

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 282 of 718
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.

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 283 of 718
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

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.		Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1		Section – 5
REV: R0	CONTROL & INSTRUMENTATION		Page 284 of 718
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)	

CONSULTANT : PROCON ENGINEERS

		MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V
		BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0		CONTROL & INSTRUMENTATION	Page 285 of 718
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 $^{\circ}\text{C}$.	
2.8.9	Accessories	Engraved phenolic nameplate affixed to front flange to identify tag number and measured variable.	

CONSULTANT : PROCON ENGINEERS

 MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V	
	Section – 5	
REV: R0	CONTROL & INSTRUMENTATION	Page 286 of 718
S.R. 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)

CONSULTANT : PROCON ENGINEERS

 MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V	
	Section – 5	
REV: R0	CONTROL & INSTRUMENTATION	Page 287 of 718
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.

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.		Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1		Section – 5
REV: R0	CONTROL & INSTRUMENTATION		Page 288 of 718
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.	

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.		Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1		Section – 5
REV: R0	CONTROL & INSTRUMENTATION		Page 289 of 718
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 $\pm$ 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.	

CONSULTANT : PROCON ENGINEERS

 MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V	
	Section – 5	
REV: R0	CONTROL & INSTRUMENTATION	Page 290 of 718
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.

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.		Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1		Section – 5
REV: R0	CONTROL & INSTRUMENTATION		Page 291 of 718
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		

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.		Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1		Section – 5
REV: R0	CONTROL & INSTRUMENTATION		Page 292 of 718
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.)

CONSULTANT : PROCON ENGINEERS

		MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V
		BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0		CONTROL & INSTRUMENTATION	Page 293 of 718
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			

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 300 of 718
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.		

CONSULTANT : PROCON ENGINEERS

	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 301 of 718
4.1	<u>CONTROL DESK</u>	
4.1.1	Devices mounted on the desk shall be flush type. Devices shall be so mounted that their removal and replacement can be accomplished without interruption of services to others.	
4.1.2	Desk shall be ergonomically designed to suit working on a 24 X 7 basis. Aesthetics, ergonomics and illumination shall be considered while positioning of the desk, large video screen and panels in control room.	
4.1.3	Control desk shall be free standing floor mounting type of table-top design with compartments for locating the hardware. Desk shall be constructed from aluminum extrusion with high pressure laminate MDF board for work surface of approved colour. Aluminium structure shall be anodized or powder coated paint finish. Thickness of sheet shall not be less than 3 mm.	
4.1.4	Monitors with retractable keyboard, emergency push buttons shall be provided on the desk. Desk shall be arranged in arc-like shape without any sharp edges. Edges shall be extruded PVC or rounded post-formed laminate.	
4.1.5	Desk shall be of modular, scalable and industrially ruggedized design and shall have Telephones and Intercom connections.	
4.1.6	Desk shall have concealed cable trays for wire dressing.	
4.1.7	Design shall include Earthing bolts.	
4.1.8	Back installed items shall be suitably concealed from front view.	
4.2	<u>BACK UP PANEL</u>	
4.2.1	Construction shall be from sheet steel of thickness not less than 3 mm.	
4.2.2	Electrical upright Panel construction & design shall be similar to back up panel. Control switches, meters, indicators, synchronizer, excitation control switch, annunciation window etc. along with associated mimic diagram, as recommended, shall be provided for manual synchronization of generator.	

CONSULTANT : PROCON ENGINEERS

	MAHARASHTRA STATE POWER GENERATION CO. LTD.		Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1		Section – 5
REV: R0	CONTROL & INSTRUMENTATION		Page 302 of 718
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.

CONSULTANT : PROCON ENGINEERS

	MAHARASHTRA STATE POWER GENERATION CO. LTD.		Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1		Section – 5
REV: R0	CONTROL & INSTRUMENTATION		Page 303 of 718
(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.		

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 304 of 718
(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.		

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 305 of 718
(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.		

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 306 of 718
(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		

CONSULTANT : PROCON ENGINEERS

	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 307 of 718
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.		

CONSULTANT : PROCON ENGINEERS

	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 373 of 718
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,		

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 374 of 718
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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10.5 INSTRUMENTATION MULTI PAIRED SIGNAL CABLE

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

CONSULTANT : PROCON ENGINEERS

	MAHARASHTRA STATE POWER GENERATION CO. LTD.		Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1		Section – 5
REV: R0	CONTROL & INSTRUMENTATION		Page 426 of 718
(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).

CONSULTANT : PROCON ENGINEERS

	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 427 of 718
HR PVC Type ST2 of IS-5831,1984. Thickness as per IS-1554, Part-I 1976. (n) Filler : Non hygroscopic with FRLS property. (o) Temperature Range : 85 °C. (p) Insulation at 20 : 100 MOhms/Km [Min] Deg.C (q) Capacitance at 800 : 120 nf/km Hz (r) Cross talk : 60 dB. (s) Attenuation : 1.2 dB/Km. (t) Codes & Standards : (i) IPCEA-S-61-402. (ii) BS 5308. (iii) IEC 332-1. (iv) ASTM-B-33. (v) IS-8130-1984. (vi) IS 1554 Part-1. (vii) IS 10810. (u) Sheath color : Inner- Black and Outer- Gray. (v) Tests (i) Oxygen Index: Min.29 at room temp. (ASTM-D-2863). (ii) Acid Gas Gen.: Max.20% by weight as per IEC 754 Part-I. (iii) Temp Index: Min 250 ° C at 21Oxy. Ind. (ASTM-D-2863).		

