shall include, but shall not be limited to:

4.2 TESTS ON BATTERY

4.2.1 Refer Section-10, Part-B, 24V Battery & Battery Charger Specification.

4.3 TESTS ON BATTERY CHARGER

4.3.1 Refer Section-10, Part-B, 24V Battery & Battery Charger Specification.

4.4 TESTS ON UPS SYSTEM

- (a) Type & routine test for various components.
- (b) Burning test on PCBS - Assembled PCBS shall be tested at 70 deg C for 72 hours in loaded condition.
- (c) Rapid temperature cycling test at 70 deg C and 0 deg C for 30 minutes at each temperature - 5 such cycles.
- (d) Functional tests to demonstrate compliance with all specified requirements and published. Specifications such as frequency, regulation, voltage regulation, current limiting, fuse clearing capability of inverters, demonstration of phase and frequency control of inverter for synchronization with range of adjustments transfer and retransfer of static switches under influence of under voltage and over current, tests on chargers, batteries and other system component to confirm compliance with specification.

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

	TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)
5.0	<u>DRAWINGS, DATA & MANUALS</u>
5.1	<u>TO BE SUBMITTED WITH THE BID</u>
5.1.1	UPS panels, Battery Charger and Battery layout drawing with dimensions.
5.1.2	General Arrangement drawing of UPS panels.
5.1.3	Bill of Material.
5.1.4	Schematic drawing of UPS circuits.
5.1.5	Battery cell voltage characteristics and data for different discharge rates.
5.1.6	Technical leaflets on :
(a)	UPS System.
(b)	Battery.
(c)	Battery charger.
(d)	Inverter.
(e)	Static Switch.
(f)	Manual bypass Switch.
5.1.7	Duty cycle diagram and battery sizing calculation in the format of IEEE Standard.
5.1.8	Sizing calculation of UPS system, charger main equipment, viz. SCRs, rectifier transformers etc.
5.1.9	Type test certificates for similar equipment.
5.2	<u>TO BE SUBMITTED AFTER AWARD OF CONTRACT.</u>
5.2.1	Dimensional UPS, battery layout diagram in plan & section.

	TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)
5.2.2 5.2.3 5.2.4 5.2.5 5.2.6 5.2.7 5.2.8 5.2.9 5.2.10 5.2.11	Connection details of take-off terminals. Dimensional general arrangement drawings of UPS, battery charger battery clearly showing device dispositions, cable entry, space requirement, etc. Sectional views of UPS System panels. Panel foundation plan and loading. UPS system <u>schematics and wiring diagrams</u>. Test reports. Detailed bill of materials. Any other relevant drawing or data necessary for satisfactory installation, operation, and maintenance. Cable <u>schedule & Inter-connection charts</u>. Instruction manuals of UPS system. The manual shall clearly indicate method of installation, check-ups, and tests to be carried out before commissioning of the equipment.
5.3	Tenderer may note that the drawings, data and manuals listed above are minimum requirement only. Tenderer shall ensure that all other necessary write-ups, curves and information required to fully describe the equipment offered are submitted with their bids.
6.0	<u>SPECIAL TOOLS AND TACKLE</u>
6.1	The Tenderer shall quote any special tools and tackles needed for his equipment or stated herein.

 TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)		
<u>RATINGS & REQUIREMENTS</u> <u>DATA SHEET-A</u>		
SR. NO.	ITEM	DESCRIPTION
1.0	<u>STATIC INVERTER</u>	
1.1	Application	UPS System for control system, MMI, receiver instruments, devices mounted in supervisory control desk /panel, PLCs and other system/sub-system requiring UPS power.
1.2	Type	static IGBT PWM type.
1.3	Duty	Continuous.
1.4	Enclosure	Sheet steel, IP-52.
1.5	Cooling	Natural convection or forced cooling using redundant fans.
1.6	Ambient temperature	as per General Electrical Specification.
1.7	Inverter capacity	To be decided by the Bidder.
1.8	Overload capacity	300% for 4 m secs.
		150% for 60 secs.
		125% for 10 mins.
		110% for continuous.
1.9	Voltage	
	(a) Inverter input, Battery output	To be decided by the Bidder.

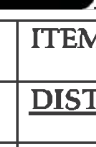
 TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)		
SR. NO.	ITEM	DESCRIPTION
	(b) Nominal output	240 V, 50 Hz, 1-phase.
1.10	Voltage Regulation:	
	(a) Steady state (0-100% load at all input voltages and all power factors)	$\pm 1.5\%$.
	(b) Transient voltage (On application or removal of 100% load)	$\pm 10\%$.
	(c) Time to recover from transient to normal voltage	50 milliseconds.
1.11	Wave form:	
	(a) Nominal frequency	50 Hz.
	(b) Frequency range for all conditions of input supplies, loads and temperature occurring simultaneous or in any combination (automatically controlled)	± 0.05 Hz.
	(c) Synchronization limits (for maintenance of synchronism between inverter and standby A.C source)	49 Hz to 51 Hz (factory set).
	(d) Field adjustment range for (c) above	50 ± 0.05 Hz to 50 ± 2 Hz.
	(e) Total Harmonic Content	5% maximum at rated load.
	(f) Harmonic content for any single harmonic	3% maximum.

 TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)		
SR. NO.	ITEM	DESCRIPTION
1.12	Rated output current at rated output voltage with current limit not operating :	
	(a) Current	200%.
	(b) Duration	100 milliseconds.
1.13	Efficiency at full load (Watt output/ watt input)	90% or better.
1.14	SCR derating from peak voltage and peak rating	50%.
2.0	<u>STATIC SWITCH</u>	
2.1	Type	Solid-state, SCR.
2.2	Duty	Continuous.
2.3	Enclosure	Sheet Steel, IP-52.
2.4	Cooling	Natural convection or forced cooling using redundant fans.
2.5	Ambient Temperature	50 Deg. C.
2.6	Capacity	
	(a) Continuous	Equal to full load capacity of the inverter.
	(b) Overload	300% for 4 m secs.
		150% for 60 secs
		125% for 10 mins
		110% for continuous

 TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)		
SR. NO.	ITEM	DESCRIPTION
	(c) Peak	1000% of continuous rating for 5 cycle.
2.7	Normal Voltage	240V, 50 Hz, 1-phase.
2.8	Transient Voltage Tolerance	340V peak above the nominal line voltage.
2.9	Transfer Time	less than 4 m secs.
3.0	<u>MANUAL BY-PASS SWITCH / BREAKER</u>	
3.1	Type	Maintained, make before break.
3.2	Voltage	600V.
3.3	Rated Current	To meet the requirement as specified in clause no.: 3.4 UPS specification.
4.0	<u>BATTERY</u>	
4.1	Application	UPS Battery
4.2	Ambient Temperature	
	(a) Maximum	50 Deg. C.
	(b) Minimum	5 Deg. C.
4.3	Type	Lead acid 'Plante' type
4.4	Nos. of Cells per Battery	To be decided by the Bidder.
4.5	Battery nominal voltage	220V.
4.6	Battery capacity in AH at 27 °C- 10 hrs. discharge for plante	Bidder to compute AH capacity considering 100% UPS load for 30 minutes followed by 60% UPS load for 30 minutes. Discharge end cell

 TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)		
SR. NO.	ITEM	DESCRIPTION
		voltage will be 1.85V/cell for Lead Acid plante type after 10 hrs .
4.7	Method of working	
	(a) Float charge (maximum)	2.2 Volt / Cell for Lead acid plante type.
	(b) Boost charge (After complete discharge)	2.75 Volts / Cell for Lead acid Plante type.
4.8	Mounting	Wooden racks for Lead Acid plante type.
4.9	Connection	Cables
4.10	Battery Size (AH Capacity)	Battery sizing calculation shall be done in line with IEEE standard considering temperature correction factor, design margin and compensation for age.
5.0	<u>BATTERY CHARGER</u>	
5.1	Charger	Float + Float-cum-Boost.
5.2	Type	Solid-state, full wave fully controlled. 3 Phase Bridge.
5.3	Duty	Continuous.
5.4	Enclosure	Sheet Steel, IP-52
5.5	Cooling	Natural convection or forced cooling using redundant fans.
5.6	Ambient Temperature	50 Deg. C.
5.7	A.C. input	

 TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)		
SR. NO.	ITEM	DESCRIPTION
	(a) Supply	415V, 3-phase, 50 Hz, 4 wire.
	(b) Voltage variation	±10%.
	(c) Frequency variation	± 5%.
	(d) Combined volt frequency Variation	10% (absolute sum).
	(e) Short-circuit level	50 KA
	(f) System earthing	Effectively earthed.
5.8	D.C. output	100% UPS load plus restoring fully discharged battery to full charge condition in 8 hours.
5.9	Blocking Diode, Peak inverse voltage	800 V (minimum).
5.10	Performance Requirement	
	(a) The output voltage of the charger shall be regulated within ± 1% of the set value for any load variation from 0 to 100% and A.C input voltage and frequency variation as indicated above	
	(b) The ripple content in charger D.C. output shall be limited to less than ±1% with battery and less than ± 2% without battery.	

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SR. NO.	ITEM	DESCRIPTION
6.0	<u>DISTRIBUTION BOARDS</u>	
6.1	Type	Fixed, Modular.
6.2	Enclosure	Sheet Steel, IP-52.
6.3	Mounting	Free standing (can be attended from both front & back).

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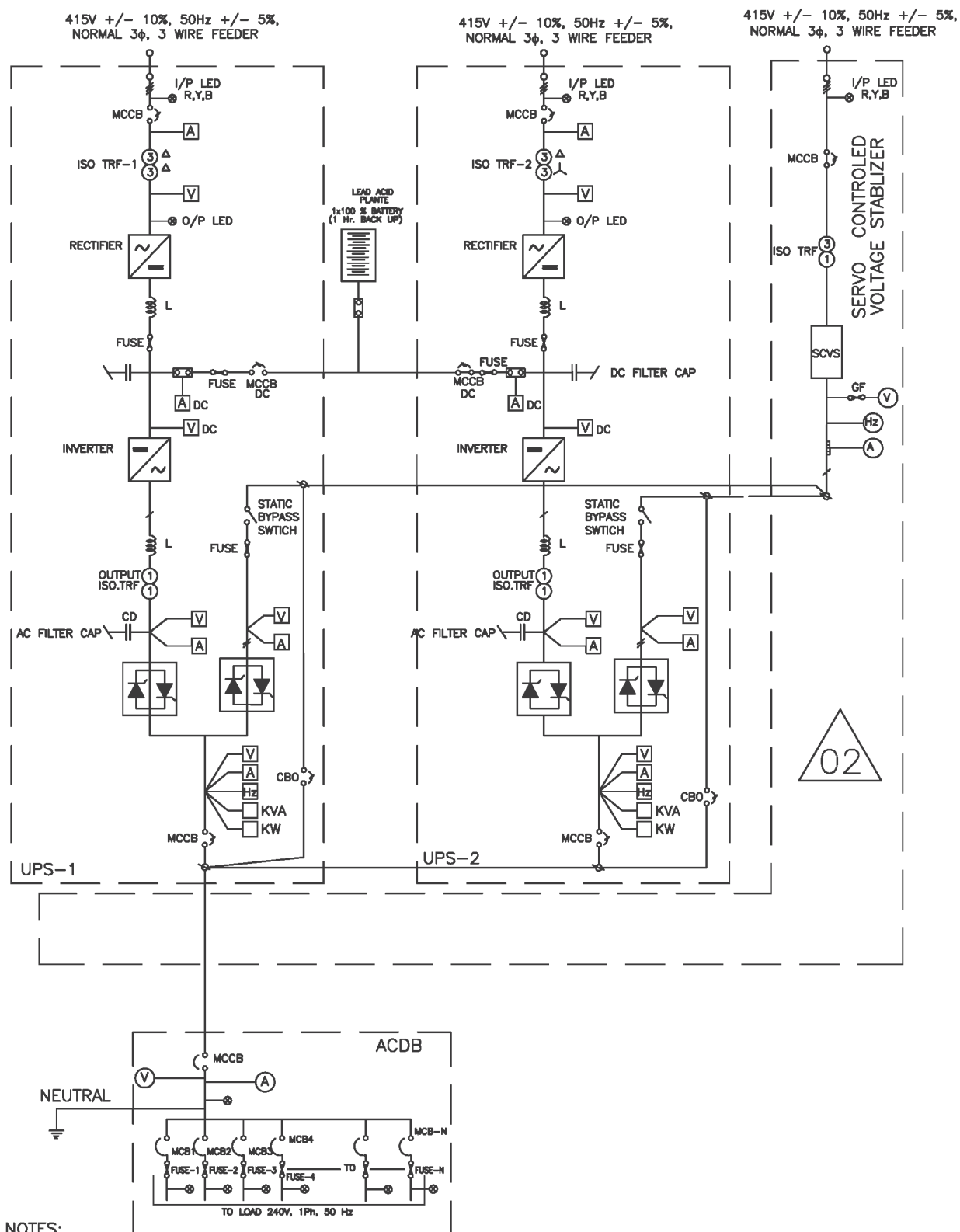
TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT

(TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)

SET OF ACCESSORIES TO BE PROVIDED FOR EACH BATTERY BANK

ANNEXURE-A

SR. NO.	ACCESSORIES/DEVICES	QUANTITY (Nos.)
1.0	HYDROMETER	2 NOS.
2.0	SET OF HYDROMETER SYRINGES SUITABLE FOR THE VENT HOLES IN DIFFERENT CELLS	2 NOS.
3.0	THERMOMETER FOR MEASURING ELECTROLYTE TEMPERATURE	5 NOS.
4.0	SPECIFIC GRAVITY CORRECTION CHARTS	2 NOS.
5.0	WALLMOUNTING TYPE HOLDER FOR HYDROMETER AND THERMOMETER	2 NOS.
6.0	CELL TESTING VOLTMETER (3-0-3 V)	2 NOS.
7.0	ALKALI MIXING JAR	1 NO.
8.0	ACID MIXING JAR	1 NO.
9.0	RUBBER APRON	2 NOS.
10.0	PAIR OF RUBBER GLOVES	2 NOS.
11.0	SET OF SPANNERS	2 NOS.
12.0	“NO SMOKING” NOTICE	2 NOS.
13.0	GOGGLES (INDUSTRIAL)	2 NOS.
14.0	INSTRUCTION CARD	10 NOS.
	IN ADDITION TO THE ABOVE, ONE (1) NO. MINIMUM AND MAXIMUM TEMPERATURE INDICATOR SHALL BE SUPPLIED.	



NOTES:

1. ACDB NEUTRAL TO BE GROUNDED TO A DEDICATED GROUND.
2. ALL OUTPUT FEEDERS OF ACDB SHALL BE PROVIDED WITH AN LED AFTER THE FUSE FOR FEEDER ON INDICATION WITH FEEDER DESCRIPTION.



1x660 MW BHUSAWAL STPP

TITLE:-

UPS SCHEME
OFFSITEDRG.
No.

PE-DG-415-145-I004

REV.
No.

02

DATE

09.07.2018

SHEET

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OF

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420

TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION
NUMBER: PE-TS-415-174-A001 REV 0)

CONTROL PANELS SPECIFICATION

|



TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT
(TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)

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.

	TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)
(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 gasketed cable gland plates and cable glands. Split type grommets shall be used for prefab cables.
- (n) Wire shall be multistranded annealed flexible high purity copper conductor with heat resistant FRLS PVC insulation and shall pass vertical flame test per IPCEAS-1981.
- (o) Wire sizes used for internal wiring shall not be lower than the followings:
 - (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

	TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)
	(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:

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.

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.



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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	<u>METERING BASES AND CHART UNITS</u>
	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 : ppm /ppb. /Sodium



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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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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

FORM NO. PEM-6666-0

	TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)			
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) ☒ 2.0 mm (FOR OTHER SIDES AND TOP)	
		OTHER		
		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		

FORM NO. PEM-6666-0

		TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)	
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:



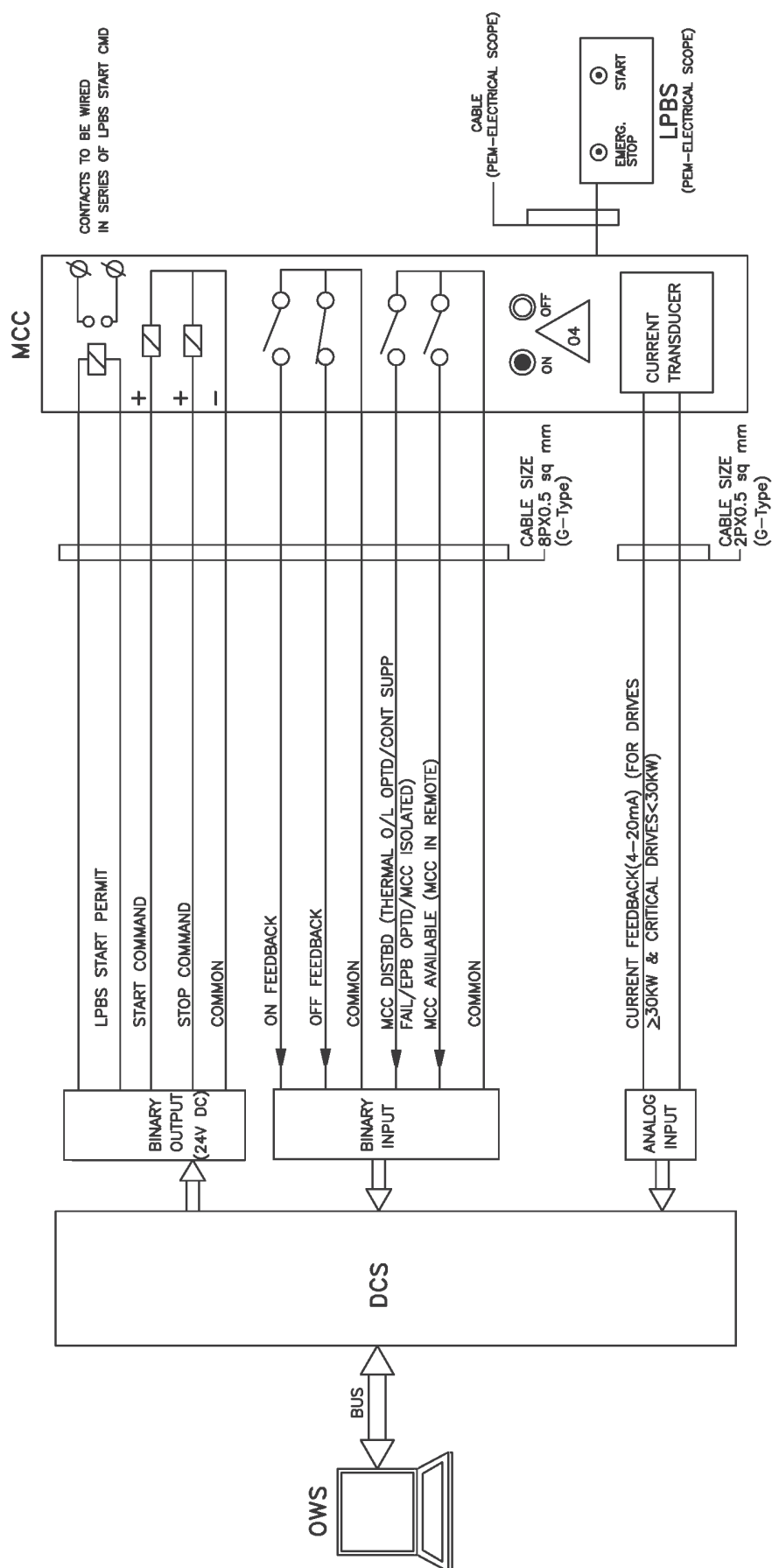
TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT
(TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)

DRIVE CONTROL PHILOSOPHY

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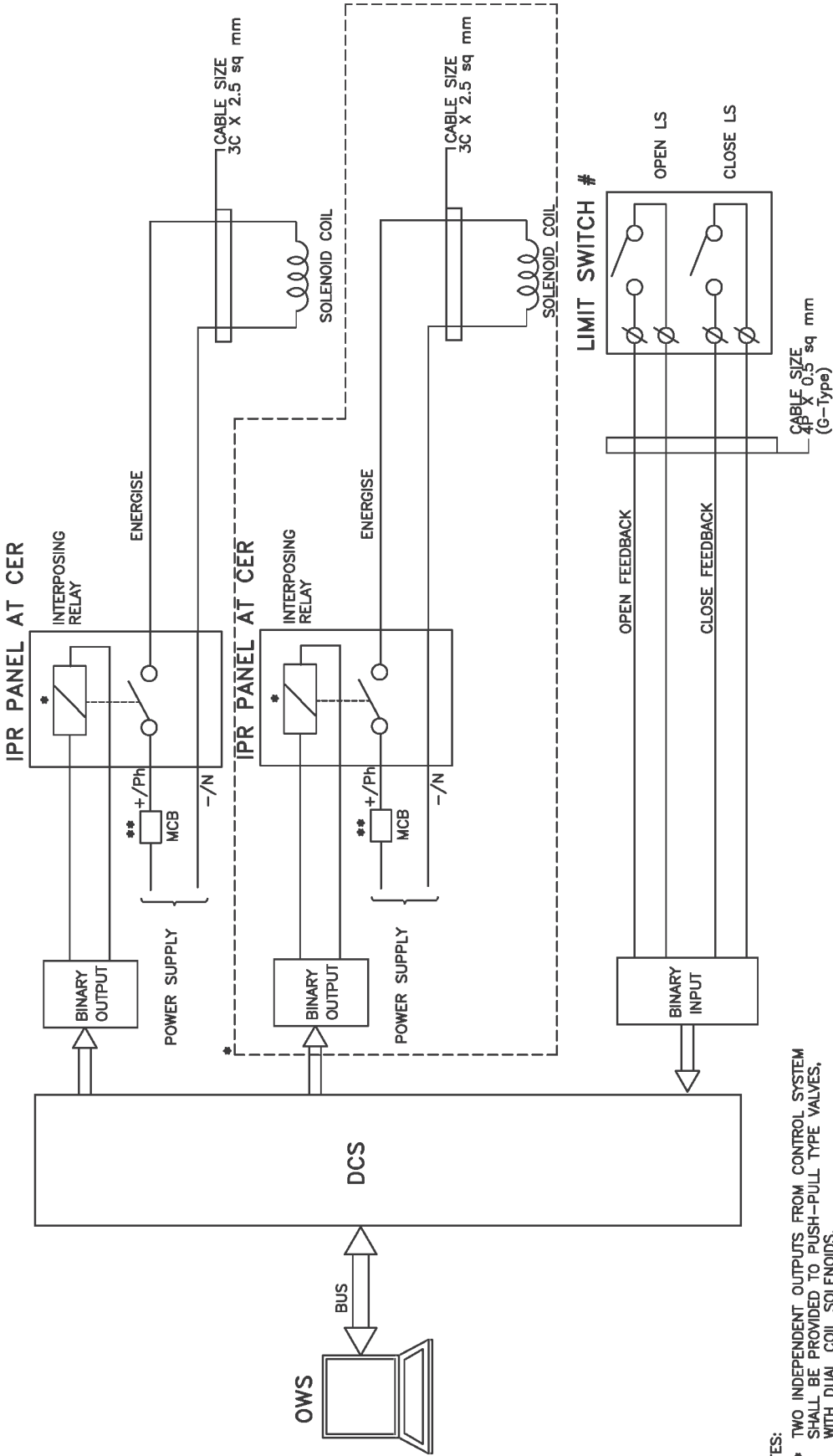
DCS INTERFACE FOR UNIDIRECTIONAL LT DRIVE(CONTACTOR OPERATED)



