b) Colour :

4.10 Diameters

a) Diameter of insulated conductor : mm

b) Cable diameter under armour : mm

c) Cable diameter over armour : mm

d) Overall diameter of cable : mm

4.11 Weight of cable : kg./km

4.12 Dimension of drum : mm

4.13 Shipping weight : kg.

(*) For single core cables, the continuous current rating shall be furnished separately for armour earthed at one end and at both ends.

DATASHEET C

GUARANTEED TECHNICAL PARTICULARS (TO BE SUBMITTED BY SUCCESSFUL BIDDER)

1.0	**GENERAL**		
1.1	Name of manufacturer	:	
1.2	Place of manufacture	:	
2.0	**STANDARDS APPLICABLE**		
2.1	**IS-1554 (Part-I)**	:	YES
	For general specification of PVC cables		
2.2	**IS:8130**	:	YES
	For conductor material		
2.3	**IS-5831**	:	YES
	For material of insulation, innersheath & outersheath.		
2.4	**IS:3975/ IS:8130**	:	YES/NO/NA
	For armour multi core/ single core cables)		
2.5	**IS:10810**	:	YES
	For method of tests		
2.6	**IS:10418**	:	YES
	For cable drums		
2.7	**ASTMD-2863**	:	YES
	For oxygen index test		
2.8	**SS:424-14-75, IEC-332-Part-III (Category-B), IEEE 383/74** For flammability test	:	YES

2.9	**IEC-754-1** For acid gas generation test	:	YES
2.10	**ASTMD-2843** For smoke generation test	:	YES
2.11	**IS:5831** For heat shock test, loss of mass test and thermal heat stability test	:	YES
2.12	Current rating of cables conforms to	:	
2.13	Short circuit rating conforms to	:	

3.0 **CABLE CONSTRUCTION**

3.1 **Conductor :**

Conductor material to IS:8130 (Class/Grade)

a) Control cables :

3.2 **Insulation**

a) Material :

b) Dielectric constant at normal frequency : KV/mm

c) Insulation resistance constant (min.)

i) at 27 deg. C : Mega-ohm km
ii) at 70/85 deg.C : Mega-ohm km

d) Minimum volume resistivity

i) at 27 deg. C : Mega-ohm km
ii) at 70/ 85 deg.C : Mega-ohm km

e) Minimum tensile strength : N/mm2

f) Minimum % Elongation at rupture :

g) Tolerance on thickness :

3.3 **Inner Sheath**

a)	PVC Type ST1 to IS: 5831	:	YES
b)	Whether FRLS	:	YES/NO
c)	Method of application		
i)	with filllers		
ii)	without fillers	:	Pressure extruded
d)	Type & shape of fillers (if used)	:	
e)	Colour		

3.4 **Armour**

a)	Galvanised steel wire/ formed wire conforming to IS:3975 for multi-core cables.	:	YES
b)	Hard drawn aluminium wire H4 grade conforming to IS:8130	:	YES/NA
c)	Method of joining	:	
d)	Breaking load of joint	:	

3.5 **Outer Sheath**

a)	PVC Type ST1 to IS: 5831	:	YES
b)	Whether FRLS	:	YES
c)	Method of application	:	
d)	Minimum Tensile strength	:	N/mm2
e)	Minimum % elongation at rupture	:	
f)	Colour		
g)	Tolerance on thickness	:	
h)	Whether progressive sequential length marking provided.	:	

4.0 **PERMISSIBLE VOLTAGE AND FREQUENCY VARIATION**

a)	Voltage	:	(±)	%
b)	Frequency	:	(±)	%
c)	Voltage-frequency combined combined	:	|ABS|	%

5.0 Permissible Conductor Temp. for

a)	Maximum Continuous Rating	:	^{o}C
b)	Short Circuit	:	^{o}C

6.0 Installation Conditions for specified current rating

a)	ambient air temperature in deg. C	:	^{o}C
b)	ground temperature	:	^{o}C
c)	depth of laying of cables buried in ground :	:	cm
d)	thermal resistivity of soil	:	^{o}C cm/W
e)	thermal resistivity of insulation	:	^{o}C cm/w

7.0 Formula for calculating short circuit current for different durations

8.0 **CHARACTERISTICS OF FRLS SHEATH**

a)	Oxygen index	:
b)	Temperature index	:
c)	Acid gas generation	:
d)	Smoke density rating	:

9.0 **CABLE DRUMS**

a)	Type & construction	:
b)	Standard drum length	:
c)	Tolerance on drum length	:

10.0 **DOCUMENTATION**

Whether following enclosed

a)	X-sectional drawing with construction details	:	YES
b)	BHEL's Quality Plan with seal of acceptance	:	YES
c)	Derating factors as stipulated in Section-D	:	YES
d)	Packing drawing	:	YES/NO

(TO BE FILLED IN FOR EACH SIZE OF CABLE IN THE FORM OF TABLE)

11.0	No. of cores x size	:	
12.0	Voltage grade	:	kV
13.0	Base current ratings (*) based on cl.5.0, cl.6.0		
	a) In air	:	Amp
	b) In ground	:	Amp
	c) In ducts	:	Amp
14.0	Short circuit rating	:	kA, sec.
15.0	a) D.C. resistance of conductor at 20 °C	:	ohm/km
	b) A.C. resistance of conductor at 70 °C/ 85 °C	:	ohm/km
	c) Reactance of cable at normal frequency	:	ohm/km
16.0	CONDUCTOR		
	a) Material, type & grade	:	
	b) No & dia of wires in each core before stranding	:	no x mm

c) Shape :

17.0 Nominal thickness of insulation : mm

18.0 Inner sheath thickness (min.) : mm

19.0 Sizes of armour : no x mm

20.0 Nominal thickness of outersheath : mm

21.0 DIAMETERS

a) i) Fictitious diameter of insulated conductor : mm

ii) Approximate cable diameter of insulated conductor : mm

b) i) Fictitious cable diameter of under armour/ over innersheath : mm

ii) Approximate cable diameter under armour/ over innersheath : mm

c) i) Fictitious cable diameter of under armour/ over innersheath : mm

ii) Approximate cable diameter over armour : mm

d) i) Fictitious overall diameter of cable : mm

ii) Approximate overall diameter of cable : mm

22.0 Tolerance on overall diameter : (±) mm.

23.0 Minimum bending radius : x O.D.

24.0 Safe pulling force : kg.

25.0 Weight of cable : kg./km

26.0 Dimension of drum : mm

27.0 Shipping weight : kg.

28.0 Identification mark on outersheath :

29.0 Identification marks on drum :

S.No.	Particulars	Unit	Description
1	Manufacturer's name	-	
2	Reference design standards	-	
3	Conductor size	sq. mm	
4	Rated Voltage	V	
5	Number of pairs	No.	
6	Cable suitable for both earthed & unearthed system	-	
7	Conductor		
	a) Material	-	
	b) Reference Standard	-	
	c) Grade	-	
	d) No. of strands	No.	
	e) Diameter of strands (nom.)	mm	
	f) Approx. dia of conductor	mm/	
	Cross Section area	sq. mm	
	g) Maximum conductor resistance per Km at 20°C	ohm	
8	Insulation		
	a) Reference Standard	-	
	b) Material composition	-	
	c) Minimum thickness	mm	
	d) Nom.Thickness	mm	
	e) Max. thickness	mm	
	f) Minimum volume resistivity as pre VDE-0207 Part-4	Ohm cm	
	g) Dielectric constant	-	
	h) The insulation will withstand conductor operating temp. of 70°C	-	
	i) Core diameter including insulation	mm	

S.No.	Particulars	Unit	Description
9	Core laying		
	a)Whether cores are twisted.	-	
	b) Maximum lay of twist	mm	
10	Individual Shield		
	a) Material	-	
	b) Thickness of tape	mm	
	c) Coverage/ Overlap	%	
	d) Noise interference better than	dB	
11	Drain wire for individual shield		
	a) Reference standard	-	
	b) Size/ No. of strands	sq. mm/ no.	
	c) Material	-	
	d) Resistance of drain wire per km at 20 deg.C	ohm	
12	Overall shield		
	a) Material	-	
	b) Thickness of tape	mm	
	c) Coverage/Overlap	%	
	d) Noise interference better than	dB	
13	Drain wire for overall shield		
	a) Reference standard	-	
	b) Size/ No.of strands	sq. mm/ no.	
	c) Material	-	
	d) Resistance per Km at 20°C	Ohm/ km	
14	Fillers if applicable		
15	Inner sheath		
	a) Material, type and standard	-	
	b) Whether FRLS	-	
	c) Colour	-	
	d) Method of application	-	
	e) Thickness (min)	mm	
16	Armour		
	a) Material,	-	
	b) Minimum Coverage	%	
	c) Method of jointing	-	
	d) Breaking load of joint	-	
	e) Size (approx.)	mm	
	f) Dia of armour	mm	
	g) No. of wires	mm	

S.No.	Particulars	Unit	Description
17	Outer sheath		
	a) Reference standard	-	
	b) Material	-	
	c) Minimum thickness of sheath	mm	
	d) Calculated dia under outersheath	mm	
	e) Oxygen index (as per ASTMD 2863)	-	
	f) Temperature index (in deg. C as per ASTMD 2863)	-	
	g) Maximum acid gas generation as per IEC754-1	%	
	h) Maximum smoke density rating as per ASTMD 2843	%	
	i) Colour of outer sheath	-	
18	Dia under armour	mm	
19	Overall diameter of cable	mm	
20	Tolerance on overall diameter	mm	
21	Weight of		
	conductor	Kgs. / km	
	PVC (insulation, sheath & fillers)	Kgs. / km	
	Armour	Kgs. / km	
	Cable (approx.)	Kgs. / km	
22	Cable parameters at 20°C(+/-3 deg. C)		
	a) Conductor resistance (max)	Ohm/ km	
	b) Insulation resistance (min)	M-Ohm	
	c) Mutual capacitance at 0.8KHz (max)	nF/ km	
	d) Cross talk at 0.8KHz (min)	dB	
	e) Attenuation at 1 KHz (max)	dB/ km	
	f) Characteristic impedence max.	Ohm	
23	Continuous operating temp. (deg.C)	deg. C	
24	Whether complete cable Flame retardant as per IEEE-383	-	
25	Whether complete cable passes Swedish Chimney test as per SEN 4241475 (F3)	-	
26	Identification		
	a) Length of cable marked at every mtr.	-	
	b) FRLS marked at every 5 mtrs	-	
	c) Each core of the pair numbered	-	
	d) Conductor identification details for pairs	-	
	e) Details of cable markings	-	

S.No.	Particulars	Unit	Description
27	Test voltage		
	a) High voltage test/ Dielectric Strength		
	i) Voltage (KV)	kV	
	ii) Duration	min	
	b) High Voltage test		
	i) Voltage (KV)	V	
	ii) Duration	min	
	c) Resistance to direct current test as per VDE-0815	-	
	Voltage	V	
	Duration	hrs/days	
28	Min bending radius	mm	
29	Ovality at any cross section	mm	
30	Variation of dia through out cable length		
31	Cable cross-sectional drawings for each type of cable furnished		
32	i) Length of single coil in a drum	M	
	ii) Marking on drum	-	
	iii) Seasoned wood drum provided	-	
	iv) Both ends of cable to be sealed with PVC/ Rubber caps to prevent water/ moisture ingress		
	v) Gross weight (approx.)	kg.	
	vi) Net weight (approx.)	kg	
33	Type test procedures as per VDE 0472, IS 10810, VDE 0815, BHEL Technical Spec. and other relevant standards enclosed.		
34	Anti termite & rodent test		

Below sub vendor list comprises of BHEL / Customer approved sub vendors for cables, LT Switchgear, Cable Trays, Earthing material. The same shall be subjected to final approval by customer at contract stage without any technical / commercial implication to BHEL.

BHEL APPROVED ELECTRICAL BOP VENDOR LISTS

Package Name	Vendor Name
LT SWITCHGEAR	ABB India Limited
LT SWITCHGEAR	C and S ELECTRIC LTD.
LT SWITCHGEAR	CONTROLS and SCHEMATICS LTD.
LT SWITCHGEAR	GE INDIA INDUSTRIAL PVT.LTD.
LT SWITCHGEAR	KMG ATOZ SYSTEMS PVT.LTD
LT SWITCHGEAR	LARSEN and TOUBRO LTD.
LT SWITCHGEAR	SCHNEIDER ELECTRIC INDIA PVT. LTD.
LT SWITCHGEAR	SPACEAGE SWITCHGEARS LTD.
LT SWITCHGEAR	TRICOLITE ELECTRICAL INDUSTRIES LTD

LT PVC POWER CABLE	APAR INDUSTRIES LTD.
LT PVC POWER CABLE	CORDS CABLE INDUSTRIES LTD.
LT PVC POWER CABLE	Diamond Power Infrastructure Ltd
LT PVC POWER CABLE	GOYOLENE FIBRES (INDIA) PVT.LTD.
LT PVC POWER CABLE	Govind Cable Industries,
LT PVC POWER CABLE	GUPTA POWER INFRASTRUCTURE LIMITED,
LT PVC POWER CABLE	Havells India Limited
LT PVC POWER CABLE	KEI INDUSTRIES LTD.
LT PVC POWER CABLE	KRISHNA ELECTRICAL INDUSTRIES LTD.
LT PVC POWER CABLE	KEC INTERNATIONAL LIMITED
LT PVC POWER CABLE	MANSFIELD CABLES COMPANY LTD.
LT PVC POWER CABLE	NICCO CORPORATION LTD.
LT PVC POWER CABLE	PARAMOUNT COMMUNICATIONS LTD.
LT PVC POWER CABLE	POLYCAB WIRES PVT. LTD.
LT PVC POWER CABLE	RADIANT CORPORATION PRIVATE LIMITED
LT PVC POWER CABLE	RAVIN CABLES LIMITED
LT PVC POWER CABLE	SUYOG ELECTRICALS LTD.
LT PVC POWER CABLE	SRIRAM CABLES PVT. LTD.
LT PVC POWER CABLE	Scot Innovation Wires and Cables Pvt. Ltd.
LT PVC POWER CABLE	Sam Cables & Conductors (P) Ltd.,
LT PVC POWER CABLE	THERMO CABLES LTD.

LT PVC CONTROL CABLE	APAR INDUSTRIES LTD.
LT PVC CONTROL CABLE	CMI LTD.
LT PVC CONTROL CABLE	CORDS CABLE INDUSTRIES LTD.
LT PVC CONTROL CABLE	CRYSTAL CABLE INDUSTRIES LTD.
LT PVC CONTROL CABLE	DELTON CABLES LTD.
LT PVC CONTROL CABLE	Diamond Power Infrastructure Ltd
LT PVC CONTROL CABLE	ELKAY TELELINKS LTD.
LT PVC CONTROL CABLE	GEMSCAB INDUSTRIES LTD.
LT PVC CONTROL CABLE	GOVIND CABLE INDUSTRIES
LT PVC CONTROL CABLE	GUPTA POWER INFRASTRUCTURE LIMITED,
LT PVC CONTROL CABLE	Havells India Limited
LT PVC CONTROL CABLE	Incom Cables (P) Ltd.,
LT PVC CONTROL CABLE	KEI INDUSTRIES LTD.
LT PVC CONTROL CABLE	KRISHNA ELECTRICAL INDUSTRIES LTD.
LT PVC CONTROL CABLE	KEC INTERNATIONAL LIMITED
LT PVC CONTROL CABLE	MANSFIELD CABLES COMPANY LTD.
LT PVC CONTROL CABLE	NICCO CORPORATION LTD.
LT PVC CONTROL CABLE	PARAMOUNT COMMUNICATIONS LTD.
LT PVC CONTROL CABLE	POLYCAB WIRES PVT. LTD.
LT PVC CONTROL CABLE	RAVIN CABLES LIMITED
LT PVC CONTROL CABLE	SUYOG ELECTRICALS LTD.
LT PVC CONTROL CABLE	SPECIAL CABLES PVT. LTD.
LT PVC CONTROL CABLE	Scot Innovation Wires and Cables Pvt. Ltd.
LT PVC CONTROL CABLE	Sam Cables & Conductors (P) Ltd.,
LT PVC CONTROL CABLE	SPM POWER & TELECOM PVT. LTD,
LT PVC CONTROL CABLE	TORRENT CABLES LTD.
LT PVC CONTROL CABLE	THERMO CABLES LTD.
LT PVC CONTROL CABLE	TIRUPATI PLASTOMATICS PVT. LTD.
LT PVC CONTROL CABLE	UNIVERSAL CABLES LTD.

SCREENED CONTROL CABLES	CMI LTD.
SCREENED CONTROL CABLES	CORDS CABLE INDUSTRIES LTD.
SCREENED CONTROL CABLES	DELTON CABLES LTD.
SCREENED CONTROL CABLES	ELKAY TELELINKS LTD.
SCREENED CONTROL CABLES	KEI INDUSTRIES LTD.
SCREENED CONTROL CABLES	MANSFIELD CABLES COMPANY LTD.
SCREENED CONTROL CABLES	PARAMOUNT COMMUNICATIONS LTD.
SCREENED CONTROL CABLES	POLYCAB WIRES PVT. LTD.
SCREENED CONTROL CABLES	SUYOG ELECTRICALS LTD.
SCREENED CONTROL CABLES	SPECIAL CABLES PVT. LTD.
SCREENED CONTROL CABLES	THERMO CABLES LTD.
SCREENED CONTROL CABLES	T C COMMUNICATION PVT. LTD.