CONSULTANT : PROCON ENGINEERS

	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V																											
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5																											
REV: R0	CONTROL & INSTRUMENTATION	Page 428 of 718																											
(iv) Smoke Density Rating: Max.60% (ASTM-D-2843). (v) Flammability Test : as per IEC 332 Part-I. (vi) Swedish Chimney Test-SS-424-1475 F3. (vii) Insulation Resistance 100 M Ohm / Km Min. (viii) High voltage test Core to core- 1.5 kV for 1 min. Core to screen- 1.0 kV for 1 min. (ix) Rodent & Termite repulsion test (Presence of lead shall be confirmed). (w) Colour of core for Instrumentation Cable (As per IS-9938) <table border="1"> <thead> <tr> <th>PAIR</th><th>CORE</th><th>COLOR</th></tr> </thead> <tbody> <tr> <td>1st</td><td>1st</td><td>Blue</td></tr> <tr> <td>1st</td><td>2nd</td><td>Red</td></tr> <tr> <td>2nd</td><td>1st</td><td>Gray</td></tr> <tr> <td>2nd</td><td>2nd</td><td>Yellow</td></tr> <tr> <td>3rd</td><td>1st</td><td>Green</td></tr> <tr> <td>3rd</td><td>2nd</td><td>Brown</td></tr> <tr> <td>4th</td><td>1st</td><td>White</td></tr> <tr> <td>4th</td><td>2nd</td><td>Black</td></tr> </tbody> </table>			PAIR	CORE	COLOR	1 st	1 st	Blue	1 st	2 nd	Red	2 nd	1 st	Gray	2 nd	2 nd	Yellow	3 rd	1 st	Green	3 rd	2 nd	Brown	4 th	1 st	White	4 th	2 nd	Black
PAIR	CORE	COLOR																											
1 st	1 st	Blue																											
1 st	2 nd	Red																											
2 nd	1 st	Gray																											
2 nd	2 nd	Yellow																											
3 rd	1 st	Green																											
3 rd	2 nd	Brown																											
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4 th	2 nd	Black																											

CONSULTANT : PROCON ENGINEERS

	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 429 of 718
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.	

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 430 of 718
(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.		

CONSULTANT : PROCON ENGINEERS

	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 431 of 718
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		

CONSULTANT : PROCON ENGINEERS

	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 432 of 718
(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		

CONSULTANT : PROCON ENGINEERS

	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 433 of 718
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		

CONSULTANT : PROCON ENGINEERS

	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 434 of 718
± 15 % for wall thickness. (h) Standard Length : 5 meter (i) Test : Flare, Hardness, Ball and Bubble Test. 11.2.4 Stainless Steel Tube Fittings (a) Reference : ASTM-A-182 (b) Type : Double ferrule double compression. (c) Material : 316 Stainless steel forged. (d) Ferrule : 316 Stainless Steel. (e) Type of Fittings : Male/female connector, elbow, cross /equal tee, straight connector, bulkhead union, ferrule etc. as required to suit installation. (f) Size : To suit SS tubing and NPT end connection. 11.2.5 C.S. Pipe (a) C.S. Pipe : ASTM-A 106 Gr. C (b) Material : Cold drawn seamless black C.S (c) Type : Seamless/Plain ends. (d) Size : ½" NB (e) Schedule : 80, 160, XXS as required. (f) Standard Length : 6 meter		

CONSULTANT : PROCON ENGINEERS

	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 435 of 718
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		

CONSULTANT : PROCON ENGINEERS

	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 436 of 718
(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/Cm2 (f) Material : Body - Stainless steel		

CONSULTANT : PROCON ENGINEERS

	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 437 of 718
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		

CONSULTANT : PROCON ENGINEERS

	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 438 of 718
(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.		

CONSULTANT : PROCON ENGINEERS

	MAHARASHTRA STATE POWER GENERATION CO. LTD.		Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1		Section – 5
REV: R0	CONTROL & INSTRUMENTATION		Page 439 of 718
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 point
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	

CONSULTANT : PROCON ENGINEERS

	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 440 of 718
(g) Tolerance ± 0.13 mm for outside diameter ± 15 % for wall thickness (h) Standard Length 5 meter (i) Test Flare, Hardness, Ball and Bubble Test		
12.0	<u>SPECIAL TOOLS & TACKLE AND TEST EQUIPMENT FOR DCS/PLC AND OTHER SYSTEMS</u>	
12.1	Bidder shall supply a complete set of new, unused and reliable type of special tools and tackle and test equipment which are necessary or convenient for erection, commissioning, maintenance and overhaul of the plant and equipment provided under this specification.	
12.2	The tools & tackle and Test Equipment shall be shipped in separate container, clearly marked with names of the equipment for which they are intended.	
12.3	Bidder shall furnish list of tools & tackle and test equipment proposed to be supplied along with the bid.	

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – I
REV: R0	CONTROL & INSTRUMENTATION	Page 61 of 718

9.0

PROCESS CONNECTION & INSTRUMENT HOOK UP

9.1

Instrument connection to the process system (piping, vessel etc.) shall be according to the process & piping specification upto and including the root valves. Root valves shall be installed as close as possible to the piping or vessel. Each instrument shall have its own independent connection to the process except for instruments located on standpipe. Each instrument shall be connected independently to the standpipe through isolation valve.

9.2

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

9.3

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

9.4

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

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

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.		Volume: V	
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1		Section – 1	
REV: R0	CONTROL & INSTRUMENTATION		Page 62 of 718	
	SR. NO.	INSTRUMENTS	EQUIPMENT/PIPE SIDE	INSTRUMENT SIDE
		(iv) DP Type	½" (min.) - welded 1" – welded for vessel like HP heaters, LP heaters, De-aerator etc. application.	½"- NPT.
		(v) External cage Level switch	1"- welded.	1"- welded.
	(b)	Flow Instruments		
		(i) DP Type	½" - welded in general. 1" – welded for high pressure/ temperature main steam, feed water, PRDS etc. application.	½" – NPT.
	(c)	Pressure Instruments		
		(i) Conventional	½" (min.)-welded 1"- welded for high pressure/ temperature main steam, feed water, PRDS etc. application.	½" – NPT.
		(ii) Diaphragm type-HFO application	3"- Flanged.	3"- Flanged.