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

	PROJECT:	1x660 MW BHUSAWAL STPP	DRG.NO.	PE-DM-415-145-I002
	TITLE	DDCMS INTERFACE FOR UNIDIRECTIONAL LT DRIVE	DATE	01.10.2018
			REV.NO.	04
			SHT	9 OF 12

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

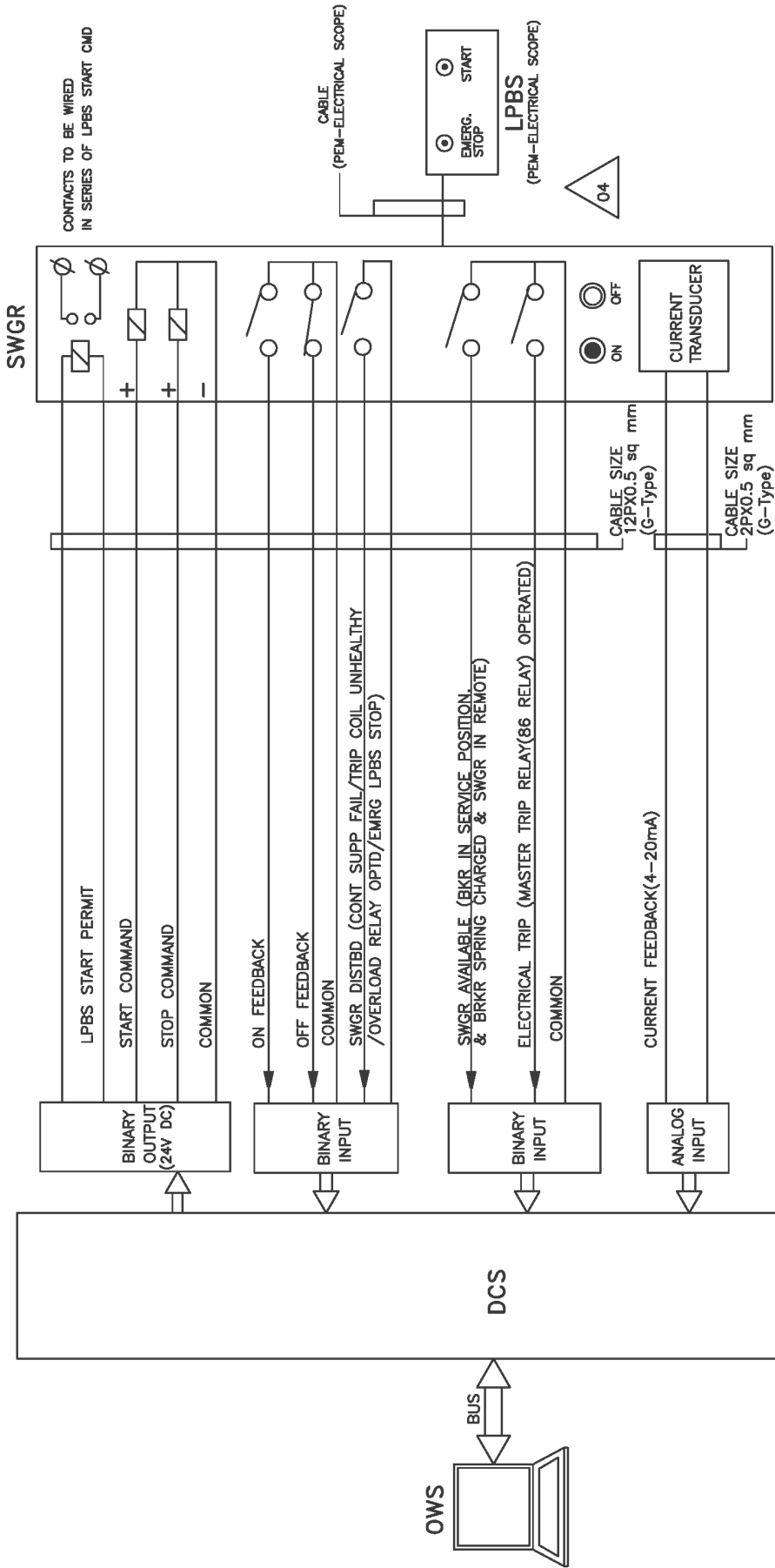


- NOTES:
- * TWO INDEPENDENT OUTPUTS FROM CONTROL SYSTEM SHALL BE PROVIDED TO PUSH-PULL TYPE VALVES, WITH DUAL COIL SOLENOIDS.
 - ** MCB SHALL BE PROVIDED FOR EACH SOLENOID VALVE.
 - # FOR ON/OFF TYPE, SOLENOID ACTUATED CONTROL

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



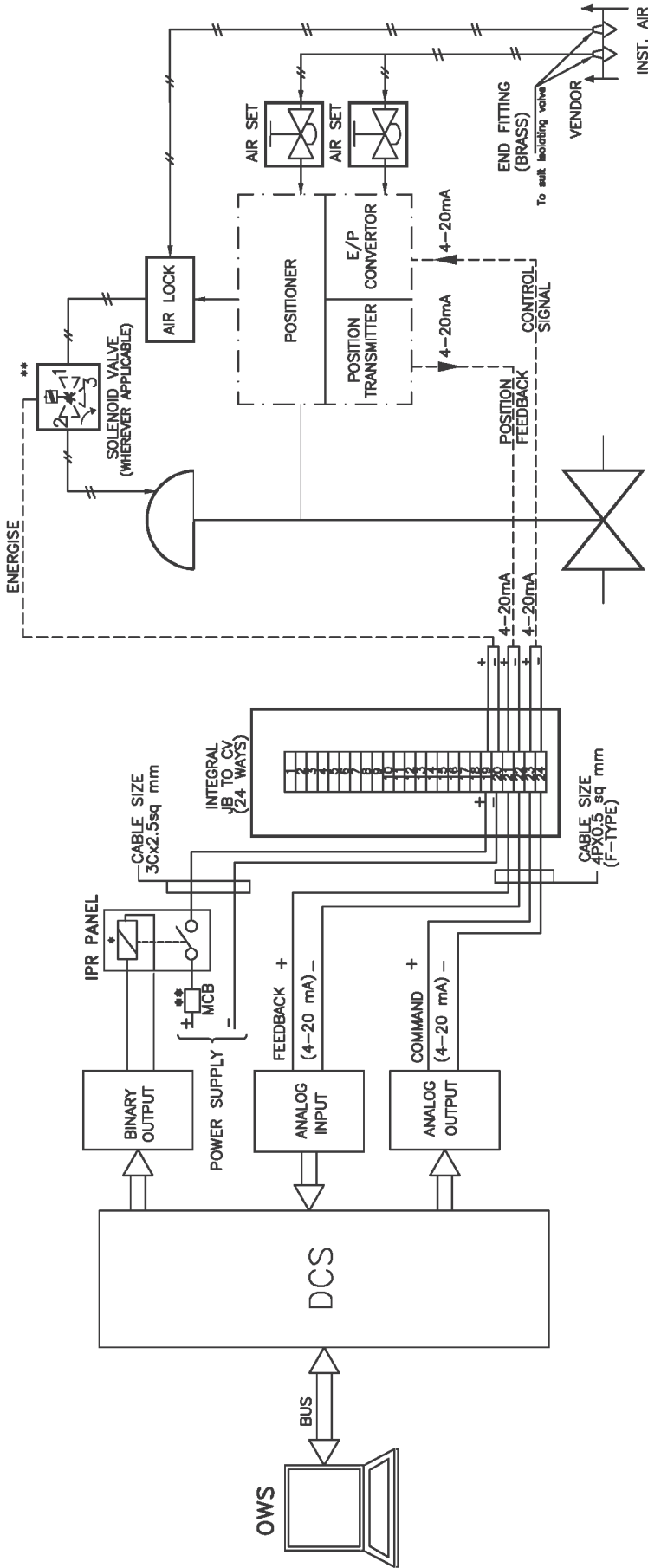
DCS INTERFACE FOR HT/LT UNIDIRECTIONAL DRIVES(BREAKER OPERATED)



NOTE:- INTERPOSING RELAYS(IPRs) TO BE SUPPLIED ALONG WITH SWITCHGEAR.
BEARING AND WINDING TEMPERATURES FOR HT DRIVES SHALL BE HOOKED TO DCS.

	PROJECT: 1x660 MW BHUSAWAL STPP		DRG.NO.	PE-DW-415-145-1002
	TITLE		DATE	01.10.2018
	DDCMIS INTERFACE FOR UNIDIRECTIONAL HT DRIVE		REV.NO.	04
		SHT	11	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		
	TITLE		DATE	01.10.2018		
	TYPICAL HOOK-UP DIAGRAM ANALOG DRIVE		REV.NO.	04		
SHT			12	OF	12	

	TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)
APPLICABLE CODES AND STANDARDS	

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TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT
(TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)

6.0 CODES AND STANDARDS

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.



TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT
(TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)

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).



TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT
(TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)

- (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.

	TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)
	(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.



TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT
(TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)

- (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.

	TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)
	(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

	TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)
	(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.

G.A. DRAWING –
TRANSMITTER RACK

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ISSUE	BY	CH	DATE	PROCON ENGINEERS (DIVISION OF NIMOTO CONSULTING ENGINEERS PVT. LTD.)		G.A. DRAWING-TRANSMITTER RACK	
				CLIENT : MAHARASHTRA STATE POWER GENERATION CO.LTD.		SCALE ~ APPROVED	
				PROJECT : BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT		DIV INST.	
						DR P.N.Z.	
						CH D.J.P.	
				DWG.NO.PE-189-IN-SK-8004		(Sht. 1 of 10) PO	