CABLE TRAYS & ACC.	EROS METAL WORKS (P) LTD.
CABLE TRAYS & ACC.	INDUSTRIAL PERFORATION (I) PVT.LTD.
CABLE TRAYS & ACC.	INDIANA GRATINGS PVT. LTD.
CABLE TRAYS & ACC.	INDIA ELECTRICALS SYNDICATE
CABLE TRAYS & ACC.	INDMARK FORMTECH PVT. LTD.
CABLE TRAYS & ACC.	JAMNA METAL COMPANY
CABLE TRAYS & ACC.	Maheshwari Electrical Mfrs. Pvt. Ltd.,
CABLE TRAYS & ACC.	NAMDHARI INDUSTRIAL TRADERS PVT. LTD
CABLE TRAYS & ACC.	PREMIER POWER PRODUCTS (CAL) PVT. LTD.
CABLE TRAYS & ACC.	PATNY SYSTEMS (P) LTD
CABLE TRAYS & ACC.	PARMAR METALS PVT.LTD.
CABLE TRAYS & ACC.	PASSIVE INFRA PROJECTS PVT. LTD.
CABLE TRAYS & ACC.	PENTAX FERRO INCORPORATE
CABLE TRAYS & ACC.	RUKMANI ELECTRICAL & COMPONENTS PVT LTD
CABLE TRAYS & ACC.	RATAN PROJECTS & ENGINEERING CO. PVT.LTD.
CABLE TRAYS & ACC.	RABI ENGINEERING WORKS PVT. LTD.
CABLE TRAYS & ACC.	SARAL INDUSTRIES
CABLE TRAYS & ACC.	UNITECH FABRICATORS and ENGINEERS PVT LTD
CABLE TRAYS & ACC.	VINFAB ENGINEERS INDIA PVT. LTD.

ABOVE GROUND EARTHING MATERIALS	INDUSTRIAL PERFORATION (I) PVT.LTD.
ABOVE GROUND EARTHING MATERIALS	INDIA ELECTRICALS SYNDICATE
ABOVE GROUND EARTHING MATERIALS	INDMARK FORMTECH PVT. LTD.
ABOVE GROUND EARTHING MATERIALS	JAMNA METAL COMPANY
ABOVE GROUND EARTHING MATERIALS	PREMIER POWER PRODUCTS (CAL) PVT. LTD.
ABOVE GROUND EARTHING MATERIALS	PATNY SYSTEMS (P) LTD
ABOVE GROUND EARTHING MATERIALS	PASSIVE INFRA PROJECTS PVT. LTD.
ABOVE GROUND EARTHING MATERIALS	RUKMANI ELECTRICAL & COMPONENTS PVT LTD
ABOVE GROUND EARTHING MATERIALS	RATAN PROJECTS & ENGINEERING CO. PVT.LTD.
ABOVE GROUND EARTHING MATERIALS	RABI ENGINEERING WORKS PVT. LTD.
ABOVE GROUND EARTHING MATERIALS	SARAL INDUSTRIES
ABOVE GROUND EARTHING MATERIALS	UNITECH FABRICATORS and ENGINEERS PVT LTD

CUSTOMER APPROVED **ELECTRICAL BOP VENDOR LIST**

	415V LT SWITCHGEAR SYSTEM
	• AMBIT SWITCH GEAR PVT LTD.
	• BHOPAL SWITCHGEAR
	• CONTROLS & SWITCHGEAR
	• ELECTRONIC APPLYANCES
	• INDUSTRIAL SWITCHGEAR & CONTROLS
	• MIKA ENGINEERS
	• POPULAR SWITCHGEARS PVT LTD.
	• R.S.I SWITCHGEAR PVT LTD.
	• TENCO SYSTEMS & SWITCHGEAR
	• VALIANT ENGINEERS
	• *BHARTIYA CUTLER HAMMER*
	• GE INDIA INDUSTRIAL PVT LTD
	• *JAKSONS*

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ELECTRICAL BOP VENDOR LIST

	LT POWER CABLES
	• CORDS CABLE INDUSTRIES
	• DELTON CABLES
	• EVERSHINE ELECTRICAL WORKS
	• GLOSTER CABLES LTD.
	• KEI INDUSTRIES LTD.

Power Sector, Hydro Marketing
Siri Fort, New Delhi

ELECTRICAL BOP VENDOR LIST

	• POLYCAB WIRES PVT LTD.
	• RADIANT
	• SUYOG ELECTRICAL
	• TORRENT CABLES
	• UNIVERSAL CABLES
	• ECKO CABLES PVT. LTD.
	• KEC INTERNATIONAL LIMITED
	• RAVIN CABLES LIMITED
	• PARAGON CABLE INDIA
	• *CABLE CORPORATION OF INDIA*
	CONTROL CABLES
	• CORDS CABLE INDUSTRIES
	• DELTON CABLES
	• EVERSHINE ELECTRICAL WORKS
	• ELKAY TELELINKS
	• HAVELLS
	• POLYCAB WIRES PVT. LTD.
	• R.J. INDUSTRIAL CORPORATION
	• RADIANT
	• SUYOG ELECTRICAL
	• TORRENT
	• TOSHNIWAL CABLES
	• ECKO CABLES PVT. LTD.
	• KEC INTERNATIONAL LIMITED
	• KEI INDUSTRIES LTD.
	• PARAGON CABLE INDIA
	• RAVIN CABLES LIMITED
	INSTRUMENT CABLES
	• BHANSALI CABLES AND CONDUCTORS
	• CORDS CABLE INDUSTRIES
	• DELTON CABLES
	• ELKAY TELELINKS
	• POLYCAB WIRES PVT. LTD.
	• SUYOG ELECTRICAL
	• TOSHNIWAL CABLES
	• KEI INDUSTRIES LTD.
	TRAYS
	• INDIA ELECTRICALS
	• J J SALES
	• JAMNA METALS
	• INDIANA GRATINGS PVT. LTD
	• MICROSGN PRODUCTS

ELECTRICAL BOP VENDOR LIST

	• METALEMMS BOMBAY PVT LTD
	• UNITED SALES CORPORATION
	• M.J. ENGINEERING WORKS (P) LTD.
	• *INDUSTRIAL PERFORATION*

Power Sector, Hydro Marketing
BHEL
Siri Fort, New Delhi

SECTION: C4

C & I SPECIFICATION

C&I TECHNICAL SPECIFICATION FOR HEATING, VENTILATION & AIR CONDITIONING (HVAC) SYSTEM

SPECIFIC TECHNICAL REQUIREMENT

1. **Complete** Control & Instrumentation for Heating, Ventilation and Air Conditioning (HVAC) System is in bidder scope of supply. Items not specifically mentioned however required for the completeness of the system shall be supplied by bidder.

2. A central computerized PLC based control system cum Annunciation panel with solid state annunciation windows along with product integrated microprocessor panel for the chilling unit for HVAC system complete with all wiring, instrumentation & associated accessories shall be in bidder scope of supply. Vendor to ensure necessary provision and hardware requirement in its PLC panel for complete HVAC System.

3. Bidder to include Field instrumentation along with necessary fittings, accessories and valve manifold etc. and Field Junction Box (JB's), in his scope of supply. Each instrument/ equipment shall have a unique KKS Tag no. Field instrument specification and Data Sheet are given elsewhere in this specification.

4. Bidder to provide local control panels for AHUs, ACUs, exhaust fans, fresh air supply fans & cooling water pumps etc. and elsewhere as per requirement.

5. All fields cabling for instruments/motor/pump/blower to JB is in bidder's scope. The field I/O s should be grouped together in JBs suitably and a common trunk cable shall be taken to the panel.

6. Each PLC to have its engineering station (EWS) and any change in the PLC shall be done from its own EWS only. Processor selection shall be based upon number of IO's for each system. Soft-link shall be provided between SCADA and PLC for monitoring purpose. PLC system shall be sized based on application/ process requirement, and controller sizing shall be guided by CPU utilization.

7. Instrument installation drawings are to be provided by bidder. All instrument fitting and erection hardware/racks as per instrument installation diagram shall be in bidder's scope.

8. All manual valves at pump discharge shall be provided with Open and Close Limit Switches.

9. PLC control system as defined in the enclosed specification and Data Sheets shall be in bidder scope. The PLC system shall comprise of (i) PLC based local panel (ii) UPS Power supply (iii) Operator interface in the form of CRT, keyboard and OWS and EWS along with required furniture.

10. PLC shall have the facility to synchronize its time with Plant master clock system using IRIG-B signals. Necessary Hardware (IRIG-B port) for same at PLC end to be provided by bidder. The cable connecting PLC and plant master clock system shall be in bidder scope.

11. PLC shall be connected to Plant SCADA through redundant bidirectional serial link with OPC Compliant for monitoring/Control. For details, please refer PLC Configuration Diagram.

12. All furniture (tables, chairs etc.) required for PLC operator HMI shall be in bidder's scope. Chairs shall be capable of being adjusted for height and position of backrest. The chairs shall be mounted on five castors, shall swivel and shall have arm rests'. One table and chair shall be provided for each operator station and separate table for each printer.

13. The requirements given below are to be read in conjunction with detailed Technical specification enclosed.

14. All the cable shall be in bidder scope.

15. Bidder shall provide at least 20% or minimum two numbers, whichever are higher, spare channels as hot on rail spares in each configured I / O modules. In addition to this 10% or minimum one number, whichever is higher, extra assigned complete spare I / O modules mounted on rails in sub racks as hot on rail spare for each category of installed I / O modules shall also be provided. Spare modules shall be distributed over each controller group. Spare channel and modules shall be fully wired up to termination cabinets.

16. Every panel-mounted instrument, requiring power supply, shall be provided with a pair of easily replaceable glass cartridge fuses of suitable rating. Every instrument shall be provided with a grounding terminal and shall be suitably connected to the panel grounding bus.

17. Supplied system shall provide critical group alarms for HVAC system to be hardwired to plant SCADA.

18. Provision for input fire signal from fire alarm system to be ensured in the PLC panel for opening/ closing of the motor operated fire dampers to be supplied by bidder.

19. Provision for separate Terminal block/wiring diagram for power and control blocks of control panel to be ensured.

20. Provision for earthing of the panel to be provided by vendor.

21. Vendor to submit GA drawing and datasheets of PLC and Local control panels indicating layout of instruments, construction details, wiring diagram, class of protection for enclosure, paint type, paint color, thickness and material of enclosure sheet, control scheme during detailed engineering.

22. Layout & space requirement of panel to be specified during detailed engineering.

23. Typical Hook Up diagram of all types of bidirectional drives (Motor Operated Valves, MOVs) is attached for use(subject to Customer approval).

24. Bidder shall provide Cable Schedule in BHEL excel format. Also, Cable Interconnections details and wiring diagram for Complete System shall be in Bidders' scope.

25. Bidder to provide all control panels, system cabinets, termination & relay cabinets complete with all accessories, wiring and all mounting and erection hardware including junction boxes, canopies, structural steel as required. All instruments/drives shall be terminated on Junction Boxes/Panel in Bidder scope of supply. 20% Spare terminals shall be provided on Junction Boxes.

26. Bidder to delegate/depute their person/experts as per owner/consultant requirements.

27. The make of all the items shall be from approved sub-vendor list.

28. The design, manufacture, inspection, testing, site calibration and installation of all C&I equipment and systems covered under this specification shall conform to the latest editions of applicable codes and standards.

29. Bidder shall provide the signal exchange, to Plant SCADA in BHEL prescribed format to be furnished during detailed engineering.

30. Salient features of the Unit Cabinet shall be:

a. Frame shall be of galvanized steel members.
b. Cabinet shall be galvanized steel casing with a pre-painted finish.
c. The assembly shall be installed outdoor and should, therefore, have adequate weather protection/ resistance.

31. Unit control Module

The unit shall be provided with Microprocessor Control System for air cooled centrifugal chiller. It shall have control logic with the Clear Language Display, which will have various functions that allow the operator to read unit information and adjust set points.

32. Chiller System Logging

The UCM will display data required to log the chiller system. The following information will be available as standard feature with the air cooled screw Chiller Microprocessor.

- Entering and leaving chilled water temperature
- Ambient air temperature
- Evaporator and condenser refrigerant temperature and pressures.
- Percent RLA for each compressor
- Percent line voltage
- Compressor starts and running hours
- Active set points:
  → Chilled water set point
  → Current limit set point
  → Low ambient lockout point
- Over 90 diagnostic and operating conditions
- Part failure diagnostics:
  → Water temperature sensors
  → Refrigerant temperature sensor
  → Compressor contractors

33. Remote Display Panel

- The system shall be provided with a twisted pair connection to an optional remote display panel. With this provision it will be possible to control chiller operation from the remote panel similar to the control interface on the chiller itself, and it will be possible to turn “On” and “Off”, change the chilled water set point, and display all operating and diagnostic conditions from this panel. The remote display panel shall be mounted indoors so that it can be accessed without the need to go to the chillers plant room/ item.
- Remote clear language display will have the ability to control multiple units. In the multiple unit configuration, the Remote Clear language Display Panel will have the capability to communicate with up to four units. Each unit will require a separate communication link with the Remote Display Panel.

34. Interface to the Station SCADA System

The system should have provisions and facility for interfacing the chiller with station SCADA system:

- Chiller inputs will include
  → Chiller enable/ disable
  → Circuit enable/ disable
  → Chilled water set point
  → Current limit set point
- Chiller outputs will include:
  → Compressor running indication
  → Alarm indication (for each circuit)
  → Maximum capacity
- Cooling water pumps:
  →Remote/local selector switch
  → Start/Stop Push Buttons

NOTES:

1. All equipment items shall be of latest design with proven on track record from reputed experienced manufacturers of specified type and range of equipment. The make/model of various instruments/items/systems and instrument sub-vendor shall be subject to approval of BHEL/Customer during detailed engineering stage.

2. The above given scope is indicative & minimum. Any item/ equipment not indicated above however required for the completeness of the system is to be supplied by bidder without any technical, commercial and delivery implication to BHEL.

3. Documents of C&I System shall be submitted to end user/owner for approval during detail engineering. Changes, if any, shall be accommodated by the bidder without any price/time implication.

7. INSTRUMENTATION AND CONTROL EQUIPMENT

7.1 General

All instrumentation and control equipment shall be of internationally reputed make having proven performance and acceptability in the field.

7.2 Design Criteria

7.2.1 General

Chapter 6, "Electrical Works", shall be considered for I & C equipment as far as applicable. Special reference is made to cabling, wiring and labeling.

All components shall be of an approved and reliable design. The highest extent of uniformity and interchangeability shall be reached. The design shall facilitate maintenance and repair of the components.

The Works shall be pre-assembled to the highest extent in the Contractor's or Sub-Contractor's workshop, e.g., shop welding of thermometer wells and other connections, wiring of boards, desks, etc., including internal wiring and installation of devices shall be carried out. Fragile instruments shall be removed for transportation to site.

All components shall be suitable for continuous operation under site conditions.

Materials for instrumentation and control equipment, including piping material, which is exposed to the measured media, shall be selected accordingly.

All components shall be compatible with other electrical, electronic and mechanical Works.

All instrumentation and control functions shall be shown on the piping and instrumentation diagrams. The symbols to be used shall be in accordance with ISO standard. The identification system (tag numbers) shall be in accordance with the Works identification system and is subject to approval by the Engineer. All measurements and alarms shall be listed in a measuring list of a standard form subject to Approval by the Engineer. For remote controls, a schedule of interlocks shall be provided. The features of automatic controls shall be shown in block diagrams.

Shielded cables shall be provided for the control and supervisory equipment where required.

7.2.2 Standards

If the Contractor intends to apply Standards and Regulations other than those specified, he shall provide the Engineer-in-chargewith two (2)

sets of such documents, which shall be complete, unabridged and written in the Contract Language.

7.2.3 Sizes of Indicating Instruments and Recorders

The meters, instruments and recorders shall be of standard size, to be selected to guarantee aesthetic appearance of switchgears, control panels, control desks, etc. The front glasses shall be of the anti-glare type. The scales shall be 90 degrees type for local control panels but must be 240 degrees type for control room instrumentation.

The control switches, adjusters, etc., on the panels and desks shall harmonise with the utilised indicator sizes.

7.3 Tests

The single components and pre-erected assemblies shall undergo functional and routine tests in the Contractor's or Sub-Contractor's workshop. The ready mounted control and supervisory system shall undergo functional tests on Site prior to commissioning of the power Works.

Calibration tests shall be made on all important pressure gauges and other instruments as required by the Engineer in charge.

7.4 Measuring Systems

Electric measuring signals of 4-20 mA shall be transmitted to the control room for emergency or regulating circuits. In this case the absence of live-zero signal shall lead to a warning signal. Measuring signals for indicating purposes will be 4-20 mA.

The components shall quickly respond to any changes of the measured magnitudes. Measuring ranges of indicators, transducers, etc. shall be selected in such a way that the rated value of the measured magnitude covers approx. 75% of the range.

All local instruments shall, as far as practicable, be mounted vibration free to allow good reading. Wherever required, damping elements shall be used.

Corresponding systems shall be grouped together in local panels.

All local indicating instruments and test connections shall be included in the respective Works as integrated parts. The scope of local indicating instruments and test connections shall enable the operator to properly survey the Works, and shall also allow to adequately carrying out all acceptance and other tests.