CONSULTANT : PROCON ENGINEERS

	MAHARASHTRA STATE POWER GENERATION CO. LTD.		Volume: V																				
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1		Section – I																				
REV: R0	CONTROL & INSTRUMENTATION		Page 63 of 718																				
<table><tr><th>SR. NO.</th><th>INSTRUMENTS</th><th>EQUIPMENT/PIPE SIDE</th><th>INSTRUMENT SIDE</th></tr><tr><td>(d)</td><td>Temperature Instruments</td><td></td><td></td></tr><tr><td></td><td>(i) Thermowell</td><td>Generally - M 33 X2 (M). 1½" Flanged- For air /FG path application.</td><td>½" NPT.</td></tr><tr><td>(e)</td><td>Analyzer</td><td></td><td></td></tr><tr><td></td><td>(i) Liquid analyzer</td><td>½" - 1" – welded.</td><td>½".</td></tr></table>				SR. NO.	INSTRUMENTS	EQUIPMENT/PIPE SIDE	INSTRUMENT SIDE	(d)	Temperature Instruments				(i) Thermowell	Generally - M 33 X2 (M). 1½" Flanged- For air /FG path application.	½" NPT.	(e)	Analyzer				(i) Liquid analyzer	½" - 1" – welded.	½".
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9.5	Size of impulse pipe for pressure measurement in air and flue gas duct path of boiler shall not be less than ¾" NB.																						
9.6	Separate stubs and take-off points with thermo well/root valves shall be provided for performance guarantee test.																						
9.7	Impulse pipes shall be clamped at suitable interval not exceeding 1.5 meter. Process pipe shall not be used for supporting the impulse pipe.																						
9.8	Fittings shall conform to ANSI B 16.11. Threads of piping component shall be of tapered construction.																						
9.9	Instrument blow down header shall in no case be lower than the material grade ASTM A 106 Gr. C.																						
9.10	Impulse pipe shall be laid at least with slope of gradient 1:10 to avoid any air pocket or water accumulation.																						
9.11	Expansion loop shall be provided at least at every 2.5 meter interval without affecting the gradient of slope in long run impulse pipe to avoid stress on the piping.																						

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	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – I
REV: R0	CONTROL & INSTRUMENTATION	Page 64 of 718
9.12	Siphon shall be provided in the impulse pipe or tube to protect the instruments where fluid temperature is 100°C or more.	
9.13	Orientation of tappings shall be as follows : (a) For liquid service within 45° at lower half of the pipe horizontal plane. (b) For gas service within 90° at upper half of the pipe horizontal plane. (c) For steam service within 45° at upper half of the pipe horizontal plane. As a rule tap orientation of high and low pressure side should be parallel and symmetrical.	
9.14	Pressure & Differential pressure instruments in steam and liquid services shall be located below the taps and the piping shall be sloped to avoid formation of air pocket.	
9.15	Pressure & Differential pressure instruments in air and flue gas service shall be located above the taps and the piping shall be sloped back to process to avoid formation of any liquid.	
9.16	Impulse pipe including taps for furnace, flue gas and coal mill application shall be provided with air purge connection. Differential instruments for such application shall have continuous and as well as intermittent purging. Whereas, pressure measurement shall have only intermittent purging.	
9.17	Material of impulse pipe for the instruments mounted on rack and enclosure shall be same as that of main process pipe except stainless steel tube of Gr. 316H or better shall be provided for connection in between impulse pipe (from tee connection on impulse pipe) and instrument manifold valve & instruments. Impulse pipe, tubes, fittings and accessories shall have the same design pressure and temperature applicable for the related main pipe.	

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 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – I
REV: R0	CONTROL & INSTRUMENTATION	Page 66 of 718
11.4	<u>ATMOSPHERIC CONTAMINATION</u> Particulate contamination from fly ash and coal dust and gaseous contaminants such as SO ₂ and other flue gas constituents in the coal fired plant are foreseen. This hazard shall be taken into design considerations.	
11.5	<u>VIBRATION</u> Design of the systems shall include features such as locking devices, anti vibration pads etc, to withstand vibration. In general, I&C equipment shall be installed away from the vibration zone.	
11.6	<u>LIGHTNING</u> Protection against lightning shall be considered by providing proper grounding, metal oxide arrestors, spark gap lightning arrestor, optical isolator and isolation transformer.	
12.0	<u>SECURITY</u>	
1	Door lock shall be provided in all Panels, Cabinets and Enclosures.	
12.2	System mode key switch or password to prevent tampering of system program.	
12.3	Redundant elements of the system shall not be exposed to the common hazards. For example routing of the redundant network cable through separate cable raceway, using separate cabinet/separate rack for redundant controller and redundant IO modules.	

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 373 of 718
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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	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 374 of 718
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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	1X660 MW Bhusawal STPP	SECTION: C SUB SECTION : C&I
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	
CONTROL PANELS SPECIFICATION		

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – I
REV: R0	CONTROL & INSTRUMENTATION	Page 52 of 718
7.9.1 Elevated Temperature Test (a) During the first 48 hours the ambient temperature shall be maintained at 50^o C and the equipment shall be made to repeatedly perform operations it will be expected to perform in service with loads on various components being equal to those which will be experienced in actual service. (b) The 48 hours test period shall be continuous but shall be divided into four 12-hour segments. The power supply voltage during each 12 hours segment shall be nominal voltage for 11 hours; followed by 110 percent of nominal voltage for 30 minutes; followed by 90 percent of nominal voltage for 30 minutes. (c) During the elevated temperature test the cubicle doors shall be kept closed and inside temperature in the zone of highest heat dissipating component/ module shall be monitored. Temperature rise inside the cubicle should not exceed 10 Deg.C above the ambient temperature of 50 Deg.C. (d) Solid-state logic systems shall be subject to the elevated temperature test and burn-in test as complete assemblies. Testing of individual components or modules shall not be acceptable. 7.9.2 Burn in Test The 48 hours elevated temperature test shall be followed by 120 hours of burn in test at normal operating temperature. This test shall also be conducted as per above procedure. 7.10 <u>PANELS, CUBICLES AND ENCLOSURES</u> 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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 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – I
REV: R0	CONTROL & INSTRUMENTATION	Page 53 of 718
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.		

CONSULTANT : PROCON ENGINEERS

	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – I
REV: R0	CONTROL & INSTRUMENTATION	Page 54 of 718
(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.		

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: V						
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – I						
REV: R0	CONTROL & INSTRUMENTATION	Page 55 of 718						
(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: <table><tr><td>(i) Control wiring (switches, pushbuttons etc.)</td><td>: 1.5 Sq.mm</td></tr><tr><td>(ii) Power supply/receptacle /illumination wiring</td><td>: 2.5 sq. mm or higher as per load/</td></tr><tr><td>(iii) 4-20mA DC current and low voltage signal upto 24V DC</td><td>: 0.5 Sq. mm</td></tr></table>			(i) Control wiring (switches, pushbuttons etc.)	: 1.5 Sq.mm	(ii) Power supply/receptacle /illumination wiring	: 2.5 sq. mm or higher as per load/	(iii) 4-20mA DC current and low voltage signal upto 24V DC	: 0.5 Sq. mm
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(ii) Power supply/receptacle /illumination wiring	: 2.5 sq. mm or higher as per load/							
(iii) 4-20mA DC current and low voltage signal upto 24V DC	: 0.5 Sq. mm							