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	PO	

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

G.A. DRAWING FOR
LOCAL INSTRUMENT RACK

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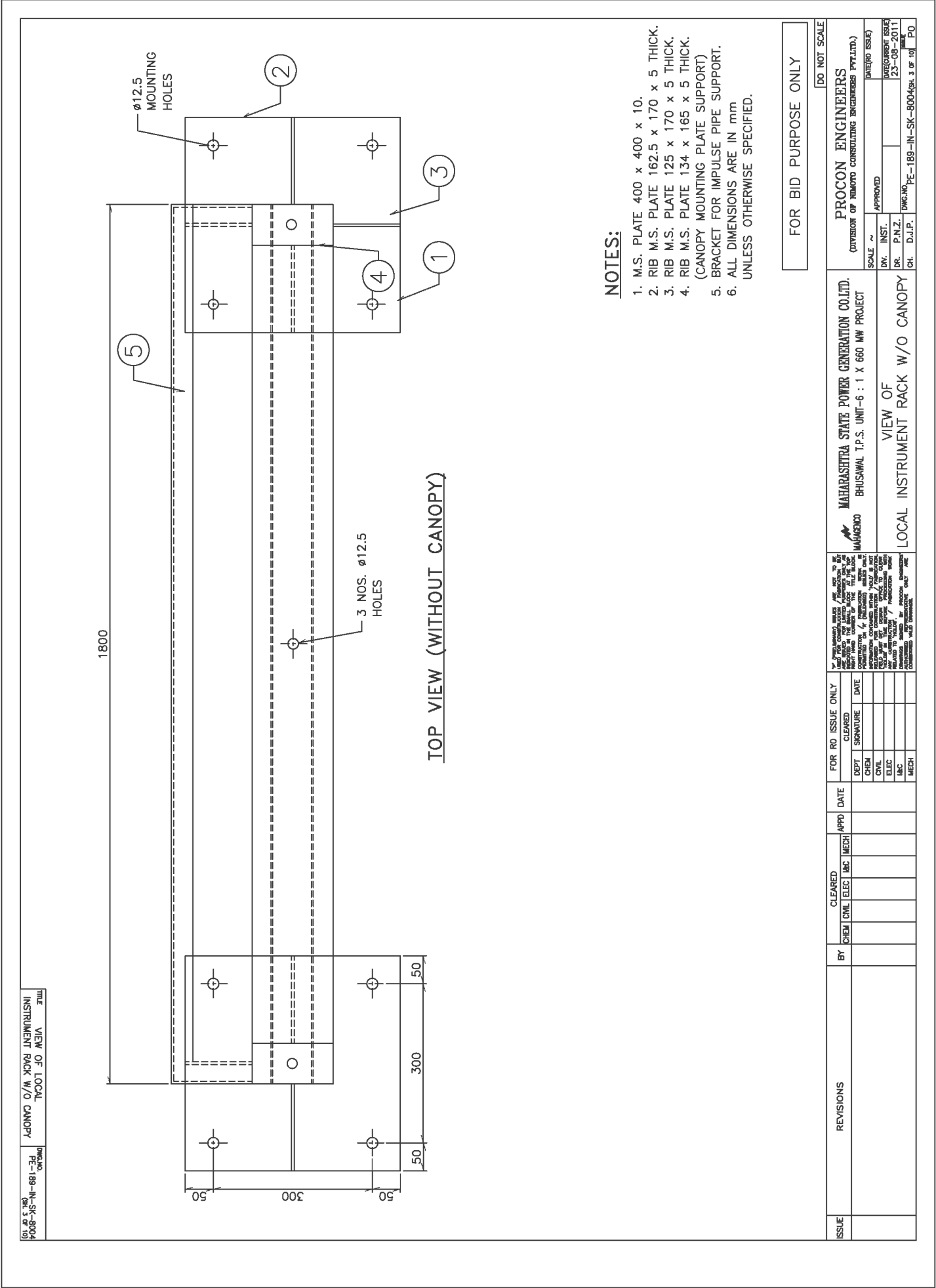
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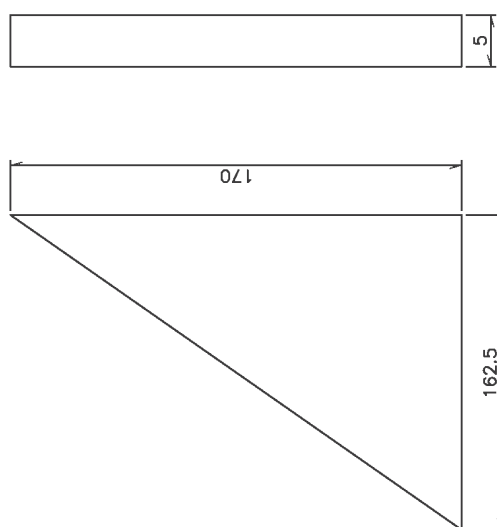
REVISIONS

ISSUE	
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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.



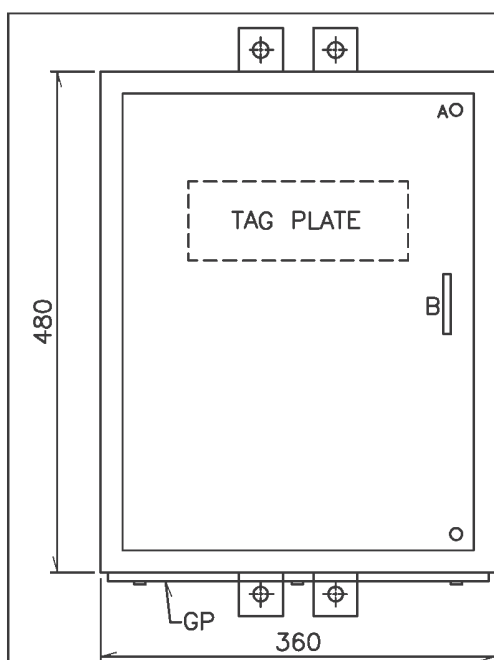
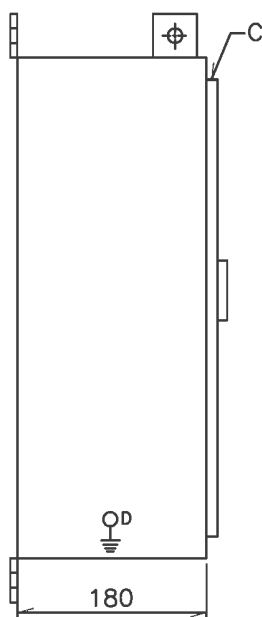
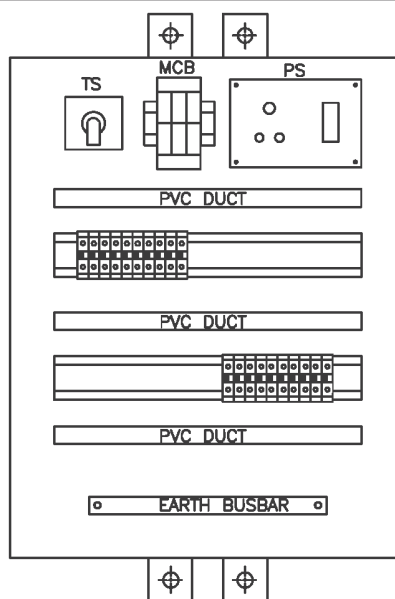


DETAIL OF-1

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

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FRONT VIEWSIDE VIEWINTERNAL FRONT 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

NOTES:

- JB WILL BE MADE OUT OF 2.0 mm CRCA SHEET.
- PROTECTION CLASS IP-65.
- COLOR: EXT.-RAL 7032, INT.-BRILLIANT WHITE.
- NUTS FOR MOUNTING THE JUNCTION BOX SHALL BE PROVIDED.
- 3 mm THICK CRCA GLAND PLATE (GP) AT BOTTOM SHALL BE PROVIDED.
- SCREWLESS CAGE CLAMP TERMINALS SHALL BE USED.
- EARTH BUS BAR SHALL BE OF 25x6 TINNED COPPER.
- INSTRUMENT TAG VIS-A-VIS SERVICE AND TERMINAL DETAILS SHALL BE PRINTED ON PHENOLIC BOARD MOUNTED ON BACK SIDE OF DOOR.
- COLOR CODE FOR POWER SUPPLY:
PHASE-RED, NEUTRAL-BLACK & EARTH - GREEN.
- CABLE FOR PANEL LIGHTING SHALL BE 1.5 SQ.mm, 1100V GRADE.
- SIGNAL WIRING SHALL BE 4Px0.5 SQ.mm TINNED COPPER, TWISTED PAIR, OVERALL SHIELDED 500V GRADE, FRLS PVC.
- ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE SPECIFIED.

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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

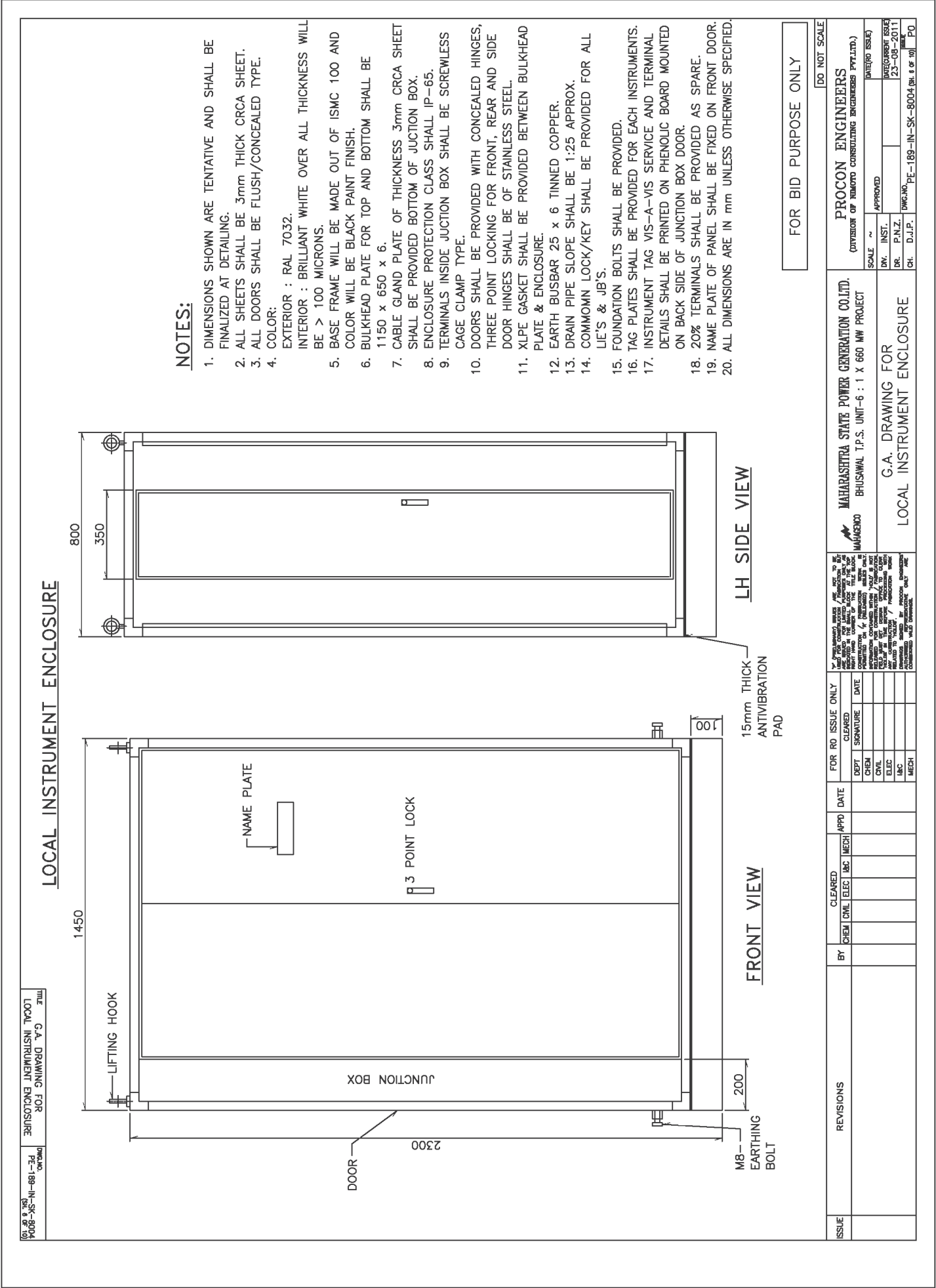
G.A. OF JB LOCAL INSTRUMENT RACK

SCALE ~	APPROVED
DIV INST.	
DR P.N.Z.	
CH D.J.P.	