The binary sensors shall be fused separately and supplied with 24 V D.C.

7.4.1 Flow Measurements

The primary elements of flow meters shall be standard Venturi tubes, pitot tubes, standard orifices, anubar inductive or ultrasonic type. Their design and performance shall be in accordance with applicable standards.

The design and arrangement of tapping points, piping and valves shall be in accordance with VDI/ VDE rules 3512.

Beginning at a rate of flow of at least 5% of the measuring range all flow transmitters shall measure correctly. The error limit shall be ±1% for a rate of flow higher than 10%. The error of the primary elements is not included in this accuracy. The root extraction of flow measurement shall be effected electrically within the transmitter.

Arrangement:

The arrangement of the throttling devices, the straight lengths upstream and downstream from the throttling device shall be in accordance with the said standards. Bends shall be at a sufficient distance upstream from the throttling device, particularly when large orifice ratios are used.

7.4.2 Temperature Measurements

All wells for capillary type thermometers, resistance temperature sensors and thermocouples shall be of the weld-in type. Wells for thermometers and temperature sensors of the screw-in type shall be restricted to measuring points for lubrication oil, and to such measuring points where welding is not suitable, e.g., at cast-iron parts. Shop-welded thermometer wells shall be covered by screw caps for protection during transportation and erection.

Resistance thermometers and thermocouples shall be equipped with waterproof connection heads. Thermometer arrangements shall be such that the connection heads do not become warmer than 80 °C, and the measuring inserts are easily exchangeable.

The temperature sensors shall be selected in such a way to minimise the number of different spare inserts. Resistance thermometers shall be used as far as possible and shall generally be of type Pt 100. Double resistance thermometers (with two resistors in one insert) should be avoided.

The use of dial-type contact thermometers shall be restricted to bearing metal and oil temperature measuring. In all other cases, thermocouples or resistance thermometers and electric contact modules (monitors) shall be used. Glass thermometers and similar thermometers will not be accepted as contact thermometers.

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7.4.3 Pressure Measurements

Pressure gauges shall be shock and vibration-proof (preferably by filling with glycerin) and shall be equipped with toothed wheels and toothed segments of the machined type. They shall completely be made of stainless steel.

Higher than rated pressure shall not deteriorate the pressure gauge or affect its calibration. The pressure gauges shall be equipped with a radial-connecting stud, to allow the mounting on a gauge holder.

Pressure gauges with potentiometers will not be accepted for use as a pressure transmitter.

The error for pressure transmitters shall be limited to ±0.5%.

Pressure gauges and transmitters for inflammable liquids shall have filled systems and the filling liquid shall be separated from the inflammable liquid by means of adequate isolating membranes.

Each gauge, pressure switch and transmitter for absolute or differential pressure shall be equipped with a pressure gauge isolating valve including a test connection of the screwed type M20 x 1.5 mm so that such device can be removed without any disturbance of the plant operation.

Pressure gauges and transmitters for pressures of 10 bar and above shall not be directly mounted on the pressure tapping point. They shall be mounted apart from the tapping point on gauge holders or gauge boards. Whenever possible, pressure gauges and transmitters shall be group wise combined on racks or consoles.

Pressure gauges for high pressures shall be equipped with a relief valve for safety reasons in case of leaks (with a rubber reverse flow check).

In case of flowing substances, the measuring point shall be selected in locations of undisturbed flow.

If the pressure is pulsating, the devices concerned shall be connected via flexible tubes or other pulse-absorbing means.

In general, all pressure gauges, transmitters and pressure contacts shall easily be accessible for maintenance and supervision.

The design and arrangement of tapping points, piping and valves shall be in accordance with VDI/VDE rules 3512.

The scales shall have a diameter of 150 mm with black letters and figures on a white background. The calibration shall be in "bar".

The adjustment of the pointer shall be possible by means of an adjustment device without removing the pointer from its axle.

The high and low-pressure connections of differential pressure gauges shall be marked accordingly.

All casings shall be dust and watertight and be made of stainless steel.

7.4.4 Level Measurements

The liquid level measurements in reservoirs and tanks with atmospheric pressure shall be made by means of pressure transmitter of mercury less-type, by displacement-type transmitters or float-disc-transmitters. The errors shall not exceed ± 1.0% of the total measuring range. Level switches shall be of the externally mounted float or displacement operated type. The switch shall be of packing less construction; there shall be a minimum of moving parts.

7.4.5 Electrical Measurements

All Electrical instruments shall be of flush mounted design, dust and moisture-proof. A.C. ammeters and voltmeters shall have digital type system of not less than 1.5 accuracy class for connection to the secondary side of instrument transformers. D.C. measuring instruments shall have digital type systems of the same accuracy. Watt meters/energy meters shall have electro-dynamic measuring mechanisms if fed by transmitters. Watt meters shall be suitable for unbalanced systems and accuracy of energy meters should be of 0.2 % accuracy class.

All indicating instruments shall generally withstand without damage a continuous overload of 20% referred to the rated output value of the corresponding instrument transformers. Ammeters shall not be damaged by fault-currents within the rating and fault duration time of the associated switchgear via the primaries of their corresponding instrument transformers.

All instruments and apparatus shall be capable of carrying their full load currents without undue heating. All instruments and apparatus shall be duly connected, and the enclosures shall be earthed. Means shall be provided for zero adjustment of instruments without dismantling.

All voltage circuits to instruments shall be protected by MCB's in the unearthed phases of the circuit, installed as close as practicable to the instrument transformer terminals, or, where instruments are direct-connected, as close as practicable to the main connection. All power factor indicators shall have the star point of their current coils brought out to a separate terminal which shall be connected to the star point of the current transformer secondary windings.

When more than one measured value is indicated on the same instrument, a measuring point selector switch shall be provided next to the instrument and shall be engraved with a legend specifying each selected measuring point.

All instruments shall be of the flush mounting type and shall be fitted with non-reflecting glass and shall comply in every respect with the requirements of IEC Publication 51. Except for instruments employed

for Works performance tests all instruments shall have an accuracy class of 1.5.

Scales shall be arranged in such a way that the normal working indication is between 50-75% of full-scale reading permitting an accurate reading. CT connected Ammeters provided for indication of motor currents shall be provided with suppressed overload scales of twice full scale. The dials of such ammeters shall include a red mark to indicate the full load current of the motor.

Instrument scales shall need the approval by the Engineer-in-charge. All instruments mounted on the same panel shall be of same style and appearance.

Transmitter connected ammeters (for example those in mosaic-type control desks) shall have 90 degrees or 240 degrees circular scales calibrated 0-120 %. The rated motor current shall correspond to 100% scale indication.

All metering circuits shall be terminated in marked terminal blocks for remote metering purposes.

7.4.6 Position Measurements

Position transmitters of the potentiometer type will not be accepted. Inductive or capacitive type shall be provided.

Position transmitters for continuous position indication and measuring transducers shall have an output current of 4-20 mA and aux. supply voltage (if required) 220 or 48 V D.C. The "potentiometer-type" position measuring principle is not permitted.

7.4.7 Limit Switches

Limit switches shall be provided for each electrically operated gate, valve or gantry to automatically stop the motor at both ends of travel. Additional switches shall be provided where necessary for control, interlocks and indication.

Limit switches shall be mounted suitable for easy adjustment and for rigidly locking in position after being adjusted. They shall be of heavy-duty rating and have two changeover contacts suitable for 220 V D.C. operations.

Switch fixings shall be positive and shall be unaffected by vibration. At the same time they should be capable of easy adjustment to suit changing parameters of the associated plant.

Particular attention shall be paid to potentially harmful environmental conditions, including water, oil, dust, dirt, temperature variations and differential expansions. Where switches operate through linkages, precautions shall be taken to eliminate variations of settings and incorrect operations resulting from wear or tolerances.

7.4.8 Contact Devices

Contacts of level switches, pressure switches, temperature switches, limit switches, and of all other devices shall be of the snap action type (SPDT). Contact devices for interlocking systems shall be separate, i.e., contact devices serving commonly for interlocking and other purposes will not be accepted.

7.5 Protection Systems

Electrical/Mechanical Protection and Interlocking Systems shall be provided for all works components and individual systems to ensure a safe and reliable operation and to limit harm and damage to personnel and works to an utmost extent.

The primary functions of these facilities shall be to disconnect selectively faulty sections of the systems prior to influence or damage to other works and to maintain operative systems as far as possible.

Moreover these devices shall facilitate the duty of the operation staff and prevent mal-operation.

7.6 Transmitter Racks and Piping

Wherever practicable, transmitters for flow, pressure, etc., shall be installed in readily accessible positions in the proximity of the measuring point, free from vibration and protected against damage, moisture, dust, corrosive air, and great temperature changes.

The transmitters shall be grouped and assembled as far as practicable on local transmitter racks or in cubicles with glass or plexi-front.

The connecting lines between the primary elements and the transmitters shall be installed to falls in order to ensure that no air pockets or water locks are created.

6. ELECTRICAL WORKS

6.1 General

The electrical items of Works of any electrical or mechanical installation to be provided under this Contract according to the Particular Technical Specifications shall - if not stated otherwise therein-fulfil the requirements of this Section.

All components shall be of an approved and reliable design. The highest extent of uniformity and interchangeability shall be reached. The design shall facilitate maintenance and repair of the components with ease and speed.

The Works shall be pre-assembled to the highest possible extent in the Contractor or Sub-Contractor's works, complete with all devices and wired up to common terminal blocks.

The power supply and control cables shall be laid up to these common terminal blocks. The required control and protection devices, instruments, etc., within the different scopes of work shall be supplied and connected by the relevant Contractor.

Unless otherwise agreed, ratings of main electrical Works (in feeds, bus-ties) as selected or proposed by the Contractor, whether originally specified or not, shall generally include a safety margin of 10% under consideration of the worst case to be met in service. Prior to approval of such basic characteristics, the Contractor shall submit all relevant information such as consumer lists, short circuit calculations, de-rating factors, etc.

Short-circuit calculations shall be evaluated giving full evidence that every electrical component can withstand the maximum stresses under fault conditions, for fault levels and durations obtained under the worst conditions, e.g.: upon failure of the corresponding main protection device and time delayed fault clearing by the back-up protection device.

All Works shall be suitable for the prevailing climatic conditions.

Outdoor installations needing protections shall be protected against solar radiation by means of adequate covers, where required.

The Contractor shall ensure that all the equipments and devices are insensitive to any signals emitted by wireless communication equipment.

6.2 Standards

The design, manufacture and testing of all Works and installations shall strictly comply with the latest edition of the relevant IEC standards or any other international standards.

6.3 Colour Code

In general, the colour code for electrical Works shall be as described in the Particular Technical Specifications.

The manufacturer's painting systems shall be used to the maximum possible extent, but shall by all means be subject to the approval of the Engineer. Final coats of paint shall be matching adjacent installations, where required.

6.4 Electric Motors

6.4.1 General

All motors shall be of approved manufacture and shall comply with the requirements of this Chapter. Motors of the same type and size shall be fully interchangeable and shall comply - as far as applicable - to IEC standard motor dimensions.

The general construction shall be stiff and rigid; no light metal alloy casings will be accepted. All precautions shall be taken to avoid any type of corrosion.

All motors shall be fitted with approved types of lifting hooks or eyebolts as suitable.

AC motors shall have squirrel cage type rotors.

Motor Voltages and Power Ratings

The service voltages and corresponding power ratings for electric motors to be used in the Project shall be as follows:

- Motors up to 100 kW
- Service voltage : 3-phase a.c. 415/240 V,50 HZ
- Mode of starting : direct-on-line up to 50 kW

Above 50 kW with suitable starters

- Motors up to 0.75 kW
- Service voltage : single-phase a.c. 240 V, 50 HZ
- Mode of starting : condenser
- Motors intended to work on the d.c. System
- Service voltage : 220 V D.C.
- Mode of starting : resistor

6.4.2 Rating

The rating of the motors shall be adequate to meet the requirements of its associated equipment. The service factor, being the ratio of the installed motor output to the required power at the shaft of the driven

machine at its expected maximum power demand, shall be applied as follows:

Power Demand of Driven Machine	Service Factor
Up to 5 kW	1.2
More than 5 kW	1.1

A.C. motors shall be capable of operating continuously under rated output conditions at any frequency between 95% and 105% of the rated frequency and/or with any voltage variation between 90% and 110% of the nominal voltage. A transient over voltage of 130% of the nominal voltage shall as well be sustained.

Further, the motors shall be capable of maintaining stable operation when running at 70% nominal voltage for a period of 10 seconds. The pullout torque for continuously loaded motors shall be at least 160% of the rated torque and for intermittently loaded motors 200% of the rated torque.

D.C. motors shall be capable of operating continuously under rated output conditions at any voltage between 90% and 110% of the nominal voltage with a fixed brush setting for all loads. Unless otherwise approved, the speed drop between no-load and full-load shall not exceed 10% of no-load speed.

6.4.3 Starting

A.C. motors shall be designed for direct on-line starting. They shall be capable of being switched on without damage to an infinite bus bar at 110% of the nominal voltage with an inherent residual voltage of 100% even in phase opposition. For starting the motors from the individual main and auxiliary bus bars, a momentary voltage drop of 20% referred to nominal voltage should be taken into consideration. With 85% of the nominal voltage applied to the motor terminals, each motor shall be capable of accelerating its associated load to full speed with a minimum accelerating torque of 5% of full load torque.

The maximum starting currents (without any tolerance) shall not exceed the following values: -

- 5 times of rated current for low voltage motors rated 100 kW or above
- 2 times of rated current for D.C. motors (by means of starting resistors)

Generally, all motors shall be able to withstand three cold starts per hour, equally spaced. In addition, each medium voltage motor shall be capable of enduring two successive starts with the motor initially at operating temperature. Each low voltage motor shall be capable of withstanding three successive starts under the same conditions or once every twenty minutes without detrimental heating.

Motors for frequent automatic starting shall have an adequate rating. In the motor list the Contractor shall state the frequency of starts permitted in compliance with the motor design.

6.4.4 Windings and Insulation Class

The insulation of all motors shall be of class F but will not exceed the temperature limits of class B materials in operation. It shall be suitable for operation in damp locations, for occasional contact with corrosive gases and vapours and for considerable fluctuations in temperature.

The stator winding shall be suitably braced to withstand the forces due to direct-on-line starting and transfer conditions as mentioned before. The winding envelopment and tails shall be non-hygroscopic. The stator winding shall withstand the maximum fault current for the period determined by the associated protective devices.

The rotor winding (if applicable) shall be designed to give trouble-free continuous service including repeated direct-on-line starting. The rotor shall be subjected to a 120% over speed test for 2 minutes without showing any winding dislocation.

6.4.5 Ventilation and Type of Enclosure

All motors shall be of the totally enclosed fan-cooled type, protection class IP 54 according to IEC Recommendation 144. Cable termination points shall be of class IP55.

They shall have a closed internal cooling air circuit re-cooled by an external cooling air circuit drawn from the opposite side of the driving end.

Where motors are installed outdoors, a weatherproof design shall be chosen. L.V. motors of IEC size 132 and above shall be equipped with automatically controlled heating elements for protection against internal condensation of moisture during standstill periods. Such A.C. heater shall be suitably fixed inside the motor casing; the leads shall be led to a separate L.V. terminal box.

Motors installed outdoors and directly subjected to solar radiation shall be rated such as not to exceed a maximum metal temperature of 85°C. Where necessary, such motors shall be provided with sun shields.

Vertical motors shall be provided with a top cover to prevent the ingress of dirt, etc.

6.4.6 Bearings

As far as possible, the motors shall have sealed ball or roller bearings. All motors with ratings of about 1 kW and above shall be equipped with lubricators permitting greasing while the motor is running and for

preventing over-lubrication. Additionally, the bearings shall be fitted with grease nipples permitting the use of a universal grease gun.

Vertical motors shall have approved thrust bearings.

Where sleeve bearings are being used, they shall be of the self or forced lubricating type. If forced lubrication is required, it shall be arranged common to both the motor and the driven machine and provisions shall be made to ensure lubrication during start-up and shutdown operations without the necessity to start an auxiliary lube oil pump. Self-lubricated bearings shall be equipped with an easily accessible oil reservoir with overflow pipe and oil collecting vessel.

All bearings shall be easily controllable during operation or standstill without dismantling the bearings. The bearings shall further be protected and sealed against dust penetration and oil leakage.

In case of independent bearings, motor and bearing pedestals shall be fitted on a common base plate.

For the transport of motors equipped with ball or roller bearings, special bearing inserts shall be provided to prevent transport damage.

6.4.7 Shafts and Couplings

The motors shall be provided with a free shaft extension of cylindrical shape with key and keyway according to IEC Recommendation 72-1 and with the motor side coupling, which shall be pressed on the motor shaft and be balanced together with it. A coupling guard shall be provided.

6.4.8 Brush gear and Commutators

Brush gear for D.C. motors shall be designed to ensure constant brush pressure. Carbon brushes shall be provided which stand at least 6 months of operation without replacement. Each brush shall be independently adjustable but should not require adjustment throughout its life. A design of brush gear which permits the brush holder to touch the commutator as the brushes wear or which passes current through the pressure fingers will not be accepted.

A sufficient number of brushes, not less than two per pole, shall be fitted to ensure that vibrations do not affect the commutation.