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – I
REV: R0	CONTROL & INSTRUMENTATION	Page 56 of 718
(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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 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: V																		
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – I																		
REV: R0	CONTROL & INSTRUMENTATION	Page 57 of 718																		
(f) Electrical meters, relays, transmitters and switching devices, operating at a voltage less than 50V may be grounded through the steel structure. 7.10.5 Panel/Cabinet/ Desk/Enclosures Environmental Protections (a) Panels, cabinets, desks, distribution boxes, junction boxes, terminal boxes and all other field mounted equipment / enclosures shall suit the environmental condition of the area and shall not be inferior than the requirement indicated in the following table: <table border="1" data-bbox="472 747 1382 1516"> <thead> <tr> <th>SR. NO.</th><th>LOCATION</th><th>ENCLOSURE TYPE</th></tr> </thead> <tbody> <tr> <td>(i)</td><td>Indoor type non- ventilated enclosure in non-hazardous area</td><td>IP-54.</td></tr> <tr> <td>(ii)</td><td>Indoor type ventilated enclosure in non-hazardous area</td><td>IP -42.</td></tr> <tr> <td>(iii)</td><td>Enclosure in Air conditioned area</td><td>IP-22 with suitable canopy at top to prevent ingress of dripping water.</td></tr> <tr> <td>(iv)</td><td>Outdoor type in non-hazardous areas</td><td>IP-55.</td></tr> <tr> <td>(v)</td><td>Outdoor in hazardous areas</td><td>As per requirements of the NEC Code for the location.</td></tr> </tbody> </table> 7.10.6 Terminal Blocks (a) Terminals shall be chromated galvanized DIN rail mounted screw less cage clamp type. Terminals shall have screwed connection for conductor cross-section above 2.5 mm². Terminal blocks shall conform to IEC 947-7-1.			SR. NO.	LOCATION	ENCLOSURE TYPE	(i)	Indoor type non- ventilated enclosure in non-hazardous area	IP-54.	(ii)	Indoor type ventilated enclosure in non-hazardous area	IP -42.	(iii)	Enclosure in Air conditioned area	IP-22 with suitable canopy at top to prevent ingress of dripping water.	(iv)	Outdoor type in non-hazardous areas	IP-55.	(v)	Outdoor in hazardous areas	As per requirements of the NEC Code for the location.
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CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – I
REV: R0	CONTROL & INSTRUMENTATION	Page 58 of 718
(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:		

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – I
REV: R0	CONTROL & INSTRUMENTATION	Page 59 of 718
(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.		

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 1
REV: R0	CONTROL & INSTRUMENTATION	Page 60 of 718

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

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

8.0 METERING BASES AND CHART UNITS

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

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

CONSULTANT : PROCON ENGINEERS

	SPECIFICATION FOR LOCAL PANELS	SPECIFICATION NO.: PE-SS -999- 145 -054A	
		VOLUME	II B
		SECTION	D
		REV. NO. 03	DATE : 16-09-2013
		SHEET	1 OF 6

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.

	SPECIFICATION FOR LOCAL PANELS	SPECIFICATION NO.: PE-SS –999- 145 –054A	
		VOLUME	II B
		SECTION	D
		REV. NO. 03	DATE : 16-09-2013
		SHEET	2 OF 6

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

	SPECIFICATION FOR LOCAL PANELS	SPECIFICATION NO.: PE-SS -999- 145 -054A	
		VOLUME	II B
		SECTION	D
		REV. NO. 03	DATE : 16-09-2013
		SHEET	3 OF 6

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.

	SPECIFICATION FOR LOCAL PANELS	SPECIFICATION NO.: PE-SS -999- 145 -054A	
		VOLUME	II B
		SECTION	D
		REV. NO. 03	DATE : 16-09-2013
		SHEET	4 OF 6

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.

	SPECIFICATION FOR LOCAL PANELS	SPECIFICATION NO.: PE-SS -999- 145 -054A	
		VOLUME	II B
		SECTION	D
		REV. NO. 03	DATE : 16-09-2013
		SHEET	5 OF 6

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, corrossion, incidental damage due



SPECIFICATION FOR LOCAL PANELS

SPECIFICATION NO.: PE-SS -999- 145 -054A	
VOLUME	II B
SECTION	D
REV. NO. 03	DATE : 16-09-2013
SHEET	6 OF 6

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

	DATA SHEET FOR LOCAL PANELS		SPECIFICATION NO.: PES-145-054A	
			VOLUME	
			SECTION	
			REV. NO. 01	DATE: 24.01.2019
			SHEET 1	OF 2
TAG No. Qty.....			Data Sheet No.: PES-145A-DS1-0	
Data Sheet A & B				
DATA SHEET-A FOR LOCAL PANEL (TO BE FILLED BY PURCHASER)			DATA SHEET-B (TO BE FILLED-UP BY BIDDER)	
GENERAL	MANUFACTURER			
	CONSTRUCTION		☐ FOLDED ☐ WELDED (As per requirement EDN)	
	ENCLOSURE SHEET THICKNESS	FRONT	■ 3.0 mm (FOR FACES SUPPORTING INSTRUMENTS/TERMINALS)	
		OTHER	■ 2.0 mm (FOR OTHER SIDES AND TOP)	
		DOOR	■ 2.0 mm	
		HEIGHT	☐ 2365 mm for stand alone panels. (THIS SHALL BE DECIDED BY BHEL DURING DETAILED ENGG.)	
		OTHER	☐	
TECHNICAL	INPUT POWER SUPPLY *		☐ 240V 50 Hz AC ☐ 220V DC ☐ 415V 3 PHASE 3W ☐ 415V 3 PHASE 4W	
	NO. OF FEEDERS		☐ ONE ■ TWO	
	CONTROL SUPPLY		☐ 110V AC ☐ 220V AC ☐ 220V DC ☐ Other. (As per requirement)	
	ALARM ANNUNCIATOR WINDOW (EXCLUDING SPARES)		____ NOS. (AS REQUIRED)	
	PAINT TYPE		☐ EPOXY ENAMEL ■ EPOXY POWDER COATED OR BETTER (THIS SHALL BE DECIDED BY BHEL DURING DETAILED ENGG.)	
	PANEL COLOUR (EXTERNAL)		☐ LIGHT GREY (Shade 631 IS-5) ☐ OPALINE GREEN (Shade 275) . ■ RAL 7032 (THIS SHALL BE DECIDED BY BHEL DURING DETAILED ENGG.)	
	FINISH (EXTERNAL)		☐ MATT ☐ GLOSSY ☐ SEMI GLOSSY	
	PANEL COLOUR (INTERNAL)		☐ WHITE ☐ CREAM ☐ OFF WHITE ■ BRILLIANT WHITE	
	FINISH (INTERNAL)		☐ MATT ☐ GLOSSY ☐ SEMI GLOSSY	
	CLASS OF PROTECTION		☐ IP-42 (FOR INDOOR SERVICE) ■ IP-55 (FOR OUTDOOR SERVICE) ☐ ANY OTHER	
	CONTROL HARDWARE		■ RELAY BASED	
	FOUNDATION ARRANGEMENT		☐ FOUNDATION BOLTS ☐ ANCHOR FASTENERS	
	WEIGHT OF PANEL (Kg.)			
	PANEL TYPE		☐ PRESSURISED ☐ UNPRESSURISED As per Requirement	
	CABLE GLAND		☐ DOUBLE COMPRESSION	
	AMMETER (TYPE OF INPUT) *		☐ 1 Amp CT ☐ 4-20 mA	