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

(Sht. 5 of 10)

PO



[illegible]

1150

200

1450

BULKHEAD PLATE

600

650

1100

200

1450

200

450

500

200

1450

BOTTOM VIEW

1450

200

500

2" NB PIPE

1450

200

C CHANNEL

500

200

1450

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.

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MAHARASHTRA STATE POWER GENERATION CO.LTD.

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

BULKHEAD DETAILS FOR LOCAL INSTRUMENT ENCLOSURE

PROCON ENGINEERS

(DIVISION OF NIMOTO CONSULTING ENGINEERS PVT.LTD.)

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23-08-2011

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DRG.NO.

PE-189-IN-SK-8004 (Rev. a of 10)

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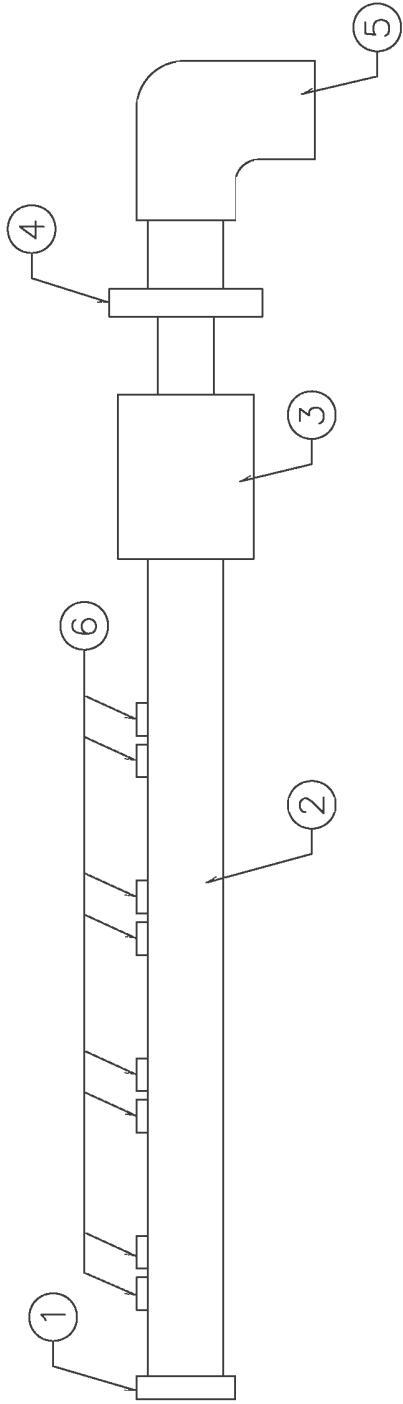
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FILE DRAIN HEADER DETAIL FOR
LOCAL INSTRUMENT ENCLOSURE

DWG NO.
PE-189-IN-SK-8004
(REV. 10 OF 10)



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.

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			CHEM	CIVIL	ELEC	IMC			CHEM	CIVIL	ELEC	IMC													
			SIGNATURE						DATE																
			DEPT						SCALE																
DR. P.N.Z.														DATE (RD ISSUE)											
CH. D.J.P.														DATE (RD ISSUE)											
DWG. NO. PE-189-IN-SK-8004 (REV. 10 OF 10)														DATE (RD ISSUE)											
LOCAL INSTRUMENT ENCLOSURE														DATE (RD ISSUE)											

TYPICAL INSTRUMENT
INSTALLATION DIAGRAM

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

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.

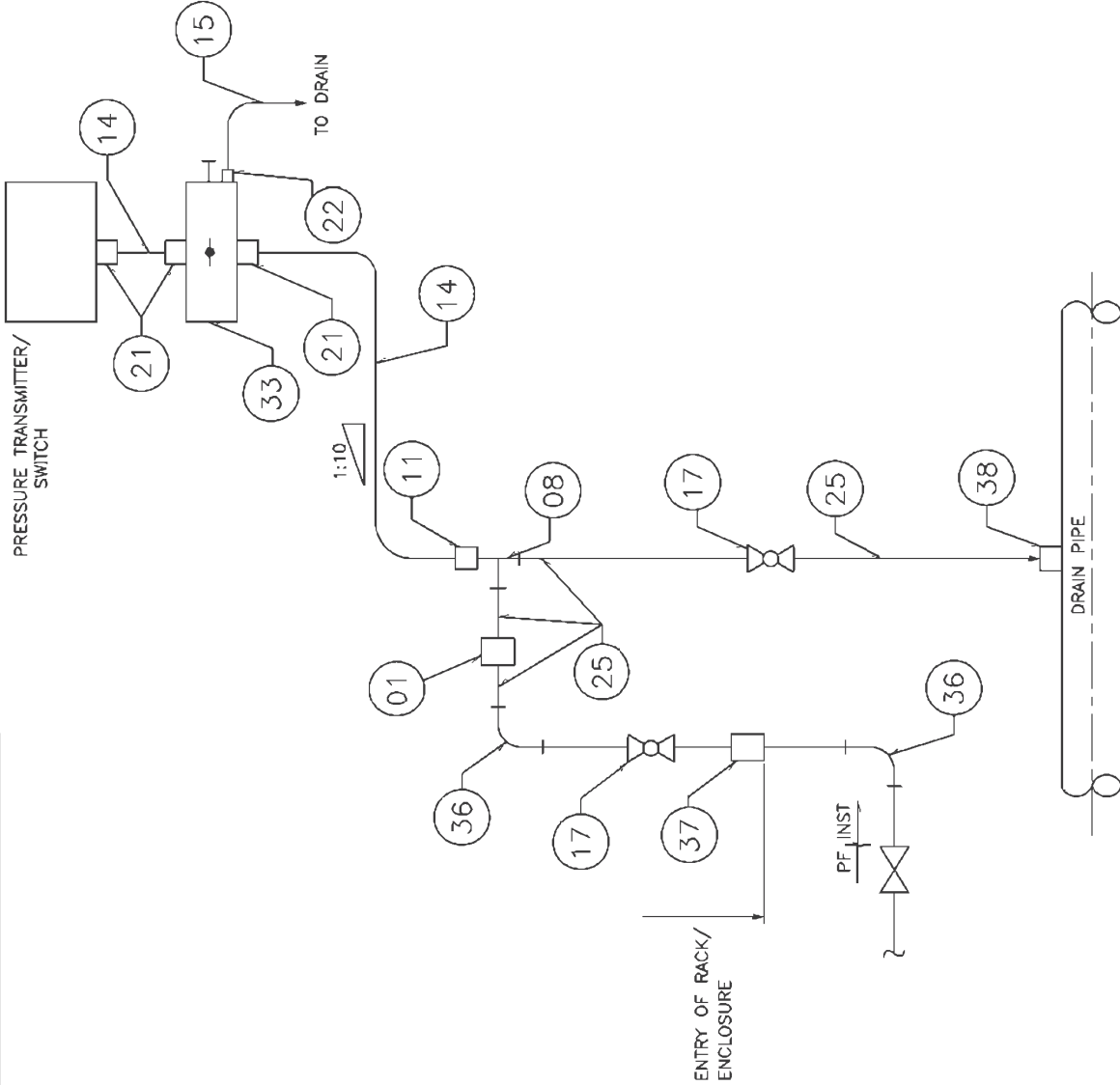
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ISSUE	BY	CH	DATE	TYPICAL INSTRUMENT INSTALLATION DIAGRAM	
				PROCON ENGINEERS (DIVISION OF NIMOTO CONSULTING ENGINEERS PVT. LTD.)	
				SCALE ~	APPROVED
				CLIENT : MAHARASHTRA STATE POWER GENERATION CO.LTD.	DIV INST.
				PROJECT : BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT	DR P.N.Z.
					CH D.J.P.
				DWG.NO.PE-189-IN-SK-8003 (Sht. 2 of 20) PO	

80365/2020/PS-PEM-MAX

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

1008-SK-NI-68-54

PRESSURE TRANSMITTER/PRESSURE SWITCH
MOUNTED ABOVE SOURCE POINT

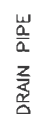


BILL OF MATERIAL		
ITEM NO.	QTY./INST	DESCRIPTION
08	1	EQUAL TEE (FEMALE) 1/2" SW 3000lbs, CS/AS
11	1	MALE CONNECTOR 1/2" PE x 1/2" OD 3000 lbs OF CS/AS
17	2	GLOBE VALVE 1/2" SW 800lbs OF CS/AS
14	3 MTRS.	TUBE 1/2" OD, 2.1mm THICK, SS 316
21	3	MALE CONNECTOR 1/2" NPT(M) x 1/2" OD 3000 lbs, SS 316
25	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

SERVICE : CONDENSER PRESSURE, INSTRUMENT AIR ETC.

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CH: D.J.P.	DATE (OF SIGN)
PE-188-NI-SK-8003PM 3 OF 30	
PO	
MAHARASHTRA STATE POWER GENERATION CO.LTD. BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT	
TYPICAL INSTRUMENT INSTALLATION DIAGRAM	

PRESSURE TRANSMITTER/
SWITCH



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 6000l 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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DATE DESCRIPTION PE - 189-IN-SK-803 INSTALLATION DIAGRAM (SHEET 1 OF 2)	DATE DESCRIPTION PE - 189-IN-SK-803 INSTALLATION DIAGRAM (SHEET 1 OF 2)
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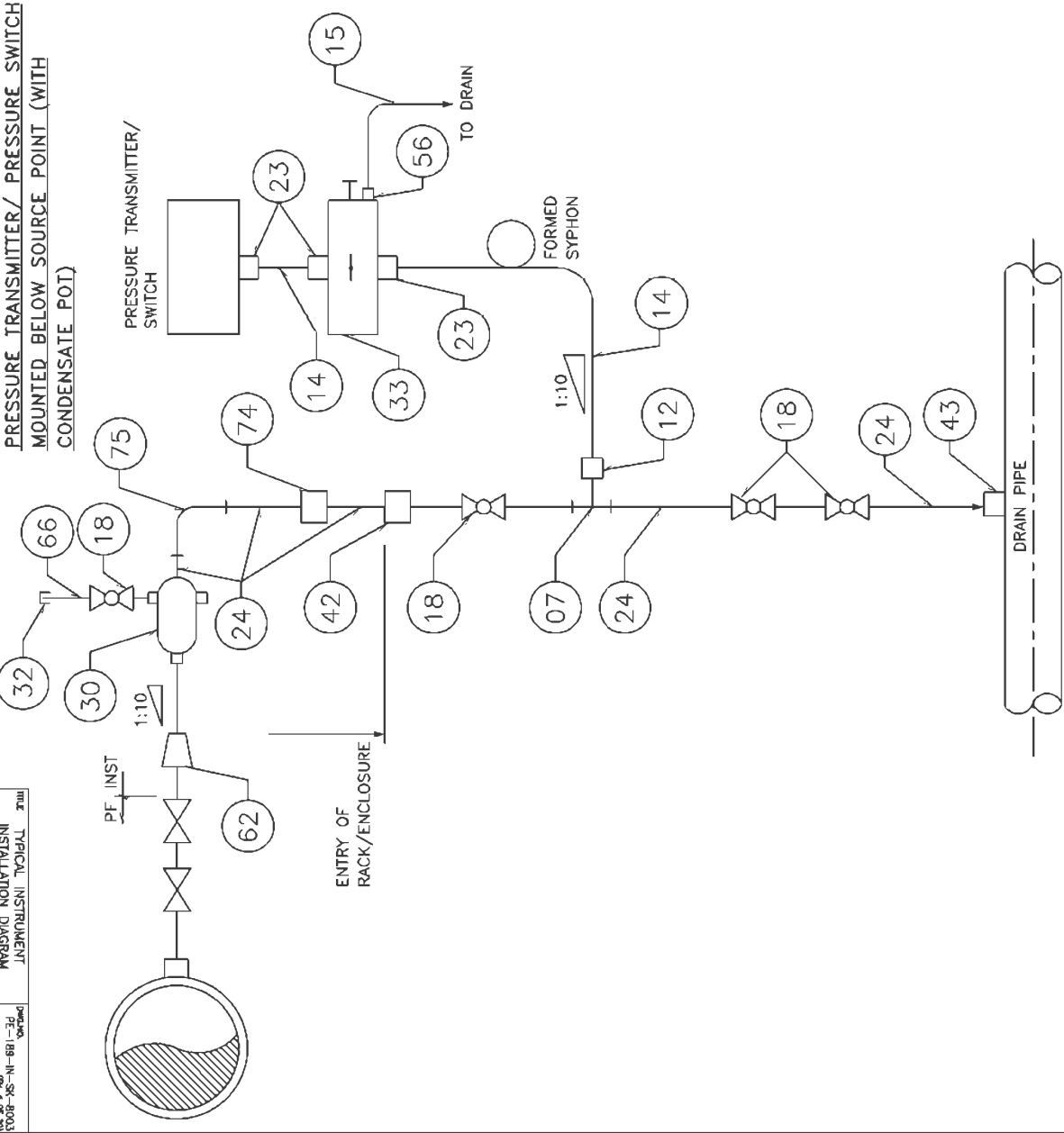