The minimum safe wearing margin of commutators shall not be less than 20 (twenty) per cent of the total thickness of the commutator bars and the minimum safe diameter shall be clearly marked on it.

6.4.9 Terminal Boxes and Earthing

The terminal leads, terminals, terminal boxes and associated equipment shall be suitable for terminating the respective type of cables as specified in these General Technical Specifications and in the Particular Technical Specifications.

The terminal boxes shall be of ample size to enable connections to be made in a satisfactory manner. Supports shall be provided at terminal boxes as required for proper guidance and fixing of the incoming cable.

The terminal boxes with the cables installed shall be suitable for connection to supply systems with the short-circuit current and the fault clearance time determined by the motor protective devices.

A permanently attached connection diagram shall be mounted inside the terminal box cover. If motors are provided for only one direction of rotation, this shall be clearly indicated.

Terminal boxes shall be totally enclosed and designed to prevent the ingress of moisture and dust. All joints shall be flanged with gaskets of neoprene or similar material. For motors above kW, the terminal box shall be sealed from the internal air circuit of the motor.

Depending on the size, the terminal box of L.V. motors shall be fitted either with an approved cable sealing end or with a gland plate drilled as required and provided with suitable fittings for cable fixing and sealing. Such openings shall be temporarily plugged or sealed during transportation.

For earthing purposes, each motor shall have adequately sized bolts with washers at the lower part of the frame. In addition, each terminal box shall contain one earthing screw. Each equipment/panel shall be earthed by at least two separate earthing strips.

The cable termination philosophy to be adopted shall be such that extensive grouping of signals by a large scale use of field-mounted group Junction boxes at strategic locations (where large concentration of signals are available, e.g. switchgear) is done. Termination / Junction boxes shall have either maxi- terminal or cage clamp type terminals

6.4.10 Noise-Level and Vibrations

Under all operating conditions, the noise level of motors shall not exceed 85 dB (A).

In order to prevent undue and harmful vibrations, all motors shall be statically and dynamically balanced.

Vibration displacements or velocity shall be measured in accordance with DIN 45 665 for IEC motor sizes 80 to 315. The results for all motors shall be within the "R" (reduced) limits.

6.4.11 Tests

Each motor shall be factory tested and shall undergo a test at site. The following tests shall be performed under full responsibility of the Contractor.

- Workshop Tests:
- Measurement of winding resistances
- No-load and short-circuit measurements
- Measurement of starting current and torque
- Efficiency measurement (type test)
- Heat test run
- Dielectric test
- Measurement of insulating resistance
- Over speed test
- Site Tests:
- Measurement of insulation resistance
- Measurement of motor vibrations
- Measurement of starting time.

6.5 M.V. and L.V. Switchgear, Cubicles and Panels

6.5.1 Starters and contactors

Motor starters and contactors shall be equipped with short circuit protection and local disconnecting devices. Preferably, all starters shall be from one manufacturer. The control circuit voltage shall be obtained from a 415/240 V isolating transformer with primary circuit breaker and secondary fuse. The secondary winding of this transformer shall be grounded. The operating coils of the contactor shall be connected between the grounded side of the transformer and the control contacts.

Starters and contactors shall comply with IEC 292.1 or NEMA IC 1 and be suitable for direct on-line starting, uninterrupted electrical duty, and capable of 30 operations per hour. They shall be installed in ventilated enclosures for indoor installation and weatherproof enclosures for outdoor installation, unless otherwise approved by the Engineer. The enclosures shall be complete with locks, cable sealing boxes, conduit entries, cable gland plates, bus bars, internal wiring, terminal boards, etc. as required by the duty of the starter or contactor.

Starters and contactors shall be of minimum size compatible with motor size and capable of satisfactory operation, without damage, for a period of 5 minutes at a voltage 25 percent below nominal, at nominal frequency.

Thermal type overload and phase failure relays shall be supplied with starters for motors of 7.5 kW or greater. For motors of less than 7.5 kW, suitable rated 3-phase thermal overloads will be acceptable. Ammeters to read current in one phase shall be provided for motors above 7.5 kW.

Each starter shall have sufficient number of auxiliary contacts required for interlocking and indication purposes plus two spare convertible contacts for Owner's use.

6.5.2 Moulded case circuit breakers

All moulded case circuit breakers shall be of 2 or 3 pole type as required, having thermal time delay and instantaneous trips with "On-Trip-Off", indicating/operating mechanism. Circuit breakers used in combination type motor starters or contactors shall have the operating mechanisms interlocked with the starter or contactor cover so that the cover cannot be opened unless the circuit breaker is open. The breakers shall comply with applicable sections of IEC 157/1 or equivalent standards.

6.5.3 Control relays

Relays used as auxiliary control devices in conjunction with motor starters and magnetic contactors shall be of the type designed for machine tool application featuring contact convertibility. All contacts shall have a minimum thermal current rating of 10A over a range of 6 to 600 V AC.

6.5.4 Pilot devices

Pilot devices such as selector switches, push-button starters and thermostats shall be of heavy duty type and, where mounted outdoors, shall be housed in weather proof enclosures specially designed for the environment.

All electrical contacts for control, alarm and shutdown shall have a thermal current rating of not less than 10 A at 220 V DC.

6.5.5 Terminal blocks

All terminal blocks shall be mounted in an accessible position with the spacing between adjacent blocks not less than 100 mm and space between the bottom blocks and the cable gland plate being a minimum of 200 mm. Sufficient terminals shall be provided to allow for the connection of all incoming and outgoing cables, including spare conductors and drain wires. In addition, 20 percent spare terminals shall be provided. In enclosed cubicles, the terminal blocks shall be inclined toward the door for facilitating terminations.

Terminals shall be of the channel mounting type and shall comprise a system of individual terminals so that terminal blocks can be formed for easy and convenient cabling consistent with the high reliability required of the circuits.

Terminal blocks shall be provided with shorting links and paralleling links where applicable and mounting identification numbers and/or letters.

Terminal blocks shall conform to the applicable standards. The smallest size to be used shall be designated for 2.5-sq. mm wire and not more than two conductors shall be connected under one terminal clamp.

Terminal identification shall be provided corresponding to wire number of connected leads.

Circuit terminals for 415 V AC shall be segregated from other terminals and shall be equipped with noninflammable, transparent covers to prevent contact with live parts. Warning labels with red lettering shall be mounted thereon in a conspicuous position.

6.5.6 Equipment wiring

All wiring connections shall be readily accessible and removable for test or other purposes. Wiring between terminals of the various devices shall be point to point.

Splices or tee connections between terminal points are not acceptable. Wire runs shall be neatly dressed inside the panels or in wiring troughs. Whenever possible, unused areas of the panels shall be kept free of wiring to facilitate the installation of future equipments.

Multi conductor cables shall be connected to the terminal blocks in such a manner as to minimise crossovers. Approved claw washers of crimp type connector shall be used to terminate all small wiring. Each conductor shall be individually identified at both ends through a system providing ready and permanent identification, utilising slip-on ferrules approved by the Engineer.

Markers may be typed individually or made up from sets of numbers and letters firmly held in place. Open markers will not be accepted.

Markers must withstand a tropical environment and high humidity and only fungus proof materials will be accepted. Ferrules of adhesive type are not acceptable.

All trip circuits shall employ markers having a red background.

Sensitive control circuits shall be effectively shielded against extraneous signals and interference. A separate terminal shall be provided for termination of individual cable shields, which will be grounded at source end only.

6.5.7 Cubicles and control panels

Cubicles and control panel enclosures shall be of sheet steel with minimum thickness of 2.5mm, of rigid, self-supporting construction and supplied with channel bases.

Cubicles shall be fitted with close fitting, gaskets, hinges, lift-off doors capable of being opened through 180 deg. The doors shall be provided with integral lock and master key.

Cubicles and panels shall be vermin proof. Removable gland plates shall be supplied and located to provide adequate working clearance for the termination of cables. Under no circumstances shall the floor/roof plate be used as a gland plate. The cables and wiring shall enter from bottom or top as approved or directed by the Engineer.

The cubicles and panels shall be adequately ventilated, if required, by vents or louvers, and shall be so placed as not to detract from the appearance. All ventilating openings shall be provided with corrosion-resistant metal screens or a suitable filter to prevent entrance of insects or vermin. Space heating elements with thermostatic control shall be included in each panel.

Where cubicles are split between panels for shipping, terminal blocks shall be provided on each side of the split with all necessary cable extensions across the splits. These cable extensions shall be confined within the panels with suitable internal cable ducts.

Unless stated otherwise, all cubicles and panels shall be provided with a ground bus with 40mm copper bar extending through out the length. Each end of this bus shall be drilled and provided with lugs for connecting ground cables ranging from 70 to 120mm^2.

The standard phase arrangement when facing the front of the motor control centres and switchboard shall be RYB from left to right, from top to bottom and front to back. All instruments, devices, buses and other equipments involving 3 phase circuits shall be arranged and connected in accordance with the standard phase arrangement, where possible. Electrical clearances shall conform to applicable standards and shall not require cutting away of adjacent framework.

All instruments, control knobs and indicating lamps shall be flush mounted on the panels. Relays and other devices sensitive to vibration shall not be installed on doors or hinged panels, and no equipment shall be installed on rear access doors.

The instrument and control wiring, including all electrical interlocks and all interconnecting wiring between sections, shall be completely installed and connected to terminal blocks by the manufacturer.

The arrangement of control and protection devices on the panels and the exterior finish of the panels shall be subject to the approval of the Engineer. The interior of all cubicles and panels shall have a mat white finish unless specified otherwise.

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Switched interior light and socket outlets shall be provided for all cubicles and control panels.

All cubicles and control panels shall be provided with lamacoid nameplates, identifying the purpose of the panel and all of its components.

6.5.8 Alarm contacts

Where applicable, all alarm contacts shall be of galvanically isolated type and provide inputs to the following devices.

- -Local annunciator
- -Station annunciator
- -Supervisory control and sequence of events / fault recorder system.

All alarm contacts shall be changeover type. Where required, relays shall be provided as contact multiplier.

6.6 Cables

Refer to particular technical specifications Section-IX.

6.7 Earthing System

The contractor of Electro-Mechanical Equipment will make the design calculation and supply the necessary material and install the earthing system during powerhouse construction in co-coordination with civil contractor

6.8 Explosion Proof Works

6.8.1 General

According to the kind of oils and fuels used, explosion in hazardous locations may be caused by standard type electrical works. Therefore, the installation in such locations shall generally be kept to a minimum with said works designed or installed in compliance with the latest issue of IEC recommendation 79 and the appropriate articles of the American National Electric Code (NEC) or the German VDE Standards 0165, 0170 and 0171.

6.8.2 Definition of Hazardous Locations

Hazardous locations shall be defined as follows:

- Class 1, Div. 1 locations are those:
- Where hazardous concentrations of inflammable vapours or gases exist continuously, intermittently, periodically under normal

conditions of operation and maintenance and with normal leakage, and

- Where the breakdown or faulty operation of process equipment could release explosive concentrations of fuel and cause simultaneous failure of electrical works.
- Class 1, Div.2 are those:
- Adjacent to Div.1 locations which may occasionally be reached by hazardous concentrations, and
- Where inflammable volatile liquids or gases are handled, processed, or used, but where concentrations are not normally hazardous because liquids or gases are handled in closed systems, and
- Where hazardous concentration is normally prevented by positive ventilation. These locations become hazardous only when the ventilation system fails.

6.8.3 Design features

The design features of electrical works and /or circuits to reach explosion proof condition shall be selected with due regards to the place of installation and the kind of works.

The main features shall be as follows:

- Pressure & flame –proof Enclosure:

All parts, which may ignite a hazardous atmosphere, shall have an enclosure of sufficient strength to withstand the maximum pressure caused by ignition of the most inflammable mixture of the gas involved. All necessary joints of such enclosures shall be provided with long fits (minimum 25 mm) and close clearances (equal or smaller than 0.6 mm) to cool the escaping flame and to prevent flame propagation to the outside atmosphere.

- Oil immersion:

The parts capable of igniting inflammable or explosive mixture shall be immersed in oil to such an extent as to prevent ignition of explosive mixtures above the surface of oil by means of sparks or hot gases produced under oil.

- Increased Safety:

To obtain an increased degree of safety on electrical works, special measures shall be taken to prevent non-permissible high temperatures, sparks or arcs inside or outside of the works on which they don't occur under normal working operations.

- Intrinsic safety

All electrical circuits or part of such a circuit shall be considered as intrinsically safe if neither during normal working operation nor under

fault conditions explosive mixture is ignited by means of arcs, sparks or any heat generation.

- Any other approved feature not mentioned above but may be felt necessary during the course of execution.

All explosion proof works shall be of approved design and must have undergone type tests according to appropriate standards.

The selection of such works with reference to design features and allocation to hazardous groups shall be subject to approval by the engineer.

6.9 Labels and Plates

6.9.1 General

Labels and data plates shall be provided in accordance with applicable standards and as detailed hereunder.

The proposed material of the labels, size, exact label lettering and proposals for the arrangement of the labels shall be submitted to the Engineer-in-charge for approval.

Where applicable, designations in the selected local language shall appear above or to the right of the designation in the Contract language. The translations into and writings in the local language shall be submitted for approval.

6.9.2 Equipment Labels and Instruction Plates

Labels written in the Contract language shall be provided for all instruments, relays, control switches, push buttons, indication lights, breakers, etc. In case of instruments, instrument switches and control switches, where the function is indicated on the device, no label is required. The label shall be fixed close to the devices in such a way that easy identification is possible. Fixing on the dial glass of instruments will not be accepted. The wording shall conform to the wording used in engineering documents.

Each separate construction unit (cubicle, panel, desk, box, etc.) shall be identified by its Works identification number. Cubicles and similar units shall also bear this identification number on the rear side if rear access is possible. The overall designation of each unit shall be given in the Contract language and - if required - also in a selected local language. These labels shall be made of anodised aluminium with black engraved inscriptions, arranged at the top section of the units. Manufacturer's trade labels shall - if desired - appear in the bottom section of the units.

All Works inside cubicles, panels, boxes, etc., shall be properly labelled with their item number. This number shall be the same as indicated in the pertaining documents (wiring diagrams, Works list, etc.).

Instruction plates in the Contract and selected local language, the sequence diagrams or instructions for maintenance shall be fitted on the inside of the front door of the electrical switchboards.

6.9.3 Warning Labels

Warning labels shall be made of synthetic resin with letters engraved in the Contract and selected local language, where required in particular cases.

For indoor circuit breakers, starters, etc., transparent plastic material with suitably contrasting colours and engraved lettering would be acceptable.

Details are stated in the Particular Technical Specifications or will be fixed at a later date.

6.9.4 Labels for Conduits

The material shall be non-corrosive and the inscription be done with 4 mm high letters/figures.

6.9.5 Labels for Cables

Each cable when completely installed shall have permanently attached to each end and at intermediate positions as may be considered necessary by the Engineer-in-charge, non-corrosive labels detailing identification number of the cable, voltage, and conductor size.

The cable identification numbers shall comply with those of the cable list.

All cables in cable pits and at the entry to buildings shall be labelled utilising the aforementioned type of label.

6.9.6 Rating Plates

Works (hoists, machines, transformers, etc.) rating plates and other technical data/informative plates shall either be of the enamelled type or be of stainless steel suitably protected after engraving with a transparent paint resistant to aggressive atmosphere and solar radiation.

6.9.7 Single-Line Diagrams

Each switchgear room shall be furnished with a copy of the final as-built single-line diagram detailing all electrical data and denominations, separate for each individual switchgear / distribution board / MCC, placed under glass and frame/wall mounted at an approved location.

The same applies to the Station Single-Line Diagram one copy of which shall be arranged in the control room(s).

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6.8 Key System for Electric Boards

Key interlocked switches shall be provided with Yale or other approved locks for locking in the neutral position. Similar locks shall be provided for selector switches for locking the switches in any of the positions.

The locks or padlocks shall be co-ordinated for the different applications and shall be supplied with three keys. A key cabinet at the end of each board (distribution board, MCC, control cubicles, etc.) shall be provided for storing the keys of that board. All keys shall have six master keys to open any lock or padlock supplied. Each key shall have one identification label fixed above the key-hanging hook inside the cabinet.

The cabinet door keys shall be similar and shall be six (6) in number.

PLC SPECIFICATION

	TITLE:	SPECIFICATION NO. PES-145-36	
BHEL	**SPECIFICATION FOR PROGRAMMABLE LOGIC CONTROLLER SYSTEM**	VOLUME **II-B**	
		SECTION **D**	
		REV. NO. 03	DATE: 18.03.2014
		SHEET 1 OF 11	

1. SCOPE

This specification covers the Design, Manufacture, Assembly, Inspection and Testing at manufacturer's works, proper packing and delivery to site, erection & commissioning, site acceptance test of the PLC Control & Monitoring System comprising PLC Control panel/Remote I/O panel (housing Processors, I/O cards, power supply packs etc.), Operator workstations(OWS), Printers, Annunciation system, UPS, cables and all other equipment and accessories required for completeness of the system as mentioned in different sections of this specification.

2. GENERAL

2.1. The offered PLC shall be of Industrial Grade and from Original Equipment manufacturer (OEM).

2.2. The PLC shall perform protection logic, interlock and sequential control functions such as binary logic operation, set/reset operation, timers, counters, logic blocks, math functions, input quality checking engineering unit conversion, Boolean functions & PID control (Analog logic function) etc.