 PEM :: C&I		STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL										STD QUALITY PLAN NO.: PE-QP-999-145-I056					
												VOLUME		IIB			
												SECTION		D			
												REV. NO.		01		DATE: 22-02-2008	
												SHEET		1		OF	
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks					
									P	W	V						
1.0	INCOMING Sheet Steel (CRCA & HR)	1. Chemical Composition	MA	Chemical analysis	Sample	IS:1079 IS:513	IS:1079 IS:513	Test Certificate	3	---	2						
		2. Bend Test	CR	Mech. test	Sample	IS:1079 IS:513	IS:1079 IS:513	Log Book	2	---	---						
		3. Surface finish	MA	Visual	100%	Factory Standard / Sample	Factory Standard / Sample	Log Book	2	---	---						
		4. Waviness	MA	Visual	100%	Factory Standard	No Waviness	Log Book	2	---	---						
		5. Thickness	MA	Measurement	100%	BHEL Spec.	BHEL Spec.	Log Book	2	---	---						
		6. Mill marking	MA	Visual	100%	Factory Standard	Factory Standard	Log Book	2	---	---	1					
2.0	Flats / Angles / Channels	1. Dimensions	MA	Measurement	Sample	IS:2062	IS:2062	Log Book	2	---	---						
		2. Surface Defects	MA	Visual	100%	Factory Standard / Sample	Factory Standard / Sample	Log Book	2	---	---						
		3. Straightness	MA	Measurement	100%	Factory Std.	Factory Std.	Log Book	2	---	---						
		4. Mill marking	MA	Visual	100%	IS:2062	IS:2062	Log Book	2	---	---	1					
3.0	Cables / Wires	1. Visual / Surface defects	MA	Visual	100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	2	---	---						
		2. IR and HV	MA	Electrical	100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	2	---	---						
LEGEND: * CR - Critical characteristics MA - Major characteristics MI - Minor characteristics \$ P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test. 1 - BHEL 2 - Vendor 3 - Sub-vendor																	

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

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

 PEM :: C&I		STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL										STD QUALITY PLAN NO.: PE-QP-999-145-I056				
												VOLUME IIB			Remarks	
												SECTION D				
												REV. NO. 01				
SHEET 4			OF 7													
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$							
									P	W	V					
9.0	Pre-treatment and Painting	1. Pretreatment Process 2. Process parameters like bath temp. concentration etc. 3. Dipping / Removal Time 4. Surface quality after every dip 5. Primer after phosphating 6. Putty Application & Rubbing after primer 7. Paint first coat 8. Putty Application and Rubbing after first coat of paint 9. Paint second coat	MA MA MA MA MA MA	Visual Measurement Measurement Visual Visual, Thickness Visual Visual, Thickness Visual Visual, Thickness, Scratch test Colour adhesion	100% Periodic 100% 100% 100% 100% 100%	Factory Standard & IS: 6005 Factory Standard & IS: 6005 Factory Standard & IS: 6005 Factory Standard & IS: 6005 Factory Standard & IS: 6005 Factory Standard & IS: 6005 Factory Standard & IS: 6005 Factory Standard & IS: 6005	Factory Standard & IS: 6005 Factory Standard & IS: 6005 Factory Standard & IS: 6005 Factory Standard & IS: 6005 Factory Standard & IS: 6005 Factory Standard & IS: 6005 Factory Standard & IS: 6005	Log Book Log Book Log Book Log Book Log Book Log Book Log Book	2 2 2 2 2 2 2	--- --- --- --- --- --- ---	1 1 1 1 1 1 1					
		LEGEND: * CR - Critical characteristics MA - Major characteristics MI - Minor characteristics														
		P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test.														
		1 - BHEL 2 - Vendor 3 - Sub-vendor														

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 V - Agency Verifying the Test.