BILL OF MATERIAL		
ITEM NO.	QTY./INST	DESCRIPTION
08	1	EQUAL TEE (FEMALE) 1/2" SW 3000lbs, CS/AS
11	1	MALE CONNECTOR 1/2" PE x 1/2" OD 3000 lbs, CS/AS
17	2	GLOBE VALVES 1/2" SW 800lbs, CS/AS
14	3 MTRS.	TUBE 1/2" OD, 2.1mm THK.
21	3	MALE CONNECTOR 1/2" NPT(M) x 1/2" OD 3000 lbs, SS 316
25	15 MTRS.	IMPULSE 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, 1.0 mm THK. SS 316
22	1	MALE CONNECTOR 1/4" NPT(M) x 8mm OD 3000 lbs, SS 316
36	1	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

FOR BID PURPOSE ONLY

[illegible]

PRESSURE TRANSMITTER/ PRESSURE SWITCH
MOUNTED BELOW SOURCE POINT (WITH
CONDENSATE POT)



BILL OF MATERIAL		
ITEM NO.	QTY./INST.	DESCRIPTION
62	1	REDUCER 1"SW x 1/2" SW 9000lbs, CS/AS
07	1	EQUAL TEE (FEMALE)1/2" SW 9000 lbs, CS/AS
12	1	MALE CONNECTOR 1/2" PE x 1/2" OD 9000 lbs, CS/AS
18	4	GLOBE VALVES 1/2" SW 1500 lbs, CS/AS
14	3 MTRS.	TUBE 1/2" OD, 2mm THK, SS 316
23	3	MALE CONNECTOR 1/2" NPT(M) x 1/2" OD 9000 lbs, SS 316
24	15 MTRS.	IMPULSE PIPE 15 NB SCH. 80, CS/AS
33	1	2 VALVES MANIFOLD 1/2" NPT(F), SS 316
74	1	FULL COUPLING 1/2" SW 9000lbs, CS/AS
15	0.15 MTRS.	TUBE 8mm OD, 1.0mm THK, SS 316
56	1	MALE CONNECTOR 1/4" NPT(M) x 8mm OD, 9000 lbs, SS 316
42	1	BULKHEAD UNION/COUPLING CL:9000 lbs- AS PER ANSI B16.11, 1/2" NB-SW, CS/AS
43	1	HALF COUPLING CL:9000 lbs, 1/2" NB-SW, AS PER ANSI B16.11, CS/AS
75	1	90° ELBOW 1/2" SW CL:9000 lbs, CS/AS
32	1	PLUG 1/2" NPT(F) 9000lbs, CS/AS
30	1	CONDENSATE POT 1/2" SW NPT(F) 9000lbs, CS/AS
66	1	15 NB SCH 80, SW x 1/2" NPT(M), SEAMLESS NIPPLE 6000 lbs, CS/AS

SERVICE : MEDIUM AND HIGH PRESSURE STEAM

FOR BID PURPOSE ONLY

ISSUE		REVISIONS		FOR BID PURPOSE ONLY		DO NOT SCALE	
BY		Cleared		DATE		PROCON ENGINEERS	
CHN		ELEC		UAC		(DIVISION OF MARGO CONSULTING ENGINEERS PVT.LTD.)	
MED		MED		MED		SCALE	
						DATE (NO. ISSUE)	
						APPROVED	
						DATE (NO. ISSUE)	
						P.N.Z.	
						23-08-2011	
						D.J.P.	
						PE-189-IN-SK-8003 (Rev. 6 of 20)	
						P0	

MAHARASHTRA STATE POWER GENERATION CO.LTD.
BRUSAWAL T.P.S. UNIT-6 : 1 X 650 MW PROJECT
TYPICAL INSTRUMENT
INSTALLATION DIAGRAM







PE-189-IN-SK-BOD
(SEE 10 OF 20)



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

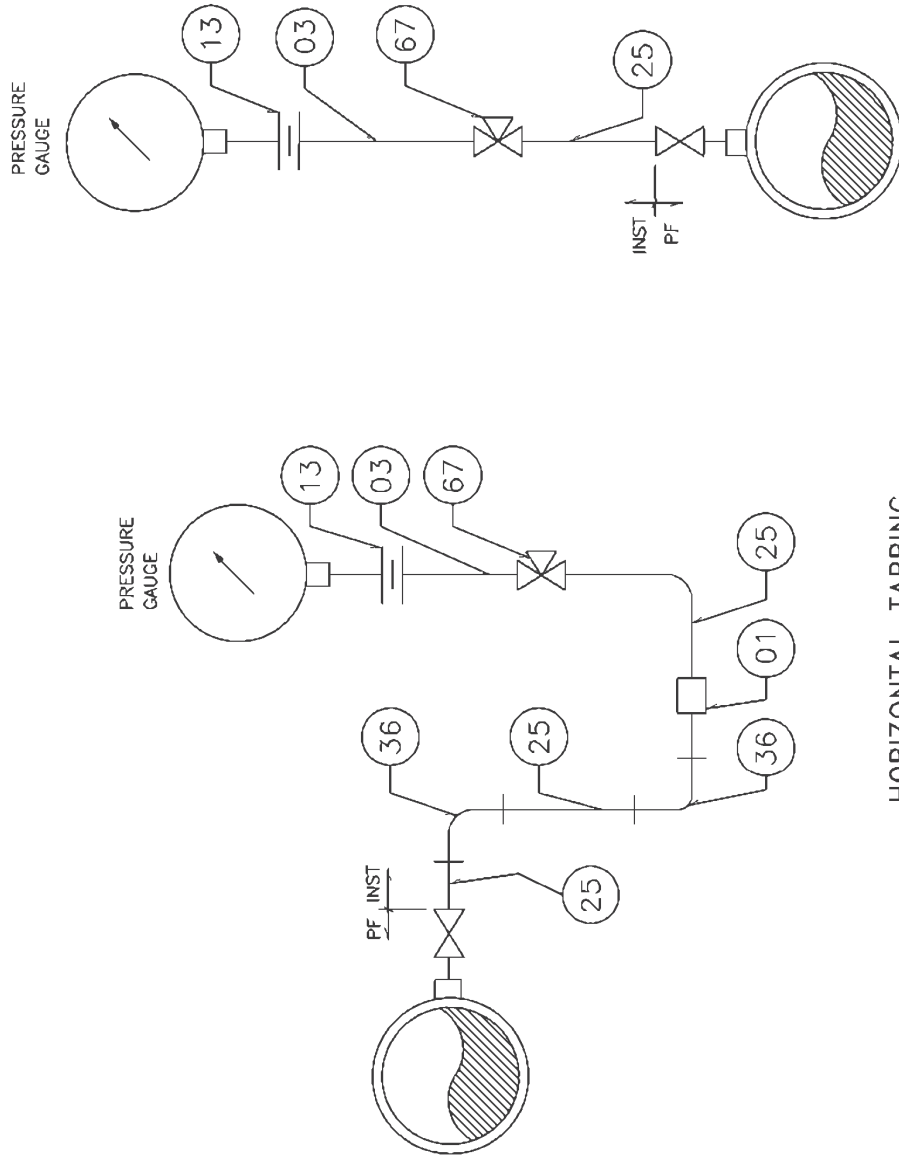
FOR BID PURPOSE ONLY

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PROCON ENGINEERS
DIVISION OF NAYO CONSULTING ENGINEERS PVT.LTD.)
SCALE ~ APPROVED
DWG. NO. PE-189-IN-SK-8003/Rev. 11 of 20
DATE 23-08-2011
BY P.N.Z.
CHK. D.J.P.

TYPICAL INSTRUMENT
INSTALLATION DIAGRAM

DATE



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

SERVICE : WATER, CONDENSATE ETC.

HORIZONTAL TAPPING

VERTICAL TAPPING

ISSUE	REVISIONS	BY	CHKD	CNCL	ELEC	UNC	MECH	APPRD	DATE	FOR RD ISSUE ONLY				MAHARASHTRA STATE POWER GENERATION CO.LTD. BRUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT				TYPICAL INSTRUMENT INSTALLATION DIAGRAM				
										DEPT	SIGNATURE	DATE										
										CHEM												
										CNCL												
										ELEC												
										MECH												

FOR BID PURPOSE ONLY

DO NOT SCALE

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

SCALE ~ APPROVED

DWG. NO. PE-189-IN-SK-8003/Rev. 11 of 20

DATE 23-08-2011

BY P.N.Z.

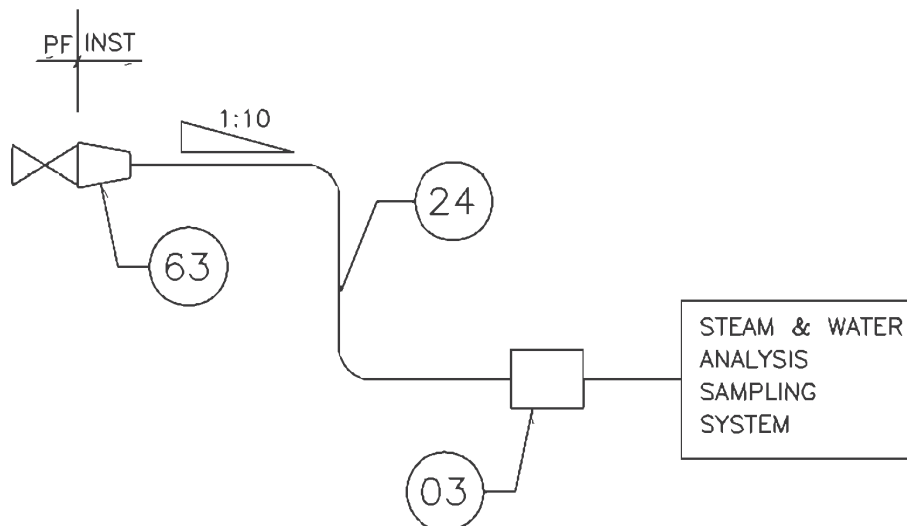
CHK. D.J.P.



SERVICE : STEAM, FEED WATER.