2.3. The system shall be redundant in processor, power supply and communication interfaces unless otherwise specified. The control of all drives and equipment shall be effected through the keyboard/mouse / panel mounted push button / control switches as per Data sheets-A&B. The system shall include self-diagnostic features not limited to the following:-

- Memory Faults, both PROM and EPROM
- Processor Faults
- Communication Faults
- I/O interface or address faults
- Voltage signal discrepancy on input and output
- Power supply faults
- Output loop check
- Channel level diagnostics such as fault monitoring, contact bounce filtering etc.
- Failure of main or I/O processor

2.4. The system shall have facility for connecting to Main Plant's Distributed control system (DCS) using hardware/software interface for two-way transfer of signals.

2.5. The mimic shall be displayed on the OWS screen and may also be provided on the control desk/panel (as per Datasheet).

2.6. In case OWS is provided, HMI functions like trends, curves, bar charts, historical storage of data, logs and reports etc. shall be provided in addition to Plant schematics. The necessary catalogue / literature elaborating the features of HMI shall be supplied along with the bid.

2.7. It shall be possible to use the same OWS as programming station.

2.8. The PLC system shall be sized to meet process/system requirements as per the approved P&IDs and Control write-up.

2.9. The PLC system shall be designed to ensure that no single device failure should result in failure of any other device.

2.10. Signal multiplication where required shall be done in PLC. Use of relays for multiplication of contacts (for control, monitoring and alarm) is not acceptable. The control/ monitoring components on the control panel/ desk shall be driven through I/O modules.

2.11. Bidder shall provide all software on CDs along with required software licenses .The original CDs of installed operating & application software shall be maintained by bidder. Software modification and up gradation (as & when required) shall also be covered under the vendor scope without any cost implication.

2.12. PLC programming console shall be provided with industry proven antivirus software with perpetual license (free version not acceptable).

3. TECHNICAL REQUIREMENTS

Details of various PLC system components shall be inclusive of but not limited to the following:

3.1. CODES AND STANDARDS

3.1.1. The equipment covered under this specification shall meet the requirements of latest edition of all applicable codes and standards like ANSI, NEMA, IEEE, IEC, NEC & IS.

3.1.2. PLC shall conform to IEC: 61131

3.1.3. The offered PLC shall comply with safety standards as per Data sheet-A&B.

3.2. CONTROL PANEL

3.2.1. PLC control panel shall be freestanding type with provision for mimic display, push-button stations, control switches, indicating lamps, metering instruments like Indicators, ammeters etc. and facia windows for critical alarms.

3.2.2. 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 2.5 mm for load bearing sections (mounted with instruments) and not less than 1.6 mm for others
Gland plate thickness: 3.0mm
Base channel: ISMC 100 with anti-vibration mounting & foundation bolts.

3.2.3. Each panel shall be identified by a name plate, which shall be of non-rusting metal or three ply lamicold, with engraved lettering.

3.2.4. Vendor shall indicate earthing details along with bid.

3.2.5. 25 x 6 mm Copper ground bus to be provided for each panel.

3.2.6. 240V AC single phase, thermostatically controlled space heaters shall be provided. Each free standing panel shall have a door switch operated fluorescent lamp and a 240V AC plug point.

3.2.7. Painting treatment shall be as per IS: 6005. Two coats of lead oxide primer shall be followed by powder coating. Paint shade shall be as specified in the “Data sheet for PLC system”-Data Sheet-A&B. Project specific paint shade, if applicable, shall be followed.

3.2.8. Panel internal wiring shall be as per NEC and NEMA standard.

3.2.9. TB points in terminal block shall be cage clamp type/screw type.

3.2.10. The annunciation system shall be facia window type, driven by the PLC. Audible alarm, Acknowledge, Reset and lamp test facility shall be provided as per ISA sequence – S18.1, M.

3.3. PROCESSORS

3.3.1. The microprocessors shall be 32 bit, and Hot redundant.

3.3.2. Hot redundancy: PLC shall be provided with two processors (Main processing unit and memories) one for normal operation and one as hot standby. In case of failure of working processor, there shall be an appropriate alarm and simultaneously the hot standby processor shall take over the complete operation automatically. This transfer from main processor to standby processor shall be bump less and shall not cause any disturbance whatsoever. In the event of both processors failing, the system shall revert to fail safe mode. It shall be possible to keep any of the processor as master and other as standby.

3.3.3. An authorized forcing facility shall be provided for changing the status of inputs and outputs, timers and flags to facilitate fault finding and other testing requirements.

3.3.4. The standby processor shall be updated automatically in line with the changes made in the working processor.

3.3.5. In the event of any replacement of the processor, synchronization of the replaced processor shall be automatic upon live insertion.

3.3.6. The cycle time for input scanning, execution of logics, overheads and output scan shall not exceed 120 m sec.

3.3.7. The processor & memory shall be loaded up to 50% at normal conditions and maximum up to 60% under worst loading conditions.

3.3.8. The memories shall be field expandable. Memory capacity shall be sufficient for complete system operation and have a capability for at least 20% expansion in future.

3.3.9. Memory shall be non-volatile, preferably EEPROM type. However, in case volatile memory is provided, battery backup shall be provided for a minimum of three months to keep the stored program intact. Battery drain indication shall be provided at least 1 week before the battery gets drained and same shall be annunciated in OWS.

3.4. INPUT / OUTPUT Modules

3.4.1. Input/output card assignments shall be modular i.e. no single card shall be assigned with more than one drive of a particular sub-system. The maximum number of channels per I/O module shall be as follows.

- Analog Input Module: 8
- Analog Output Module: 8
- Binary Input Module: 16
- Binary Output Module: 16
- Analog Input/output combined: 16
- Binary Input/output combined: 32

3.4.2. On line module replacement (hot swappable): All modules cards shall have quick disconnect terminations allowing for card replacement without disconnection of external wiring and without switching off the power supply.

3.4.3. Each I/O shall be protected against the reversal of polarity of the power voltage to I/O.

3.4.4. 10% spare capacity shall be ensured in each card channel assignment. Overall minimum 20% spare channels shall be provided.

3.4.5. Output command to MCC/Switchgear shall be through coupling relays, whose mounting location shall be as per “Data sheet A & B for PLC System”. In case coupling relays are located in PLC Panel, the same shall be in PLC vendor’s scope of supply.

3.4.6. Status feedback from MCC shall be in the form of potential free contact.

3.5. DATA BUS/ I/O BUS

3.5.1. The Data bus connecting PLC and HMI work stations shall be TCP/IP on Ethernet.

3.5.2. The Data bus and I/O bus communication medium shall be twisted pair shield copper conductor for indoor locations and those areas not subjected to induced signals. Repeaters/signal amplifiers shall not be used. Copper conductor cable used shall be Category-5 or better. The communication medium shall be Fibre optic cable in the event any portion of communication cable run is in outdoor or where distances are beyond 500 meters.

3.6. OPERATOR WORK STATION (OWS)

3.6.1. The OWS and Keyboard shall be desktop mounted and shall be used for controlling, monitoring and programming function.

3.6.2. Colour CRT(s) with keyboard and mouse shall be as per Data Sheet-A&B. CRT shall have graphic display facility.

3.6.3. The OWS shall be with Windows based operating system having necessary Engineering/Configuring software.

3.6.4 Specification of OWS

(a) CPU

1. Processor	32 Bit or better
2. Main Memory	Min. 1 GB and expandable to at least 4 GB
3. Hard drive	Min 40 GB
4. Floppy drive	3.5”, 1.44 MB
5. Removable bulk storage	DVD (R/RW)
6. Graphic memory	Min. 16 MB
7. Auto controller	16 bit or better
8. Operating system	Window XP or better
9. Communication ports	2 serial, 1 parallel, 8 Nos. USB, Dual 100 MB Ethernet
10. Expansion slot	3 Nos. or more

(b) Monitor

1. Type	LCD colour monitor (TFT based)
2. Screen diagonal	22” (approx.) flat
3. Display	XGA or better
4. Degree of Protection	IP-30
5. External controls	Brightness, Contrast, Horizontal/vertical amplification & shift
6. Power supply	240 VAC, 50 Hz, 1 phase
7. Version	Industrial grade

(c) Keyboard & Mouse

1. Type	Flat spill membrane or positive depression type ASCII
2. Life expectancy	50 Million cycles per key
3. Version	Industrial
4. Mouse	Optical

3.7. PRINTER

Printers shall be provided as per Data Sheet-A&B.

3.8. COMMUNICATION WITH PLANT DCS/ THIRD PARTY SYSTEM

3.8.1. The PLC system shall be provided with hardwired/serial interface for communication with plant DCS. Hardwired outputs from PLC shall be isolated. Necessary isolators shall be part of PLC.

3.8.2. Serial communication to / from DCS where provided shall be engineered to ensure that signal communication time from / to DCS shall not exceed 1 seconds for control / feedback.

3.8.3. Serial communication to DCS shall be OPC (Data access 2.0), Ethernet based TCP/IP Protocol. Alternatively the serial communication shall be MODBUS protocol on RS 485 network.

3.8.4. Data transmitted from PLC to DCS shall include all information necessary for the DCS graphic displays to monitor and control the process equipment and PLC. Such data may include pertinent analog and digital status information, interlock, alarms and maintenance conditions. Data transmitted from DCS to the PLC shall include necessary signals to provide operator control interface from DCS for the process/ equipment being controlled by PLC.

3.8.5. Bidder to include 'Light interface units, converters, Ethernet switch, accessories etc. at both ends viz PLC and DCS for connectivity to other system. The bidder's terminal point shall be Ethernet port in case of copper medium connection to DCS or LIU in case of Fiber optic medium for connectivity with plant DCS. In case distance between PLC & DCS is greater than 1.8 Km, single mode of optical fiber cable with compatible accessories shall be used. For distance less than 1.8 Km multimode optical fiber ports shall be used.

3.9. POWER SUPPLY Scheme

3.9.1. PLC Panel and I/O Cabinets: PLC system shall be provided with 2x100% UPS fed from Two Nos. redundant 415V, 3-ph feeders, as per the scheme PE-SD-999-145-001, sh-08 of 08. Each UPS shall have 30 minutes back up. Input feeder failure shall be monitored in the PLC system. Necessary redundant power pack and transformers shall be provided (in the PLC panel) to derive the power supply for control desk, PLC panel and input / output cabinets etc

3.9.2. Remote I/O panels: Similar power supply arrangement as for PLC panels shall be provided if it is not possible to extend the power cable form UPS of PLC panels.

3.9.3. Each OWS and associated HMI peripherals shall be provided with a feeder from Either one of the UPS

4. DRAWING/DOCUMENT AND DATA TO BE FURNISHED AFTER AWARD OF THE CONTRACT:

4.1. For Approval:

- PLC system configuration drawing along with functional write-up.
- Input/output signal list.
- BOM of PLC
- List of PLC controlled devices
- Control panel/control desk GA drawings.
- Control desk/panel component layout drawing.
- Control panel/control desk Foundation detail and cutout drawings.

- Power distribution scheme.
- Block logic diagrams/ Ladder diagram mimic.
- Annunciation list.
- PLC control room layout drawing.
- List of soft signal exchange with Plant DCS.
- List of mandatory spares.
- UPS load calculation details.
- Quality plan
- FAT
- Data Sheet-C
- CRT display
- Power supply scheme for PLC system, HMI & peripherals, Remote I/O etc.

4.2. For Information:

- Cable schedule and cable interconnection drawing(in BHEL approved format)
  - Between Field and PLC
  - Between Field and MCC
  - Between MCC and PLC
- Electronic earthing requirements.
- Panel Heat dissipation data
- Product/component catalogues.
- Operation & Maintenance Manual on CDs.
- Softcopy of Final/As-built drawings on CDs.
- Calculation for Processor, Memory & Data bus loading

The above list is the minimum requirements. Additional documents/calculations required shall be finalized during contract stage.

5. DRAWINGS AND DOCUMENTS TO BE SUBMITTED ALONG WITH THE BID

- Proposed PLC system configuration drawing with write-up
- Product catalogues and specifications for PLC as well as HMI application.
- Proposed power supply schemes for PLC system, peripherals, and Remote I/O panels.

6. TESTING AND INSPECTION

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

6.2. BHEL's standard Quality Plan for PLC 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.

6.3. The complete PLC system, including all instrument and devices shall be subjected to standard factory tests (i.e. Type Tests and Routine Tests) as per relevant IS, NEMA, IEEE, IEC.

6.4. Factory Acceptance Test-FAT (Functional Tests) shall be performed prior to shipment and Owner/Purchaser shall be notified 15 days before the schedules dates of the test.

6.5. The certificates for following type tests, as per IEC Standard, shall be submitted: -

- Surge protection test as per IEC-225-4
- Dry heat test as per IEC-68-2-2
- Damp Heat test as per IEC-68-2-3
- Vibration Heat test as per IEC-68-2-6
- Electrostatic discharge test as per IEC-801-2 or equivalent
- Radio frequency Immunity test as per IEC-801-6 or equivalent
- Electromagnetic Immunity test as per IEC-801-3 or equivalent

7. SPARES AND CONSUMABLES

7.1. 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.

7.2. Mandatory Spares

The bidder shall offer along with 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.

7.3. 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 along with unit rate against each item to enable BHEL/BHEL's Customer to place a separate order later, if required.

7.4. Special Tools & Tackles

The bidder shall supply all Special Tools & Tackles 'as required' during Start-up and further maintenance of the system, as part of the main equipment supply.

7.5. Spares, Service support

Bidder shall provide availability of spares and service support for minimum 15 years after guarantee period.

8. MARKING AND PACKING

8.1. Marking:

A stainless steel name-plate shall be permanently fixed on each equipment giving its Tag/serial Number and salient technical specification.

8.2. Packing:

All equipment/materials shall be suitably packed and protected for the entire period of dispatch, storage and erection against impact, abrasion, corrosion, incidental damage due 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.

9. PERFORMANCE AND GUARANTEE

The PLC system shall be guaranteed to meet the performance requirement as specified and also for trouble-free continuous operation for 12 months from the date of commissioning or 18 months from the date of delivery at site whichever is later unless specified otherwise in Vol-IIB Section - B or Section - C.

10. APPLICABLE DATA SHEET FORMS

This document shall be read with the following data sheet forms :

- Data Sheet A & B for PLC system - PE-DC-999-145-I036-1
- Data Sheet C for PLC system - PE-DC-999-145-I036-2

PLC DATA SHEET

FORM NO. PEM-6666-0

	DATA SHEET FOR PLC SYSTEM FOR AIR CONDITIONING & VENTILATION SYSTEM	SPECIFICATION NO.: PE-TS-411-
		VOLUME II B
		SECTION D
		REV. NO. 00 DATE: 19.03.2015
		SHEET 1 OF 2

Data Sheet No.: PES-145-36-DS1-0

Data Sheet A&B

	DATA SHEET – A FOR PLC SYSTEM **(TO BE FILLED BY PURCHASER)**		DATA SHEET – B FOR PLC SYSTEM **(TO BE FILLED BY BIDDER)**
GENERAL	PROJECT	4X270 MW BHADRADRI TPS	
	SERVICE	AIR CONDITIONING & VENTILATION SYSTEM	
	QUANTITY	☐ UNITISED ■ COMMON	
	LOCATION	■ INDOOR ☐ OUTDOOR ■ AC ☐ NON-AC*	
PLC EQUIPMENT	MAKE / MODEL NO.	BIDDER TO INDICATE	
	PROCESSOR	REDUNDANT WITH HOT STANDBY	
	DATA BUS (HMI)	☐ COPPER WIRE ☐ FIBRE OPTIC	
	DATA BUS (I/O - CPU)	☐ COPPER WIRE ☐ FIBRE OPTIC	
	DATA BUS (REMOTE I/O - CPU)	☐ COPPER WIRE ☐ FIBRE OPTIC	
	FIELD CONTACTS INTERROGATION VOLTAGE	■ 24 V DC ☐ 48 V DC ☐ 110 V AC	
	LOCATION OF COUPLING RELAYS	■ MCC ☐ PLC PANEL	
	DESKTOP OWS QUANTITY	☐ ONE ☐ TWO ☐ _____ ■ DESKTOP VERSION ☐ SERVER VERSION ☐ WORK STATION VERSION REQUIREMENT OF OWS IN CCR ☐ YES ☐ NO QUANTITY_____	OWS, EWS and LVS shall be as per PLC Configuration diagram attached elsewhere in the specification.
	DESKTOP MONITOR TYPE	☐ 19" ■ 24" TFT/CRT MONITOR ☐ GIU ☐ OTHERS	
	PRINTER	INKJET ☐ A3___NOS ☐ A4___NOS LASER B/W ☐ A3___NOS ☐ A4___NOS COLOR INKJET ☐ A3 __NOS ☐ A4___NOS COLOR LASER ■ A3_1_NOS ☐ A4___NOS	
	PROGRAMMING / CONFIGURATION FACILITY	A) ☐ HAND HELD ☐ LAPTOP B) ENGINEERING SOFTWARE ☐ ONE OWS ☐ ALL OWS ☐ LAPTOP	OWS, EWS and LVS shall be as per PLC Configuration diagram attached elsewhere in the specification.
	SAFETY STANDARD	☐ SIL-3 ☐ SIL-2 ■ NIL	
	COMPUTER FURNITURE	BOQ ■ YES ☐ NO INDUSTRIAL GRADE ■ YES ☐ NO	
SPARE LIST	SPARE LIST	☐ START UP & COMMISSIONING ■ MANDATORY SPARE ☐ RECOMMENDED	
	SPARE LIST ATTACHED	■ YES ☐ NO	
REDUNDANCY	CPU	■ YES ☐ NO	
	POWER SUPPLY	■ YES ☐ NO	
	COMMUNICATION	■ YES ☐ NO	
	I/O CARD	☐ YES ☐ NO	
	OTHER ELECTRONICS	☐ YES ☐ NO	**As per vendor practice**