1 - BHEL
 2 - Vendor
 3 - Sub-vendor

STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL													STD QUALITY PLAN NO.: PE-QP-999-145-I056					
													VOLUME IIB					
													SECTION D					
													REV. NO. 01			DATE: 22-02-2008		
													SHEET 5			OF 7		
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks						
									P	W	V							
10.	Panel Wiring	1. Wiring Layout 2. Wiring Termination (Crimped Lugs) 3. Ferrule numbers 4. Colour of wiring 5. Size of Conductor	MA MA MA MA MA	Visual Visual Visual Visual Measurement	100% 100% 100% 100% 100%	Approved drgs. & Specs. Approved drgs. & Specs. Approved drgs. & Specs. Approved drgs. & Specs. Approved drgs. & Specs.	Approved drgs. & Specs. Approved drgs. & Specs. Approved drgs. & Specs. Approved drgs. & Specs. Approved drgs. & Specs.	Log Book Log Book Log Book Log Book Log Book	2 2 2 2 2	--- --- --- --- ---	--- --- --- 1 1							
11.	Component Mounting	1. Correct components 2. Fixing	MA MA	Visual Visual	100% 100%	Approved drgs., Specs. & BOM Approved drgs., Specs. & BOM	Approved drgs., Specs. & BOM Approved drgs., Specs. & BOM	Log Book Log Book	2 2	--- ---	--- ---							
12.	FINAL Final Inspection	1. Workmanship 2. Component layout (neatness, accessibility & safety) Mounting / Proper fixing of all components 3. Components identification Marking / Name plates	MA MA MA	Visual Visual Visual	100% 100% 100%	Factory Standard BHEL approved drg. / Spec. BHEL approved drg. / Spec.	Factory Standard BHEL approved drg. / Spec. BHEL approved drg. / Spec.	Inspection Report Inspection Report Inspection Report	2 2 2	1 1 1	1 1 1	At Random by BHEL, based on 100 % internal test reports by Mfr.						
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भारतीय वाहन BHEL PEM :: C&I		STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL						STD QUALITY PLAN NO.: PE-QP-999-145-I056					
		VOLUME		IIB									
		SECTION		D									
		REV. NO.		01		DATE: 22-02-2008							
		SHEET		6		OF		7					
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks	
		5. Dimensions	MA	Measurement	100%	BHEL approved drg. / Spec., BOM	BHEL approved drg. / Spec., BOM	Inspection Report	2	1	1	At Random by BHEL, based on 100 % internal test reports by Mfr.	
		6. Door functioning	MA	Functional	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1		
		7. Paint Shade	CR	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1		
		8. Paint Thickness	CR	Measurement	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1		
		9. Workmanship of Gaskets	MA	Visual	100%	Factory Standard	Factory Standard	Inspection Report	2	1	1		
		10. Wiring Layout	MA	Visual	100%	BHEL approved drg.	BHEL approved drg.	Inspection Report	2	1	1		
		11. Wire Termination	MA	Pulling manually	Sample	-----	Firm termination	Inspection Report	2	1	1		
		12. Continuity	MA	Electrical	100%	-----	Continuity OK	Inspection Report	2	1	1		

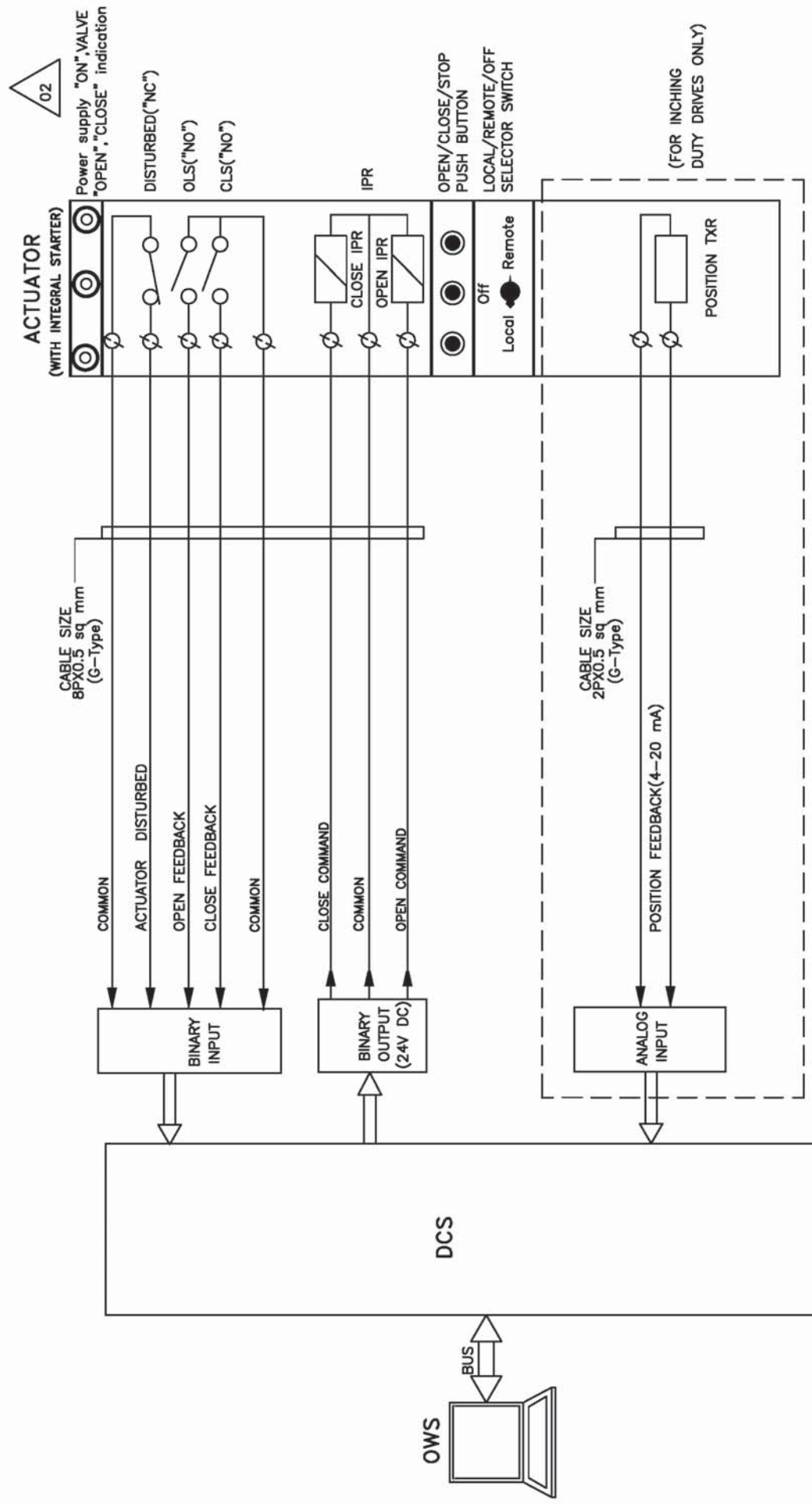
LEGEND: *		CR	- Critical characteristics	\$	P	- Agency Performing the Test.	1	- BHEL
		MA	- Major characteristics		W	- Agency Witnessing the Test.	2	- Vendor
		MI	- Minor characteristics		V	- Agency Verifying the Test.	3	- Sub-vendor

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

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

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

DCS INTERFACE FOR BIDIRECTIONAL DRIVE(WITH INTEGRAL STARTER)



PROJECT:

1x860 MW BHUSAWAL STPP

DRG.NO. PE-DM-415-145-1002

DATE 01.10.2018

TITLE DDCMIS INTERFACE FOR

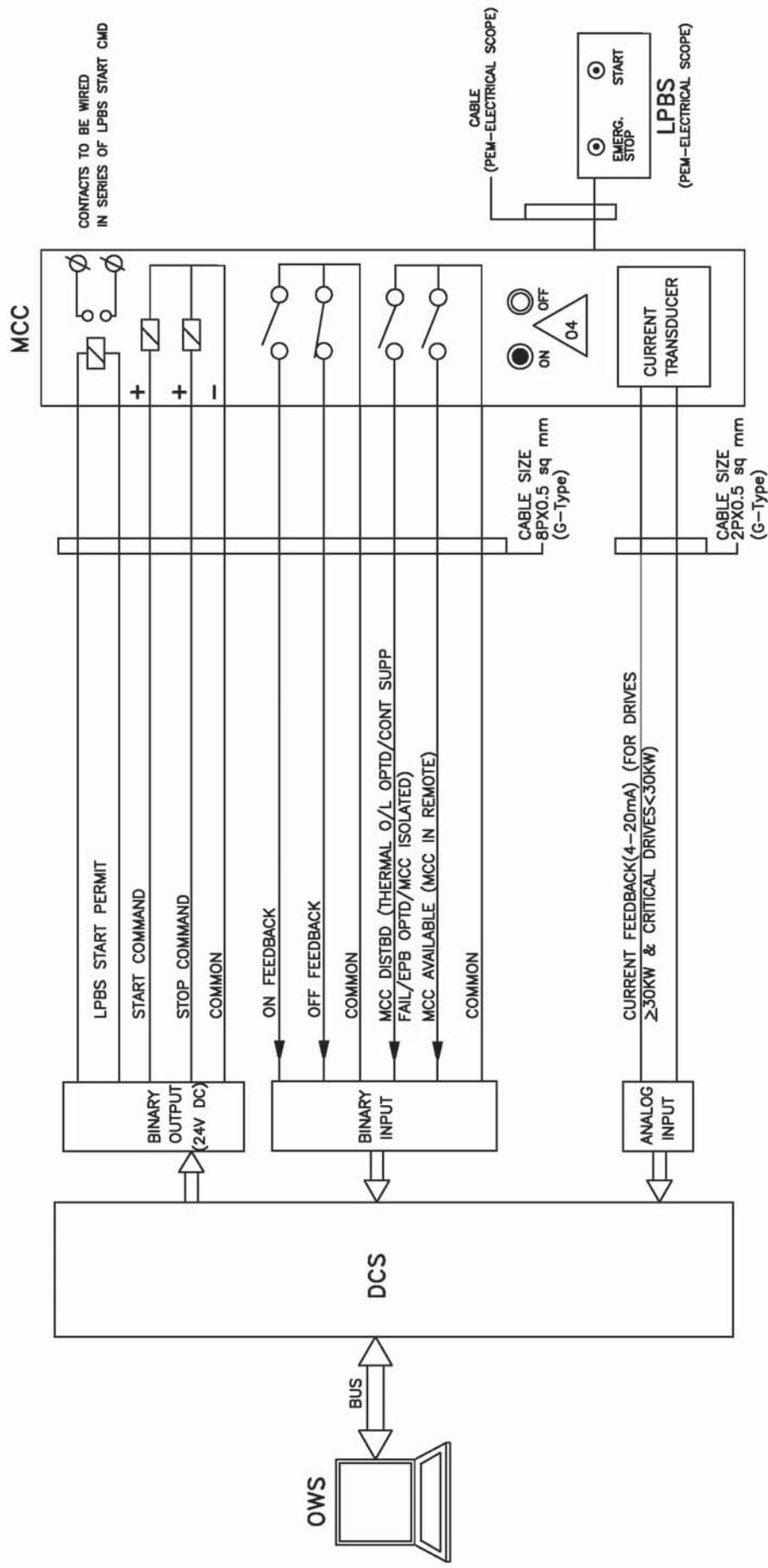
REV.NO. 04

BIDIRECTIONAL DRIVE

SHT 8 OF 12

446 of 527

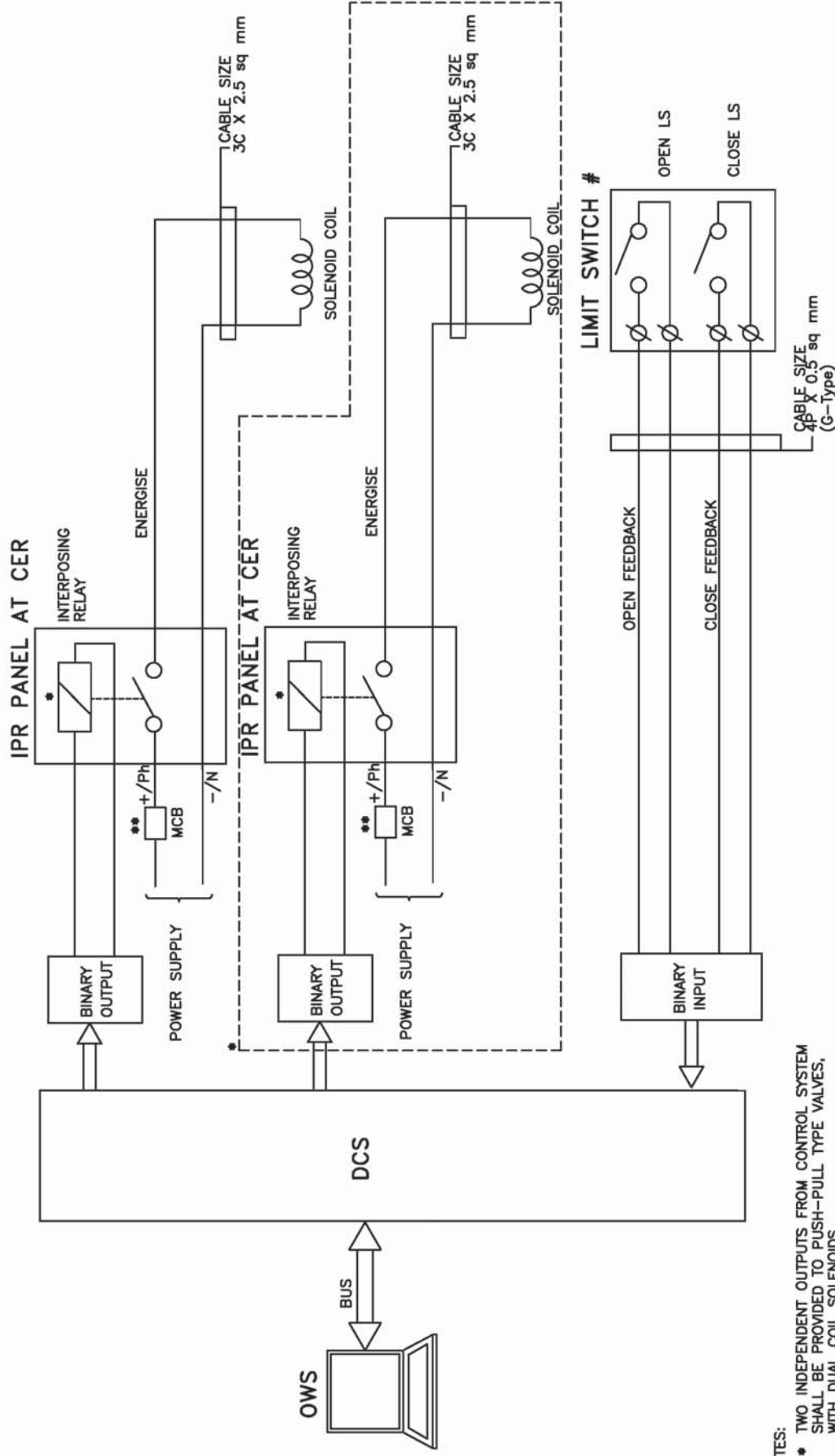
DCS INTERFACE FOR UNIDIRECTIONAL LT DRIVE(CONTACTOR OPERATED)