FOR BID PURPOSE ONLY

SCALE ~	APPROVED	DATE (MO / DAY)	
P.W.	INST.	DATE (DAY / MONTH / YEAR)	
D.R.			
P.N.Z.			
D.J.P.			
		DRAWING NO. 1-80 IN SW - 2007 VOL. 1	

FOR SWAS

BILL OF MATERIAL

ITEM NO.	QTY./ INST	DESCRIPTION
03	1	FULL COUPLING 1/2" SW 6000lbs, CS/AS
63	1	REDUCER 1" SW x 1/2" SW 6000lbs, CS/AS
24	A/R	IMPULSE PIPE 15 NB SCH 80, CS/AS

LEGEND:

A/R – AS PER REQUIREMENT

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 ~ APPROVED

DIV INST.DR P.N.Z.CH D.J.P.

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

SHEET 13 OF 20

PO

DATE: PE-189-NI-SX-800 PL 1 of 30	FILE: TYPICAL INSTRUMENT INSTALLATION DIAGRAM
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LEGEND:

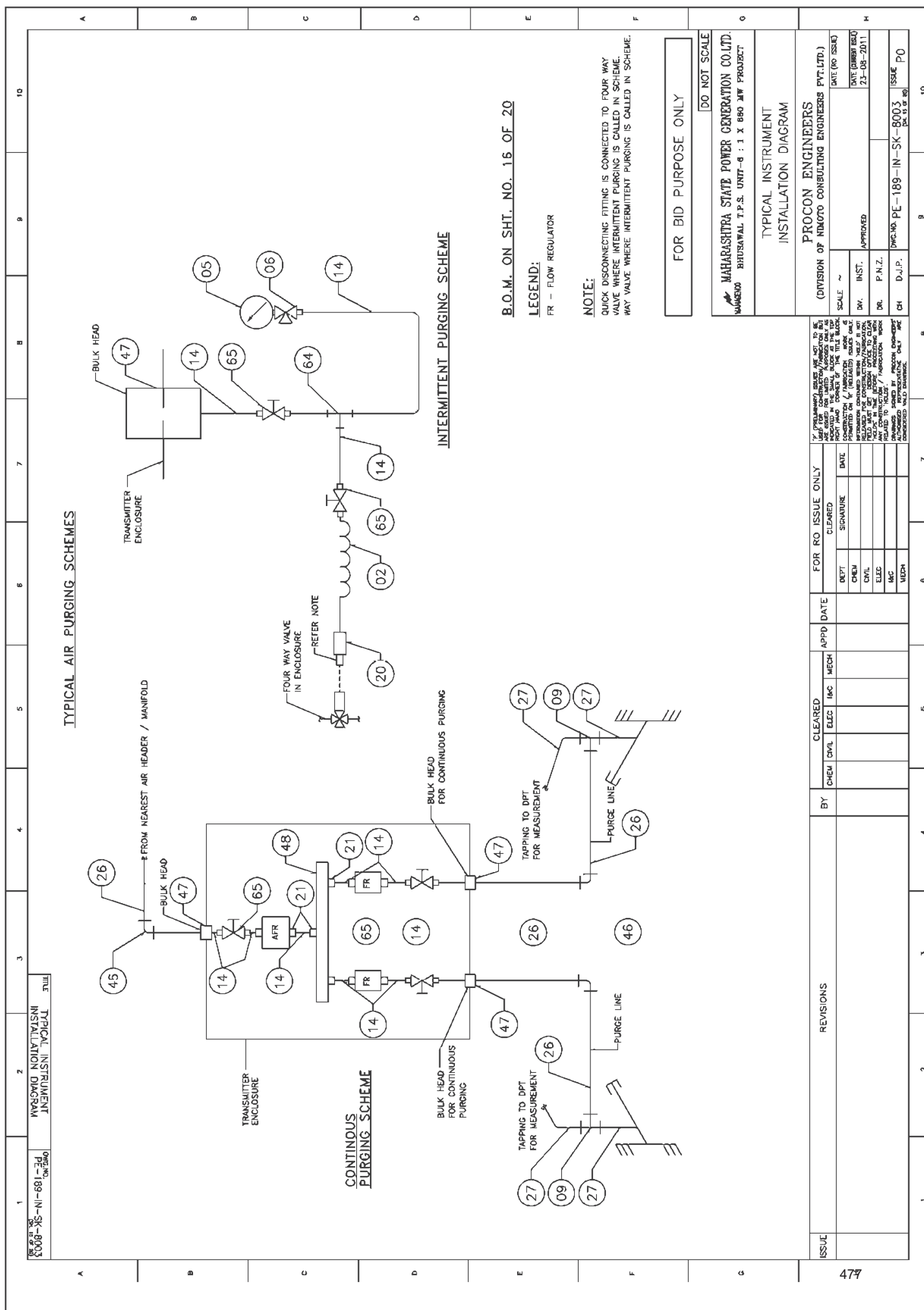
A/R - AS PER REQUIREMENT,

NOTE:

1. QUANTITY IN COLUMNS TO BE DOUBLED FOR DP MEASUREMENT.

FOR BID PURPOSE ONLY

[illegible]



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

DO NOT SCALE

DATE : 23-08-2011

ISSUE	BY	CH	DATE

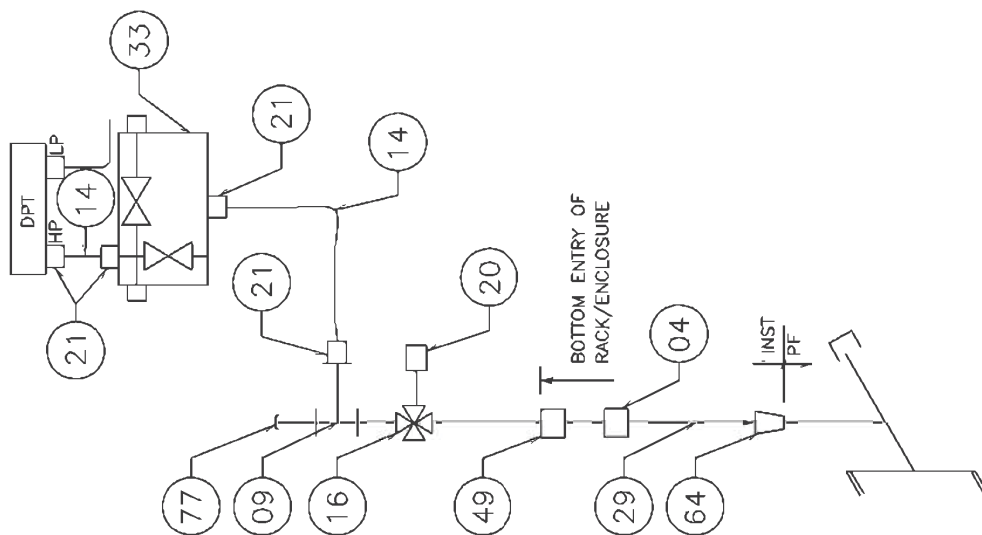
PROCON ENGINEERS
(DIVISION OF NIMOTO CONSULTING ENGINEERS PVT. LTD.)

CLIENT : MAHARASHTRA STATE POWER GENERATION CO.LTD.

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

TYPICAL INSTRUMENT INSTALLATION DIAGRAM	
SCALE ~	APPROVED
DIV <u>INST.</u>	
DR <u>P.N.Z.</u>	
CH <u>D.J.P.</u>	DWG.NO.PE-189-IN-SK-8003 (SHEET 16 OF 20) PO

DIFF. PRESSURE TRANSMITTER
MOUNTED ABOVE SOURCE POINT



BILL OF MATERIAL		
ITEM NO.	QTY./INST	DESCRIPTION
64	1	REDUCER 1" BSPF x 3/4" NB-SW CL 3000
04	1	FORGED COUPLING 3/4" SW CL 3000. AS PER ANSI B16.11
09	1	FORGED UNEQUAL TEE AS PER ANSI B16.11 SIZE : 2 x 3/4" NB-SW x 1/2" NPTF, CL 3000
77	1	NIPPLE & CAP 3/4" NB-SCH 80,CAP-3/4" NPTF, CS/AS
14	6 MTRS.	SEAMLESS TUBE 1/2" OD, x 2.1mm THK., SS 316
16	1	FOUR WAY VALVE SIZE : (2 x 3/4" NB-SW)x(2 x 1/2"NPTF) CL 800.
20	1	QUICK DISCONNECTING FITTING SIZE : 1/2"NPTM
21	5	MALE CONNECTOR, SS 316 1/2" NPT(M) x TO SUIT 1/2" OD TUBE
29	30 MTRS.	SEAMLESS PIPE/3/4" NB SCH 80
33	1	2 VALVE MANIFOLD 1/2" NPT(F), SS 316
49	1	BULK HEAD COUPLING SIZE : 3/4" SW, CL 3000 lbs AS PER ANSI B16.11

SERVICE : FLUE GAS, PRIMARY AIR, SECONDARY AIR ETC.

NOTE:

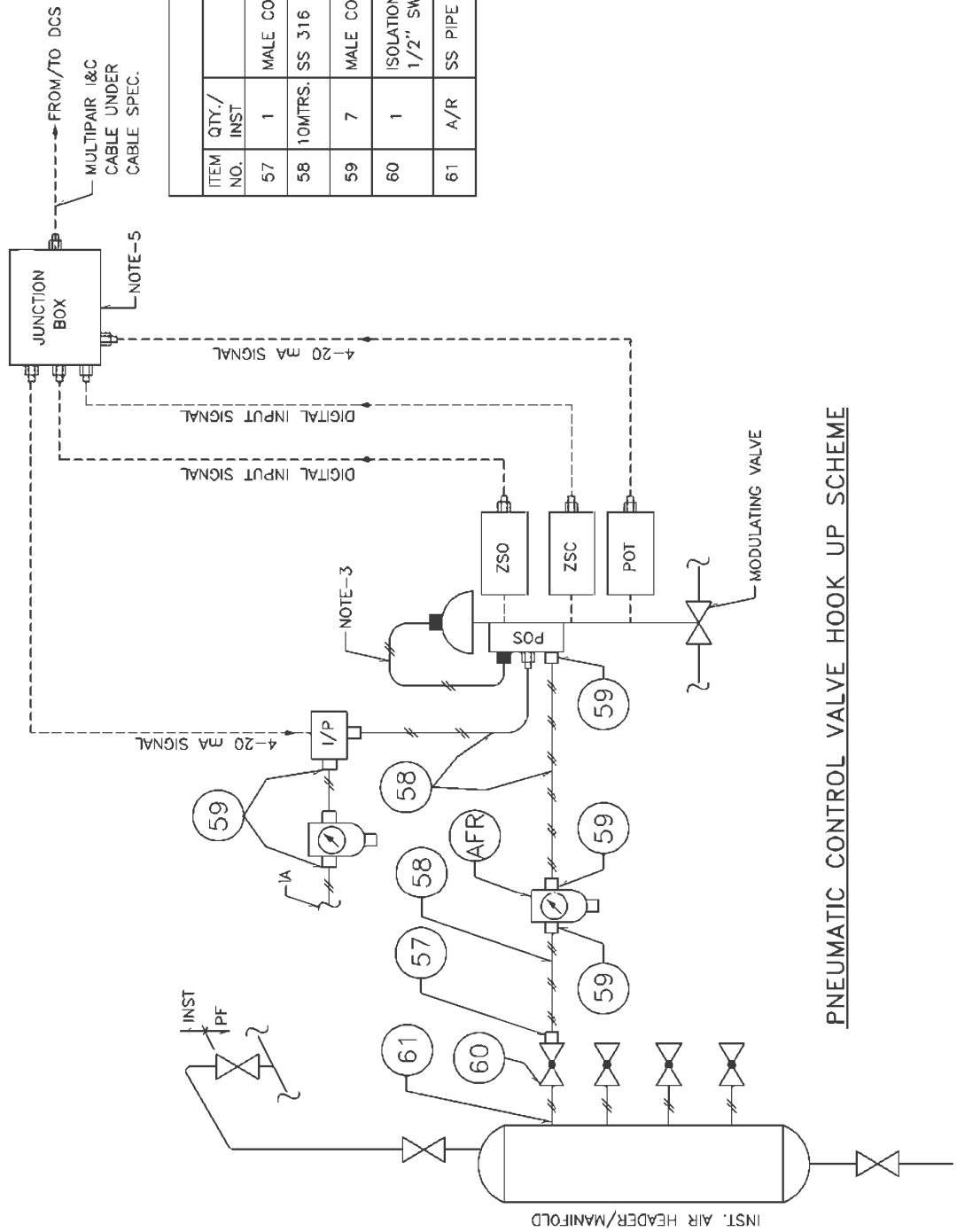
1. AIR PURGING ARRANGEMENT SHALL BE INCLUDED.