BHEL	**DATA SHEET FOR PLC SYSTEM FOR AIR CONDITIONING & VENTILATION SYSTEM**	SPECIFICATION NO.: PE-TS-411- VOLUME II B SECTION D REV. NO. 00 DATE: 19.03.2015 SHEET 2 OF 2

Data Sheet No.: PES-145-36-DS1-0

Data Sheet A&B

		DATA SHEET – A FOR PLC SYSTEM **(TO BE FILLED BY PURCHASER)**	DATA SHEET – B FOR PLC SYSTEM **(TO BE FILLED BY BIDDER)**
No. of CHANNELS PER CARD	ANALOG INPUT	■ 8 NOs ☐ 16 NOs	
	ANALOG OUTPUT	■ 8 NOs ☐ 16 NOs	
	BINARY INPUT	■ 16 NOs ☐ 32 NOs	
	BINARY OUTPUT	■ 16 NOs ☐ 32 NOs	
	RTD**	4 NOs	
	THERMOCOUPLE**	8 NOs	
	ELECTRONIC CARD ISOLATION	☐ GALVANIC ☐ OPTICAL ☐ OTHER	
PANEL	QUANTITY	BIDDER TO INDICATE	
	CLASS OF PROTECTION(Refer Location of PLC)	■ IP-42	
	REMOTE I/O PANEL	■ YES ☐ NO AC REQUIREMENT ■ YES ☐ NO	
	COLOUR#	RAL 7032	
	BACK-UP DESK	☐ YES ■ NO	
	MIMIC	☐ YES ■ NO IF YES,THEN ☐ PANEL MOUNTED GUI ☐ ACRYLIC	
	CONTROL HARDWARE	☐ PB ☐ INDICATORS ■ FACIAS 25 Nos. ☐ OTHERS	
	CONFORMAL COATING	☐ YES ■ NO	
COMMUNICATION WITH OTHER SYSTEM	HARDWIRED	■ YES ☐ NO	
	PURPOSE	☐ CONTROL ■ MONITORING	
	MEDIUM	☐ UTP ■ FIBRE OPTIC ☐ OTHERS	
	TIME SYNCRONIZATION SIGNAL FORMAT	☐ PULSE ☐ RS-485 ■ IRIG-B ☐ NTP	
	SOFTLINK	☐ MODBUS ■ OPC IF MODBUS THEN ☐ RS-485 ☐ ETHERNET	
	SERIAL LINK	COMMUNICATION PORT TYPE _____	
POWER SUPPLY INPUT FEEDER	PLC PANEL	BIDDER TO INDICATE LOAD DATA	
	REMOTE I/O PANEL	BIDDER TO INDICATE LOAD DATA	
POWER SUPPLY	SOURCE $$	■ UPS (INDUSTRIAL GRADE) ☐ 24V DC CHARGER	
	BATTERY TYPE	☐ Ni-Cd ■ LEAD ACID ☐ OTHERS	
	BACK-UP TIME	☐ 30 MINS ■ 60 MINS ☐ OTHERS	
	BATTERY CONFIGURATION	☐ 1X100% ■ 2X100% ☐ 2X50%	As per MAX philosophy
CUSTOMER TRAINING	TRAINING	■ REQUIRED ☐ NOT REQUIRED	
	NO OF DAYS	3 DAYS	
	LOCATION	☐ VENDOR'S WORK ☐ PROJECT SITE ☐ OTHERS	

*IF THE LOCATION IS INDOOR,KINDLY SPECIFY IF PLC PANEL IS PLACED IN AC OR NON-AC ENVIRONMENT.
**SHALL NOT BE APPLICABLE IF TEMPERATURE TRANSMITTERS ARE ENVISAGED.
PROJECT SPECIFICPAINT SHADES, IF APPLICABLE TO BE USED.
$$ CHECK & REPLACE WITH MAIN UPS SLD IF POWER SUPPLY IS NOT APPROVED BY CUSTOMER.

BHEL	**DATA SHEET FOR PLC SYSTEM FOR AIR CONDITIONING & VENTILATION SYSTEM**	SPECIFICATION NO.: VOLUME II B SECTION D REV. NO. 03 DATE: 21.03.2014 SHEET 1 OF 2

Data Sheet No.: **PES-145-36-DS2-0**

DATA SHEET – C

GENERAL	PROJECT	
	SERVICE	
	QUANTITY	
	LOCATION	
PLC EQUIPMENT	MAKE / MODEL NO.	
	PROCESSOR	
	DATA BUS (HMI)	
	DATA BUS (I/O - CPU)	
	DATA BUS (REMOTE I/O - CPU)	
	FIELD CONTACTS INTERROGATION VOLTAGE	
	LOCATION OF COUPLING RELAYS	
	DESKTOP OWS QUANTITY	
	DESKTOP MONITOR TYPE	
	PRINTER	
	PROGRAMMING / CONFIGURATION FACILITY	
	SAFETY STANDARD	
	COMPUTER FURNITURE	
SPARE LIST	SPARE LIST	
	SPARE LIST ATTACHED	
REDUNDANCY	CPU	
	POWER SUPPLY	
	COMMUNICATION	
	I/O CARD	
	OTHER ELECTRONICS	
No. of CHANNELS PER CARD	ANALOG INPUT	
	ANALOG OUTPUT	
	BINARY INPUT	
	BINARY OUTPUT	
	RTD**	
	THERMOCOUPLE**	
	ELECTRONIC CARD ISOLATION	
PANEL	QUANTITY	
	CLASS OF PROTECTION(Refer Location of PLC)	
	REMOTE I/O PANEL	
	COLOUR#	
	BACK-UP DESK	
	MIMIC	

BHEL	**DATA SHEET FOR PLC SYSTEM FOR AIR CONDITIONING & VENTILATION SYSTEM**	SPECIFICATION NO.: VOLUME II B SECTION D REV. NO. 03 DATE: 21.03.2014 SHEET 2 OF 2

Data Sheet No.: **PES-145-36-DS2-0**

DATA SHEET – C

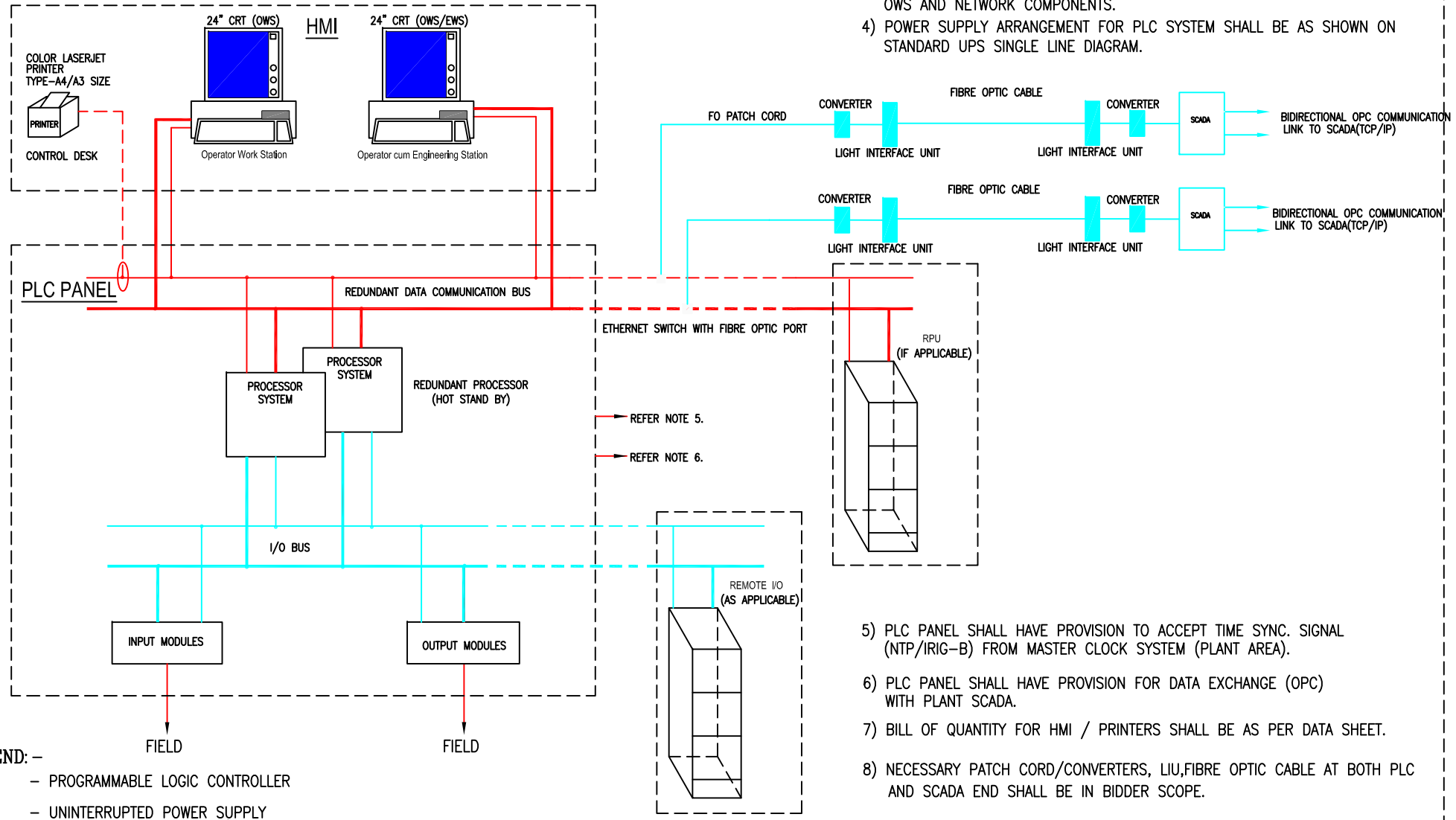
	CONTROL HARDWARE	
	CONFORMAL COATING	
COMMUNICATION WITH OTHER SYSTEM	HARDWIRED	
	PURPOSE	
	MEDIUM	
	TIME SYNCRONIZATION SIGNAL FORMAT	
	SOFTLINK	
	SERIAL LINK	
POWER SUPPLY INPUT FEEDER	PLC PANEL	
	REMOTE I/O PANEL	
POWER SUPPLY	SOURCE $$	
	BATTERY TYPE	
	BACK-UP TIME	
	BATTERY CONFIGURATION	
CUSTOMER TRAINING	TRAINING	
	NO OF DAYS	
	LOCATION	

*IF THE LOCATION IS INDOOR,KINDLY SPECIFY IF PLC PANEL IS PLACED IN AC OR NON-AC ENVIRONMENT.
**SHALL NOT BE APPLICABLE IF TEMPERATURE TRANSMITTERS ARE ENVISAGED.
PROJECT SPECIFICPAINT SHADES, IF APPLICABLE TO BE USED.
$$ CHECK & REPLACE WITH MAIN UPS SLD IF POWER SUPPLY IS NOT APPROVED BY CUSTOMER.

PLC CONFIGURATION

NOTES:

1) TABLE TOP OWS/EWS SHALL BE 24" OR AVAILABLE INDUSTRY STANDARD.
2) PLC SYSTEM SHALL HAVE REDUNDANCY IN PROCESSOR,POWER SUPPLY AND COMMUNICATION SYSTEM.
3) UPS POWER SUPPLY SHALL BE PROVIDED BY BIDDER FOR PLC PANEL(S), OWS AND NETWORK COMPONENTS.
4) POWER SUPPLY ARRANGEMENT FOR PLC SYSTEM SHALL BE AS SHOWN ON STANDARD UPS SINGLE LINE DIAGRAM.



5) PLC PANEL SHALL HAVE PROVISION TO ACCEPT TIME SYNC. SIGNAL (NTP/IRIG-B) FROM MASTER CLOCK SYSTEM (PLANT AREA).
6) PLC PANEL SHALL HAVE PROVISION FOR DATA EXCHANGE (OPC) WITH PLANT SCADA.
7) BILL OF QUANTITY FOR HMI / PRINTERS SHALL BE AS PER DATA SHEET.
8) NECESSARY PATCH CORD/CONVERTERS, LIU,FIBRE OPTIC CABLE AT BOTH PLC AND SCADA END SHALL BE IN BIDDER SCOPE.

LEGEND: –

PLC – PROGRAMMABLE LOGIC CONTROLLER
UPS – UNINTERRUPTED POWER SUPPLY
OWS/EWS – OPERATOR WORK STATION/ ENGINEERING WORK STATION
HMI – HUMAN MACHINE INTERFACE
NTP – NETWORK TIME PROTOCOL
OPC – OLE PROCESS CONTROL
MCCB – MOULDED CASE CIRCUIT BREAKER
MCB – MINIATURE CIRCUIT BREAKER
RPU – REMOTE PROCESSING UNIT

PLC SYSTEM CONFIGURATION 2X60MW VYASI HEP HVAC SYSTEM	DRG. NO.	PES-145-36A	
	REV. No.	00	DATE 29.05.2015
	SHEET	01 OF 01	

Dwg. no. PE-TS-410-145-I881A

PLC Quality Plan

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STANDARD QUALITY PLAN
FOR
PROGRAMMABLE LOGIC CONTROLLER

QUALITY PLAN NO.:	**PE-QP-999-145-I036___**
VOLUME	IIB
SECTION	D
REV. NO.	01 DATE: 24.08.2007
SHEET	1 OF 8

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

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

PEM :: C&I

STANDARD QUALITY PLAN
FOR
PROGRAMMABLE LOGIC CONTROLLER

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

VOLUME IIB

SECTION D

REV. NO. 01 DATE: 24.08.2007

SHEET 2 OF 8

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

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

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1 - BHEL 2 - Vendor 3 - Sub-vendor

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

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

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1 - BHEL 2 - Vendor 3 - Sub-vendor

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

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

FACTORY ACCEPTANCE TEST (FAT) PROCEDURE

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

a) Technical Specification of PLC.

b) PLC System Configuration

c) General Assembly Drawings.

d) Panel Wiring Diagrams.

e) Bill of Quantity for PLC System.

f) Logic Diagram.

g) HMI Schematics.

h) Input / Output List.

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

APPLICABLE TEST PROCEDURE:

1. Input/Output Functional Verification.

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

2. Processor Verification

PLC Configuration drawing to be referred for ascertaining

i) Redundancy

ii) Type (Hot or Cold)

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

3. Power Supply Module Verification

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

4. Communication System Verification

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

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

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

5. Diagnostic Verification

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

6. Control Panel /Desk Verification

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

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

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

7. Software Verification

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

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

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

8. Burn in Elevated Temperature test

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

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

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

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

Actuator Data Sheet

BHEL	**SPECIFICATION FOR MOTORISED VALVE ACTUATOR**	SPECIFICATION NO.: PE-SS-999-145-I007 VOLUME II B SECTION D REV. NO. 03 DATE: 20.06.13 SHEET 1 OF 3