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

PROJECT: 1x860 MW BHUSAWAL STPP		DRG.NO.	PE-DM-415-145-1002
TITLE		DATE	01.10.2018
DDCMIS INTERFACE FOR UNIDIRECTIONAL LT DRIVE		REV.NO.	04
447 of 527		SHT	9 OF 12

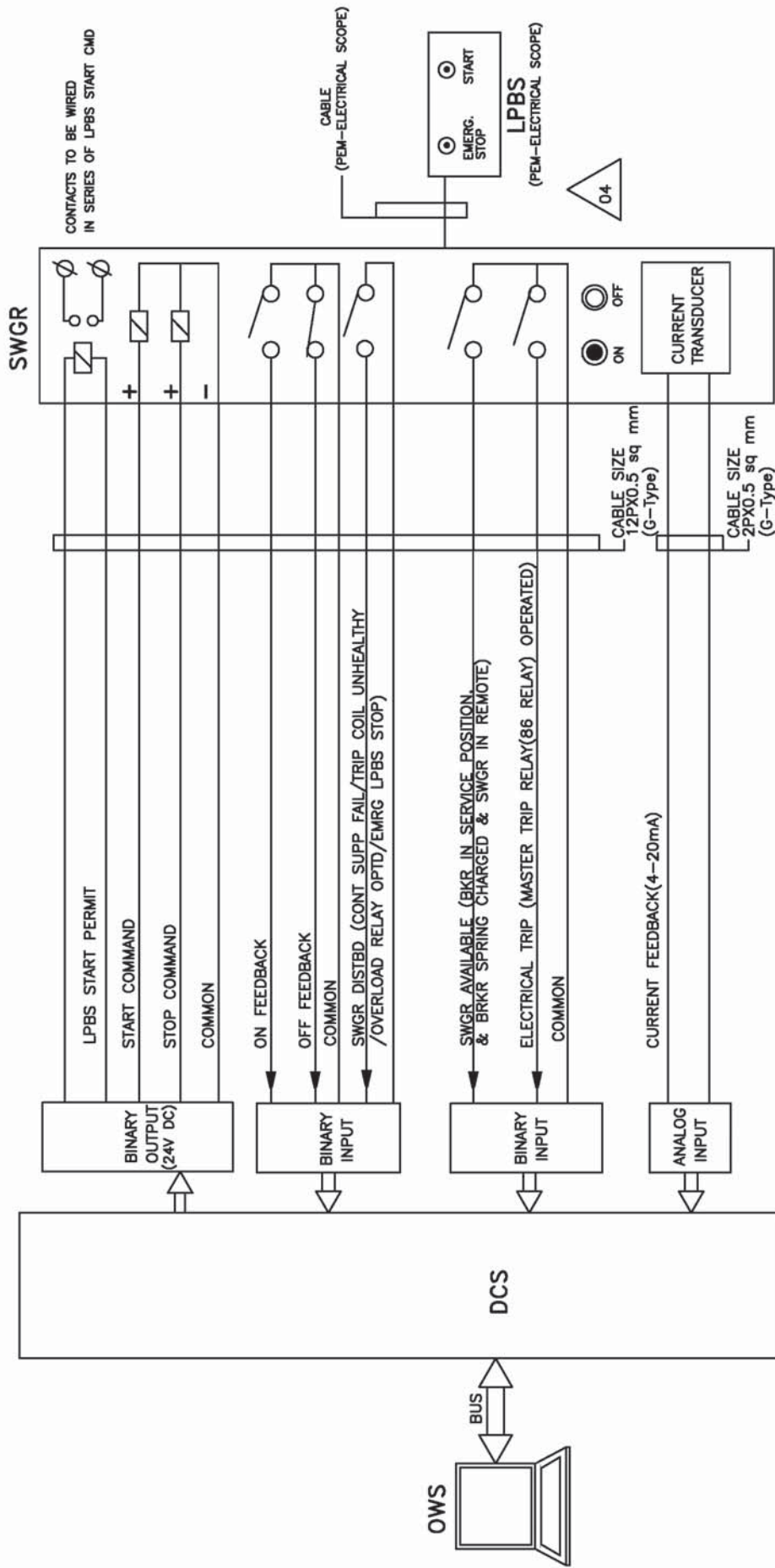
DCS INTERFACE FOR SOLENOID DRIVE (24V DC / 240V AC UPS)



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

	PROJECT:	1x860 MW BHUSAWAL STPP	DRG.NO.	PE-DM-415-145-1002
	TITLE	DDCMS INTERFACE FOR SOLENOID DRIVE	DATE	01.10.2018
			REV.NO.	04
			SHT	10 OF 12
448 of 527				

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:	1x860 MW BHUSAWAL STPP		DRG.NO.	PE-DM-415-145-1002
	DDCMIS INTERFACE FOR UNIDIRECTIONAL HT DRIVE		DATE	01.10.2018
TITLE			REV.NO.	04
449 of 527		SHT	11	OF 12

*** 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-I002	
	TITLE		TYPICAL HOOK-UP DIAGRAM ANALOG DRIVE		DATE	01.10.2018	
					REV.NO.	04	
					SHT	12	OF 12
450 of 527							