FOR BID PURPOSE ONLY

[illegible]

INTC TYPICAL INSTRUMENT
INSTALLATION DIAGRAM

PE-189-IN-SK-8003
Rev. 20 of 20



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

LEGEND:

- A/R - AS PER REQUIREMENT
- POT - POSITIONER TRANSMITTER
- AFR - AIR FILTER REGULATOR
- IA - INSTRUMENT AIR

NOTES:

- ALL TUBE FITTINGS ARE OF DOUBLE COMPRESSION TYPE AND OF SS 316 MATERIAL.
- QTY. SHOWN ARE TYPICAL FOR ONE INSTALLATION ONLY.
- TUBE & FITTINGS MARKED ARE INTEGRAL TO THE VALVE.
- LIMIT SWITCHES WILL BE CONNECTED WHEREVER APPLICABLE.
- JUNCTION BOX WILL BE INTEGRAL TO ACTUATOR.
- ISOLATION VALVE SHALL BE INSTALLED CLOSE TO THE VALVE ASSEMBLY.

FOR BID PURPOSE ONLY

REVISIONS		FOR RD ISSUE ONLY				DO NOT SCALE			
ISSUE	BY	CHECK	CHIL	ELEC	UAC	MECH	APPR	DATE	DATE
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 NAYAT CONSULTING ENGINEERS PVT.LTD.)									
SCALE	BY	INST.	APPROVED	DATE	ISSUED				
1:1	SW.	INST.	APPROVED	23-08-2011	23-08-2011				
DR.	P.N.Z.	DR.	DR.	DR.	DR.				
CHK.	D.J.P.	CHK.	CHK.	CHK.	CHK.				

80365/2020/PS-PEM-MAX



TITLE :

1X660 MW BHUSAWAL TPS, UNIT # 6

SPECIFICATION NO. PE-TS-415-174-A001

SECTION : III

TECHNICAL SPECIFICATION FOR OZONE
GENERATION PLANT

SUB-SECTION:

REV. NO. 00

SECTION – III

80365/2020/PS-PEM-MAX



TITLE :

1X660 MW BHUSAWAL TPS, UNIT # 6

SPECIFICATION NO. PE-TS-415-174-A001

SECTION : III

TECHNICAL SPECIFICATION FOR OZONE
GENERATION PLANT

SUB-SECTION:

REV. NO. 00

SCHEDULE OF PRE-BID CLARIFICATION

All clarification from the Technical Specification shall be filled in by the BIDDER clause by clause in this format only.

VOLUME	SECTION	CLAUSE NO.	PAGE NO.	SPECIFICATION REQUIREMENT	CLARIFICATION	REASONS FOR CLARIFICATION

80365/2020/PS-PEM-MAX

	TITLE:		SPECIFICATION NO. PE-TS-415-174-A001	
	1X660 MW BHUSAWAL TPS, UNIT # 6		SECTION : III	
	TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT		SUB-SECTION:	
			REV. NO. 00	

COMPLIANCE CUM CONFIRMATION SCHEDULE

The bidder shall confirm compliance with following by signing/ stamping this compliance certificate and furnishing same with the offer:

1. The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusions/ deviations with regard to same.
2. QP/ test procedures shall be submitted in the event of order based on the guidelines given in the specification & QP enclosed therein.
3. QP will be subject to BHEL/Customer approval in the event of order & 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.
The charges for 3rd party inspection (Lloyds, TUV or equivalent) for imported components shall be included in the base price of the equipment by the bidder.
4. All drawings/data – sheets etc. to be submitted during contract shall be subject to BHEL/Customer review/ approval. GA drawings, as submitted with offer at tender stage are for reference purpose only and shall be subject to approval during contract stage.
5. There are no other deviations with respect to specification other than those furnished in the 'Schedule of Deviations'.
6. The offered materials shall be either equivalent or superior to those specified. Also for components where material is not specified it shall be suitable for intended duty, materials shall be subject to approval in the event of order.
7. The commissioning spares (if any) are supplied on 'As Required Basis' & prices for same included in the base price (If bidders reply to this is "No commissioning spares are required" and if some spares are actually required during commissioning same shall be supplied by bidder without any cost to BHEL).
8. All sub vendors shall be subject to BHEL/CUSTOMER approval.
9. Any special tools & tackles, if required, shall be in bidder's scope.
10. Performance guarantee test parameters shall stand valid till the satisfactory completion of Performance guarantee test and its acceptance by BHEL/Customer.
11. Prices for recommended spares (if any) for three year operation shall be furnished separately and not to be included in the base price.

80365/2020/PS-PEM-MAX

	TITLE : 1X660 MW BHUSAWAL TPS, UNIT # 6		SPECIFICATION NO. PE-TS-415-174-A001	
			SECTION : III	
	TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT		SUB-SECTION:	
			REV. NO. 00	

DECLARATIONS

Icertify that all the technical data and information pertaining to this specification are correct and are true representation of the equipment/system covered by our format proposal number Dated and there is no deviation to the specification.

I hereby certify that I am duly authorized representative of the Bidder's company whose name appears above my signature.

Bidders Company Name

Authorized representative's Signature

Name

Bidder's Name

The bidder hereby agrees to fully comply with the requirements and intent of this specification for the price indicated.

 SCHEDULE OF DEVIATIONS WITH COST OF WITHDRAWAL									
PROJECT:- 1X660 MW BHUSAWAL TPS, UNIT # 6									
OZONE GENERATION PLANT									
TENDER ENQUIRY REFERENCE:-									
NAME OF VENDOR:-									
SL NO	VOULME/ SECTION	PAGE NO.	CLAUSE NO.	TECHNICAL SPECIFICATION/ TENDER DOCUMENT	COMPLETE DESCRIPTION OF DEVIATION	COST OF withdrawal OF DEVIATION	REFERENCE OF PRICE SCHEDULE ON WHICH COST OF withdrawal OF DEVIATION IS APPLICABLE	NATURE OF COST OF withdrawal OF DEVIATION (POSITIVE/ NEGATIVE)	REASON FOR QUOTING DEVIATION
TECHNICAL DEVIATIONS									
COMMERCIAL DEVIATIONS									
PARTICULARS OF BIDDERS/ AUTHORISED REPRESENTATIVE									
NAME		DESIGNATIONS				SIGN & DATE			
NOTES:									
1. For self manufactured items of bidder, cost of withdrawal of deviation will be applicable on the basic price (i.e. excluding taxes, duties & freight) only.									
2. For directly dispatchable items, cost of withdrawal of deviation will be applicable on the basic price including taxes, duties & freight.									
3. All the bidders have to list out all their Technical & Commercial Deviations (if any) in detail in the above format.									
4. Any deviation not mentioned above and shown separately or found hidden in offer, will not be taken cognizance of.									
5. Bidder shall submit duly filled unpriced copy of above format indicating "quoted" in "cost of withdrawal of deviation" column of the schedule above along with their Techno-commercial offer, wherever applicable.									
6. Bidder shall furnish price copy of above format along with price bid.									
7. The final decision of acceptance/ rejection of the deviations quoted by the bidder shall be at discretion of the Purchaser.									
8. Bidders to note that any deviation (technical/commercial) not listed in above and asked after Part-I opening shall not be considered.									
9. For deviations w.r.t. Payment terms, Liquidated damages, Firm prices and submission of E1/ E2 forms before claiming 10% payment, if a bidder chooses not to give any cost of withdrawal of deviation loading as per Annexure-VIII of GCC, Rev-06 will apply. For any other deviation mentioned in un-priced copy of this format submitted with Part-I bid but not mentioned in priced copy of this format submitted with Priced bid, the cost of withdrawal of deviation shall be taken as NIL.									
10. Any deviation mentioned in priced copy of this format, but not mentioned in the un-priced copy, shall not be accepted.									
11. All techno-commercial terms and conditions of NIT shall be deemed to have been accepted by the bidder, other than those listed in unpriced copy of this format.									
12. Cost of withdrawal is to be given separately for each deviation. In no event bidder should club cost of withdrawal of more than one deviation else cost of withdrawal of such deviations which have been clubbed together shall be considered as NIL.									
13. In case nature of cost of withdrawal (positive/negative) is not specified it shall be assumed as positive.									
14. In case of discrepancy in the nature of impact (positive/ negative), positive will be considered for evaluation and negative for ordering.									



TITLE:

TECHNICAL SPECIFICATION FOR
OZONE GENERATION PLANT
1 X 660 MW BHUSAWAL TPS, UNIT # 6

BHEL DOCUMENTS NO.: PE-TS-415-174-A001

SECTION –III

SUB-SECTION:

REV. NO. 00

**FORMAT FOR GUARANTEED AUXILIARY POWER CONSUMPTION FIGURES
(TO BE FILLED BY THE BIDDER)**

S.NO.	DESCRIPTION OF EQUIPMENT	NO OF EQUIPMENT		Multiplication Factor	TOTAL GUARANTEED POWER CONSUMPTION FOR WORKING DRIVES AT MOTOR INPUT TERMINAL (IN KW) (after considering the multiplication factor of 0.9)
		WORKING	STANDBY		
1	2	3A	3B	4	5
1	SCREW COMPRESSOR	2	1	0.9	
2	OZONE GENERATOR(s) FOR CW SYSTEM AND CONDENSOR (Total for 16Kg/hr)	1	0		
3	OZONE GENERATOR(s) FOR PT PLANT (Total for 2.1 Kg/hr)	1	0		
4	WATER COOLED CHILLER	1	1		
5	CHILLED WATER RE-CIRCULATION PUMP	1	1		
6	DOSING PUMP FOR CW SYSTEM AND CONDENSOR	1	1		
7	DOSING PUMP FOR PT PLANT	1	1		

Note-Base auxiliary power consumption figure for the system (for working drives only) has been considered as **493 KW**. As long as bidder's quoted guaranteed power consumption (GPC) above remains within Base auxiliary power consumption figure, there will be no technical loading of bid on power consumption for evaluation. However, if bidder's quoted GPC exceeds base auxiliary power consumption figure, there shall be technical loading of bid for evaluation @ Rs 3,00,000/- (Rupees three lacs per Kilowatt) per KW of additional power over Base auxiliary power consumption figure.

Bidder's guaranteed power consumption as furnished above shall be demonstrated by the successful bidder during performance testing at works/ site. In case power consumption is noted higher than Base auxiliary power consumption figure / bidder's quoted GPC whichever is higher, during inspection/ PG test, penalty @ Rs 4,50,000/- (Rupees four lacs fifty thousand per Kilowatt) per additional KW shall be levied on vendor.