Data Sheet A & B

	DATA SHEET-A (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
GENERAL*	* PROJECT	
	OFFER REFERENCE	
	* TAG NO. SERVICE	
	* DUTY	☐ ON / OFF ☐ INCHING
	* LINE SIZE (inlet/outlet): MATERIAL	
	* VALVE TYPE	☐ GLOBE ☐ GATE ☐ REG. GLOBE ☐ BUTTERFLY
	* OPENING / CLOSING TIME	
	* WORKING PRESSURE	
	AMBIENT CONDITION	SHALL BE SUITABLE FOR CONTINUOUS OPERATION UNDER AN AMBIENT TEMP. OF 0-55 DEG C AND RELATIVE HUMIDITY OF 0-95%
	VALVE SEAT TEST PRESS	BIDDER TO SPECIFY
	REQUIRED VALVE TORQUE	BIDDER TO SPECIFY
	ACTUATOR RATED TORQUE	BIDDER TO SPECIFY
CONSTRUCTION AND SIZING	CONSTRUCTION	TOTALLY ENCLOSED, WEATHER PROOF, IP:65
	MECHANICAL POSITION INDICATOR	TO BE PROVIDED FOR 0-100% TRAVEL
	BEARINGS	DOUBLE SHIELDED, GREASE LUBRICATED ANTI-FRICTION.
	GEAR TRAIN FOR LIMIT SWITCH/TORQUE SWITCH OPERATION	METAL (NOT FIBRE GEARS). SELF-LOCKING TO PREVENT DRIFT UNDER TORQUE SWITCH SPRING PRESSURE WHEN MOTOR IS DE-ENERGIZED.
	SIZING	OPEN/CLOSE AT RATED SPEED AGAINST DESIGNED DIFFERENTIAL PRESSURE AT 85% OF RATED VOLTAGE. FOR ISOLATING SERVICE THREE SUCCESSIVE OPEN-CLOSE OPERATIONS OR 15 MINS. WHICHEVER IS HIGHER. **FOR INCHING SERVICE - 150 STARTS/HR MINIMUM & FOR REGULATING SERVICE - 600 STARTS/HR MINIMUM.**
HANDWHEEL	* REQUIRED	■ YES ☐ NO
	* ORIENTATION	☐ TOP MOUNTED ☐ SIDE MOUNTED
	*TO DISENGAGE AUTOMATICALLY DURING MOTOR OPERATION.	
ELECTRIC ACTUATOR	ACTUATOR MAKE/MODEL	BIDDER TO SPECIFY
	MOTOR MAKE / MODEL / TYPE / RATING (KW)	BIDDER TO SPECIFY
	@ MOTOR TYPE	SQUIRREL CAGE INDUCTION MOTOR, STARTING CURRENT LIMITED TO SIX TIMES THE RATED CURRENT-INCLUSIVE OF **I.S.** TOLERANCE
	ACTUATOR APPLICABLE WIRING DIAGRAM	■ ENCLOSED (BIDDER TO CONFIRM) A: ☐ DRG. NO. 3-V-MISC-24227 R00 B: ☐ DRG. NO. 3-V-MISC-24550 R00 C: ☐ DRG. NO. 3-V-MISC-24283 R00 D: ☐ DRG. NO. 4-V-MISC-90271 R11 E: ☐ For Thyristor based Integral starter, Bidder/Vendor to furnish wiring diagram
	COLOUR SHADE	☐ BLUE (RAL 5012) ☐ …….
	PAINT TYPE **(## Refer Notes)**	☐ ENAMEL ☐ EPOXY ☐ …….
	SHAFT RPM	BIDDER TO SPECIFY
	OLR SET VALUE	BIDDER TO SPECIFY
	@ STARTING / FULL LOAD CURRENT	BIDDER TO SPECIFY
	NO. OF REV FOR FULL TRAVEL	BIDDER TO SPECIFY
	@ PWR SUPP TO MTR / STARTER	415V, 3PH, AC
	@ CONTROL VOLTAGE REQUIREMENT	TO BE DERIVED FROM THE POWER SUPPLY TO THE STARTER ☐ 230 V ☐ 110 V

BHEL	**SPECIFICATION FOR MOTORISED VALVE ACTUATOR**	SPECIFICATION NO.: PE-SS-999-145-I007 VOLUME II B SECTION D REV. NO. 03 DATE: 20.06.13 SHEET 2 OF 3

Data Sheet A & B

	DATA SHEET-A (TO BE FILLED BY PURCHASER)		DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
	@ ENCLOSURE CLASS OF MOTOR	☐ IP 67 ☐ FLAME PROOF	
	@ INSULATION CLASS	CLASS-F TEMP. RISE LIMITED TO CLASS-B	
	@ WINDING TEMP PROTECTION	■ THERMOSTAT (3 Nos.,1 IN EACH PHASE) ☐ ----------	
	SINGLE PHASE / WRONG PHASE SEQUENCE PROTECTION	REQUIRED	
INTEGRAL STARTER	INTEGRAL STARTER	☐ REQUIRED ☐ NOT REQUIRED	
	TYPE OF SWITCHING DEVICE	☐ CONTACTORS ☐ THYRISTORS	
	TYPE	☐ CONVENTIONAL ☐ SMART (NON-INTRUSIVE)	
	IF SMART		
	a) SERIAL LINK INTERFACE	☐ INTEGRAL ☐ FIELD MOUNTED	
	b) SERIAL LINK PROTOCOL	☐ FOUNDATION FIELD-BUS ☐ PROFI-BUS ☐ DEVICE NET ☐……	
	c) SERIAL LINK MEDIA	☐ TWISTED PAIR Cu-CBL ☐ CO-AXIAL Cu-CBL ☐ OFC	
	d) HAND HELD PROGRAMMER	☐ REQUIRED ☐ NOT REQUIRED	
	e) TYPE OF HAND HELD PROGRAMMER	☐ BLUETOOTH ☐ INFRARED ☐.....	
	f) MASTER STATION	☐ REQUIRED ☐ NOT REQUIRED	
	g) MASTER STN INTRFACE WITH DCS	☐ MODBUS ☐ TCP/IP	
	h) DETAILS OF SPECIAL CABLE	☐ ENCLOSED ☐ NOT REQUIRED	
	STEP DOWN CONT. TRANSFORMER	☐ REQUIRED	
	OPEN / CLOSE PB	☐ REQUIRED ☐ NOT REQUIRED	
	STOP PB	☐ REQUIRED ☐ NOT REQUIRED	
	INDICATING LAMPS	☐ REQUIRED ☐ NOT REQUIRED	
	LOCAL REMOTE S/S	☐REQUIRED ☐ NOT REQUIRED	
	STATUS CONTACTS FOR MONITORING	☐ REQUIRED ☐ NOT REQUIRED	
	INTEGRAL STARTER DISTURBED SIGNAL	REQUIRED (O/L RELAY OPERATED, CONT./POWER SUPPLY FAILED, S/S IN LOCAL, TORQUE SWITCH OPTD. MID WAY)	
INTERPOSING RELAY/OPTO COUPLER (Applicable for integral Starter)	TYPE OF ISOLATING DEVICE	☐ INTERPOSING RELAY ☐ OPTO COUPLER ☐ EITHER	
	QUANTITY	☐ 2 NOs. ☐ 3 NOs.	
	DRIVING VOLTAGE	■ 20.5 – 24V DC ☐ _____V DC	
	DRIVING CURRENT	■ 125mA MAX ☐ _____mA MAX	
	LOAD RESISTANCE	■ > 192 ohms - <25 k ohms ☐ > _____ohms - < _____ohms	
TORQUE SWITCH (Not Applicable for Smart Actuator) **($$ Refer Notes)**	MFR & MODEL NO.	BIDDER TO SPECIFY	
	OPEN / CLOSE	■1 No. ☐2Nos. / ■1 No. ☐2Nos	
	CONTACT TYPE	2 NO + 2 NC	
	RATING	5A 240V AC AND 0.5A 220V DC	
	CALIBRATED KNOBS(OPEN&CLOSE TS)	REQUIRED FOR SETTING DESIRED TORQUE	
	ACCURACY	+3% OF SET VALUE	
LIMIT SWITCH (Not Applicable for Smart Actuator) **($$ Refer Notes)**	MFR & MODEL NO.	BIDDER TO SPECIFY	
	OPEN : INT : CLOSE	■1 No ☐2 Nos. / 2 Nos. (ADJ.) / ■1 No. ☐2Nos.	
	CONTACT TYPE	2 NO + 2 NC	
	RATING (AC / DC)	5A 240V AC AND 0.5A 220V DC	

BHEL	**SPECIFICATION FOR MOTORISED VALVE ACTUATOR**	SPECIFICATION NO.: PE-SS-999-145-I007 VOLUME II B SECTION D REV. NO. 03 DATE: 20.06.13 SHEET 3 OF 3

Data Sheet A & B

	DATA SHEET-A (TO BE FILLED BY PURCHASER)		DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
POSITION TRANSMITTER	POSITION TRANSMITTER (For inching duty & other specific applications)	☐ REQUIRED ☐ NOT REQUIRED	
	MFR & MODEL NO.	BIDDER TO SPECIFY	
	TYPE	☐ ELECTRONIC (2 WIRE) R/I CONVERTER ☐ ELECTRONIC (2 WIRE) CONTACTLESS	
	SUPPLY	■ 24V DC ☐ ……	
	OUTPUT	■ 4-20mA	
	ACCURACY	± 1% FS	
SPACE HEATER	@SPACE HEATER	REQUIRED	
	@ POWER SUPPLY (NON INTEGRAL)	230V AC,1 PH.,50 Hz	
	@ POWER SUPPLY (INTEGRAL)	BIDDER TO SPECIFY	
	@ RATING		
TERMINAL BOX	ACTUATOR/MOTOR TERMINAL BOX	REQUIRED	
	ENCL CLASS ACTUATOR/MOTOR T.B.	@☐ IP 68 @☐……	
	@ EARTHING TERMINAL	REQUIRED	
	PLUG & SOCKET(9 PIN) (FOR COMMD, LS/TS FEED BACK, PoT)	☐ REQUIRED ☐ NOT REQUIRED☐ ☐ 2 NOS. ☐ ----------	
CABLE GLANDS	@ POWER CABLE GLAND	SIZE:----------	
	@ SPACE HEATER CABLE GLAND	SIZE:----------	
	OTHER CONTROL CABLE GLANDS-1	☐ 1No. for BFV of CW PUMP(Cable size 2Px1.5mm2)	
	OTHER CONTROL CABLE GLANDS-2	QUANTITY & SIZE :----------	
WEIGHT	TOTAL WEIGHT (ACTUATOR + ACCESSORIES)	BIDDER TO SPECIFY	_____ Kg.

NOTES:

1. **SCOPE**: DESIGN, MANUFACTURE, INSPECTION, TESTING AND DELIVERY TO SITE OF ELECTRIC ACTUATOR FOR INCHING OR OPEN / CLOSE DUTY.
2. **CODES & STANDARDS**: DESIGN AND MATERIALS USED SHALL COMPLY WITH THE RELEVANT LATEST NATIONAL AND INTERNATION STANDARD. AS A MINIMUM, THE FOLLOWING STANDARDS SHALL BE COMPLIED WITH:
   IS-9334, IS-2147, IS-2148, IS-325, IS-2959, IS-4691 AND IS-4722
3. TEMPERATURE RISE SHALL BE RESTRICTED TO 70 DEG. C FOR AMBIENT TEMPERATURE OF 50 DEG C.
4. CABLE GLANDS OF DOUBLE COMPRESSION TYPE, BRASS MATERIAL SHALL BE PROVIDED.
5. THE TORQUE SWITCHES SHALL BE PROVIDED WITH MECHANICAL LATCHING DEVICE TO PREVENT OPERATION WHEN UNSEATING FROM THE END POSITIONS. THE LATCHING DEVICE SHALL UNLATCH AS SOON AS THE VALVE LEAVES THE END POSITION. IF SUCH PROVISION IS NOT POSSIBLE, THE TORQUE SWITCHES SHALL BE BYPASSED BY END-POSITION LIMIT SWITCHES WHICH OPENS ON VALVE LEAVING END POSITION.THESE LIMIT SWITCHES ARE ADDITIONAL TO THE NUMBER OF LIMIT SWITCHES SPECIFIED ELSEWHERE.
6. THE MOTOR SHALL OPERATE SATISFACTORILY UNDER THE +/- 10% SUPPLY VOLTAGE VARIATION AT RATED FREQUENCY, -5% TO +3% VARIATION IN FREQUENCY AT RATED SUPPLY VOLTAGE, SIMULTANEOUS VARIATION IN VOLTAGE & FREQUENCY THE SUM OF ABSOLUTE PERCENTAGE NOT EXCEEDING 10%.
7. THE MOTOR SHALL BE SUITABLE FOR DIRECT ON LINE STARTING.

$$ TORQUE SWITCH & LIMIT SWITCH SHALL ACT INDEPENDENT OF EACH OTHER. TANDEM OPERATION IS NOT ACCEPTABLE.

EPOXY PAINT IS RECOMMENDED FOR COASTAL AREAS.

.

	PREPARED BY	CHECKED BY	APPROVED BY	VENDOR COMPANY SEAL
NAME	ANUJ WADHWA	CHETAN MALIK	M.A.MANSOORI	NAME
SIGNATURE				SIGNATURE
DATE	20.06.2013	20.06.2013	20.06.2013	DATE

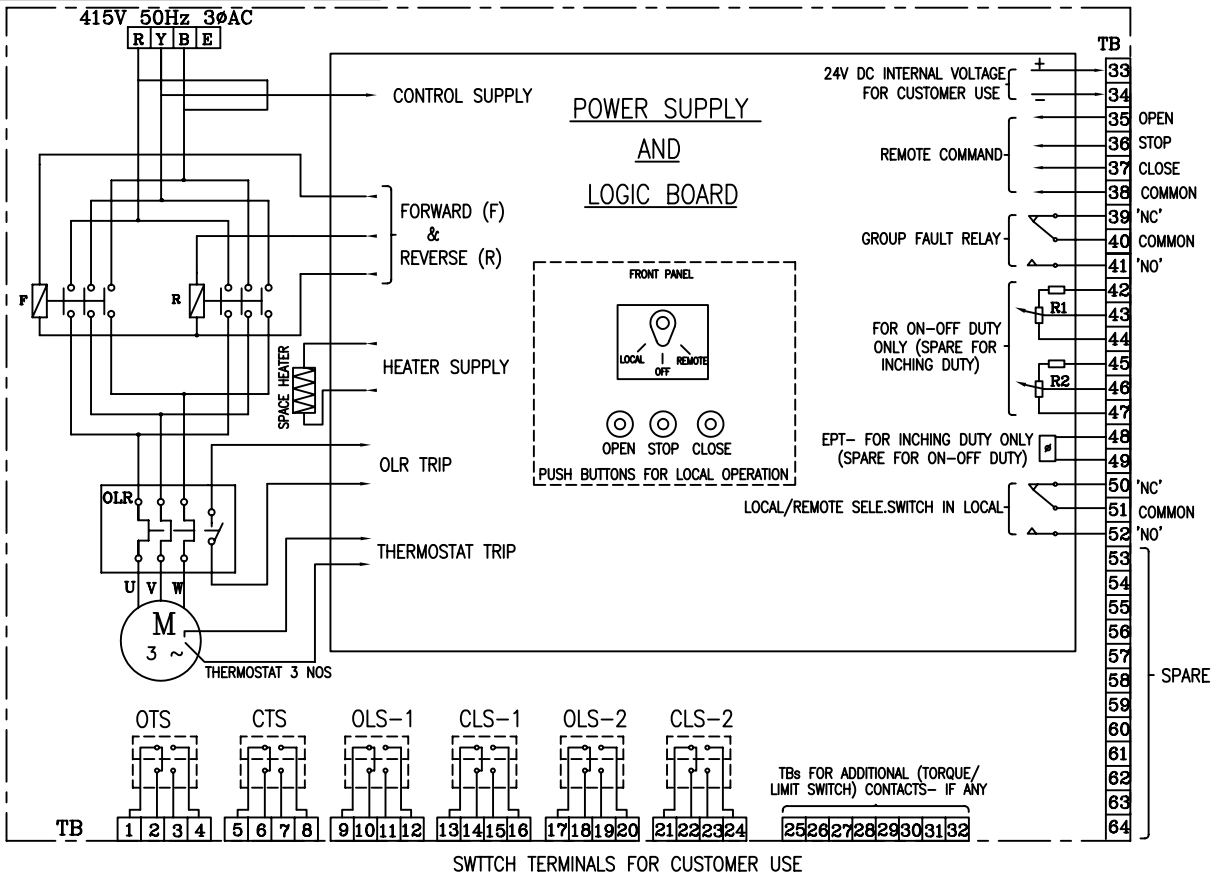
NOTES* = TO BE FILLED BY MPL (LEAD AGENCY). @= TO BE FILLED BY ES

Data Sheet A & B

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

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

DRAWING NO. 3-V-MISC-24227



CONTACT DEVELOPMENT DIAGRAM

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

INDICATES CONTACT CLOSED

INDICATES CONTACT OPEN

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

SETTING PROCEDURE OF POSITION LIMIT AND TORQUE SWITCH

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

\# - CLS NOT TO BE CONNECTED IN TRIP CIRCUIT

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

NOTE:-

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

REV	DATE	ALTERED
		CHD & APPD

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

BHARAT HEAVY ELECTRICALS LTD.,
UNIT: HIGH PRESSURE BOILER PLANT.
TIRUCHIRAPALLI-620014.
365-121

	NAME	SIGN	DATE	NO.OF VAR.
DRN	N.P.ESWAR	N.P	07.10.04	
CHD	D.DINAKARAN	D.D	07.10.04	
APPD	K.ARUNACHALAM	K.A	07.10.04	

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

TITLE: WIRING DIAGRAM (TERMINAL PLAN) FOR ACTUATOR WITH INTEGRAL STARTER

CARD CODE: U 01

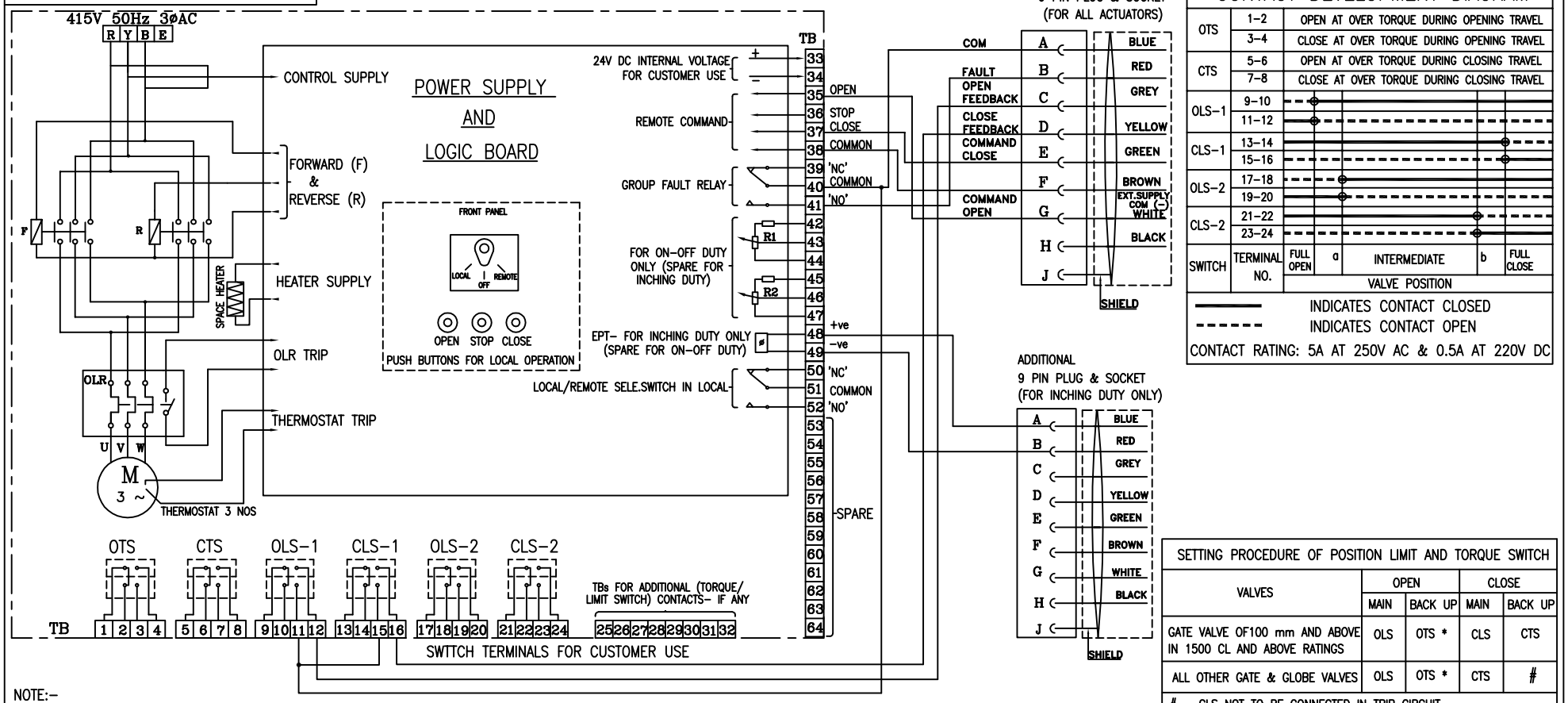
DRAWING NO.: 3-V-MISC-24227

REV: 0

Size A3

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

DRAWING NO. 3-V-MISC-24550



CONTACT DEVELOPMENT DIAGRAM

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

SWITCH TERMINAL NO. | FULL OPEN | a | INTERMEDIATE | b | FULL CLOSE | VALVE POSITION

INDICATES CONTACT CLOSED

INDICATES CONTACT OPEN

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

SETTING PROCEDURE OF POSITION LIMIT AND TORQUE SWITCH

VALVES	OPEN		CLOSE	
	MAIN	BACK UP	MAIN	BACK UP
GATE VALVE OF100 mm AND ABOVE IN 1500 CL AND ABOVE RATINGS	OLS	OTS *	CLS	CTS
ALL OTHER GATE & GLOBE VALVES	OLS	OTS *	CTS	#

\# - CLS NOT TO BE CONNECTED IN TRIP CIRCUIT

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

NOTE:-

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

REV	DATE	ALTERED
		CHD & APPD

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT: ELECTRICAL VALVE ACTUATORS (AC) WITH INTEGRAL STARTERS AND PLUG & SOCKET (DRAWN FOR INTERMEDIATE POSITION OF VALVES)

BHARAT HEAVY ELECTRICALS LTD.,
UNIT: HIGH PRESSURE BOILER PLANT.
TIRUCHIRAPALLI-620014.
365-121

	NAME	SIGN	DATE	NO.OF VAR.
DRN	M.VIJAYABHARATHI	N.P	28.02.07	-
CHD	D.DINAKARAN	D.D	28.02.07	
APPD	K.ARUNACHALAM	K.A	28.02.07	

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

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

CARD CODE: U 01

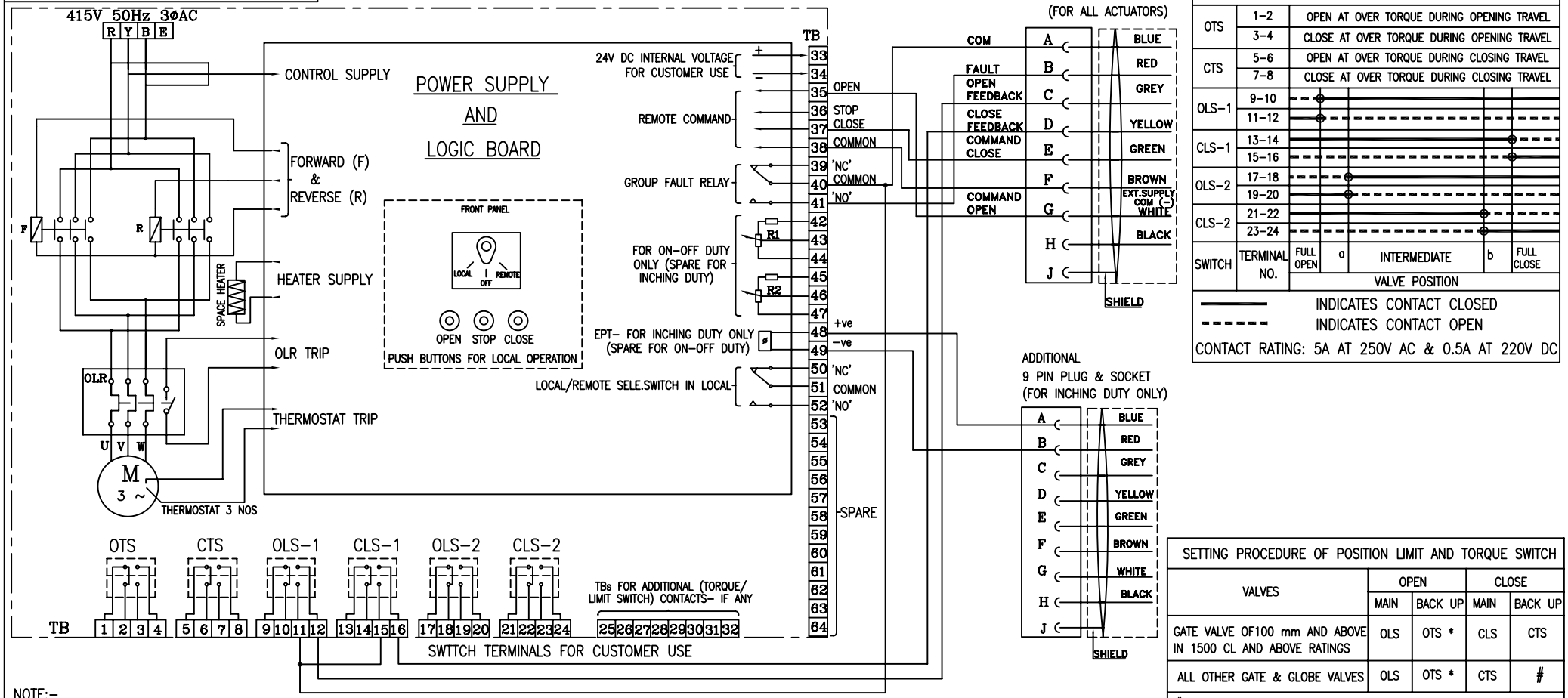
DRAWING NO.: 3-V-MISC-24550

REV: 0

Size A3

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

DRAWING NO. 3-V-MISC-24283



CONTACT DEVELOPMENT DIAGRAM

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

SWITCH TERMINAL NO. — FULL OPEN | a | INTERMEDIATE | b | FULL CLOSE — VALVE POSITION

INDICATES CONTACT CLOSED

INDICATES CONTACT OPEN

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

SETTING PROCEDURE OF POSITION LIMIT AND TORQUE SWITCH

VALVES	OPEN		CLOSE	
	MAIN	BACK UP	MAIN	BACK UP
GATE VALVE OF100 mm AND ABOVE IN 1500 CL AND ABOVE RATINGS	OLS	OTS *	CLS	CTS
ALL OTHER GATE & GLOBE VALVES	OLS	OTS *	CTS	#

\# - CLS NOT TO BE CONNECTED IN TRIP CIRCUIT

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

NOTE:-

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

REV	DATE	ALTERED
		CHD & APPD

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

BHARAT HEAVY ELECTRICALS LTD.,
UNIT: HIGH PRESSURE BOILER PLANT.
TIRUCHIRAPALLI-620014.
365-121

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

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

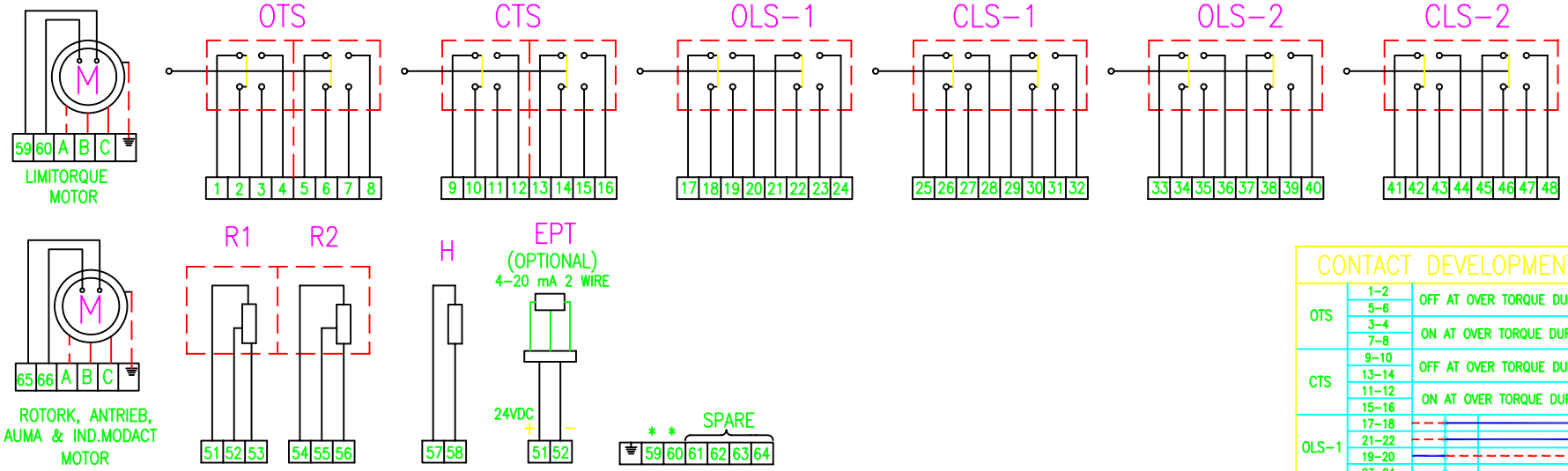
TITLE: WIRING DIAGRAM (TERMINAL PLAN) FOR ACTUATOR WITH INTEGRAL STARTER WITH PLUG & SOCKET FOR NTPC PROJECTS

CARD CODE: U 01

DRAWING NO.: 3-V-MISC-24283

REV: 0

Size A3



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

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

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

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

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

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

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

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

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

OTS, CTS – TWO INDEPENDENT SWITCHS IN ANTRIEB & LIMITORQUE

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

R1–R2– POTENTIOMETER 2 x 100 OHMS

H – SPACE HEATER 1ø 240V AC SUPPLY

M – MOTOR 3ø 415V 50 Hz AC SUPPLY

SETTING PROCEDURE OF POSITION LIMIT AND TORQUE SWITCH

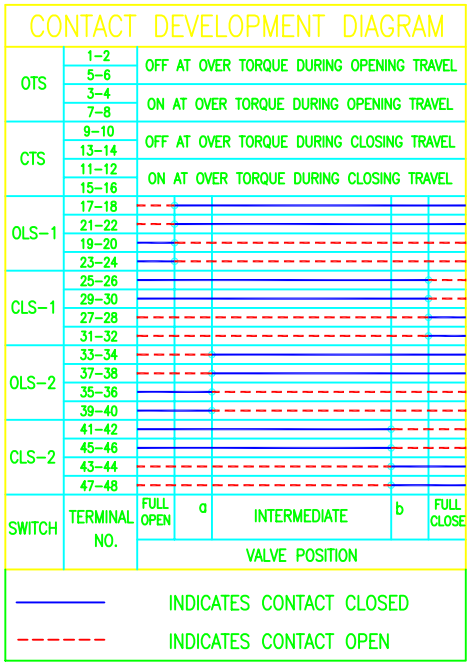
VALVES	OPEN		CLOSE	
	MAIN	BACK UP	MAIN	BACK UP
GATE VALVE OF 100 mm AND ABOVE IN 1500 CL AND ABOVE RATINGS	OLS	OTS	CLS	CTS
ALL OTHER GATE & GLOBE VALVES	OLS	OTS	CTS	@

@ – CLS NOT TO BE CONNECTED IN TRIP CIRCUIT

NOTE:

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

CONTACT DEVELOPMENT DIAGRAM



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

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

365-139

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

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

TITLE

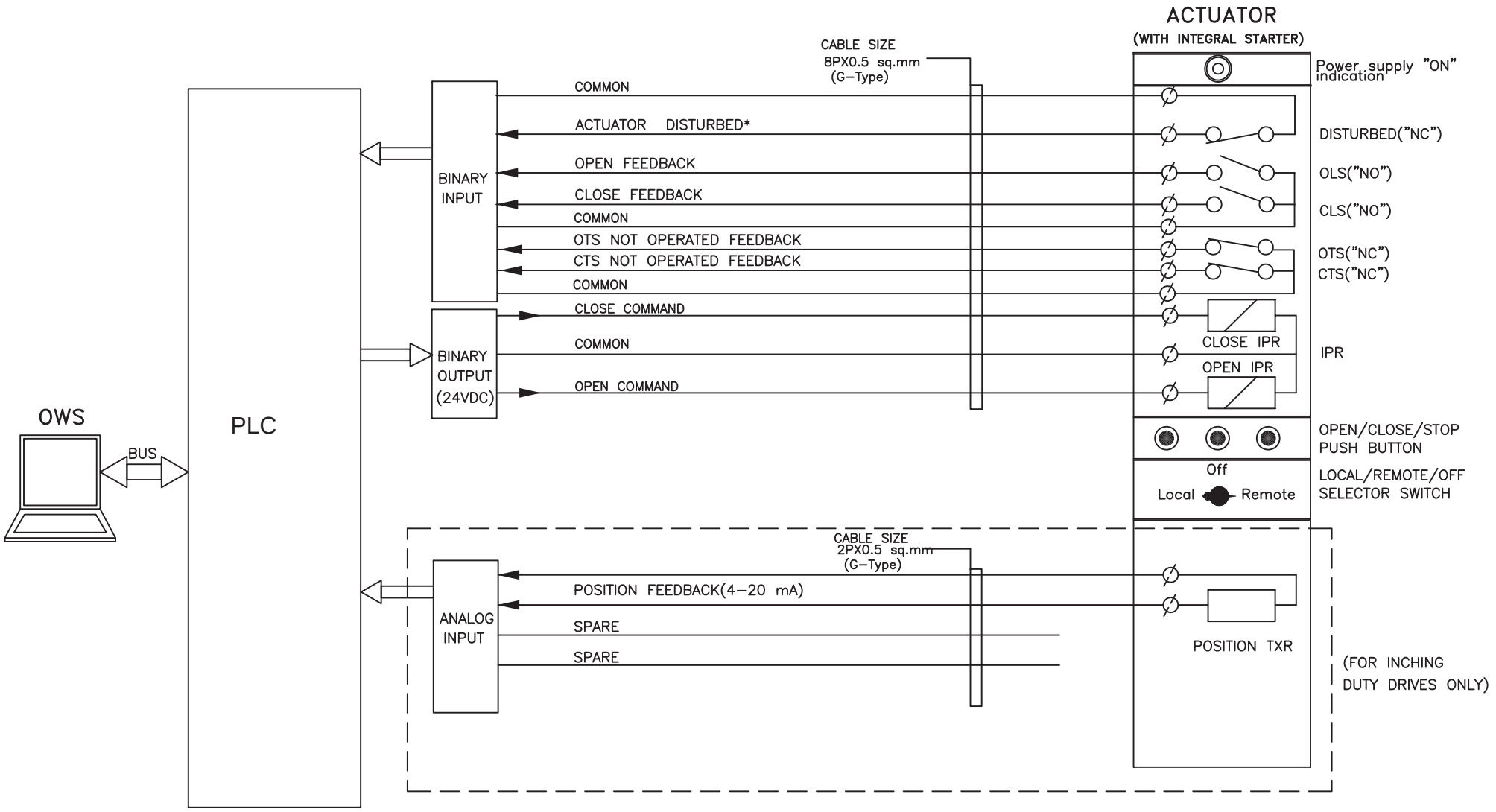
INTERNAL WIRING DIAGRAM
FOR
ELECTRICAL VALVE ACTUATORS (AC)
(DRAWN FOR INTERMEDIATE POSITION OF VALVES)

DRAWING No. 4–V–MISC–90271 REV 11

RETRACED WITH REVISION 11

Drive Control Philosophy

PLC INTERFACE FOR BIDIRECTIONAL DRIVE(WITH INTEGRAL STARTER)

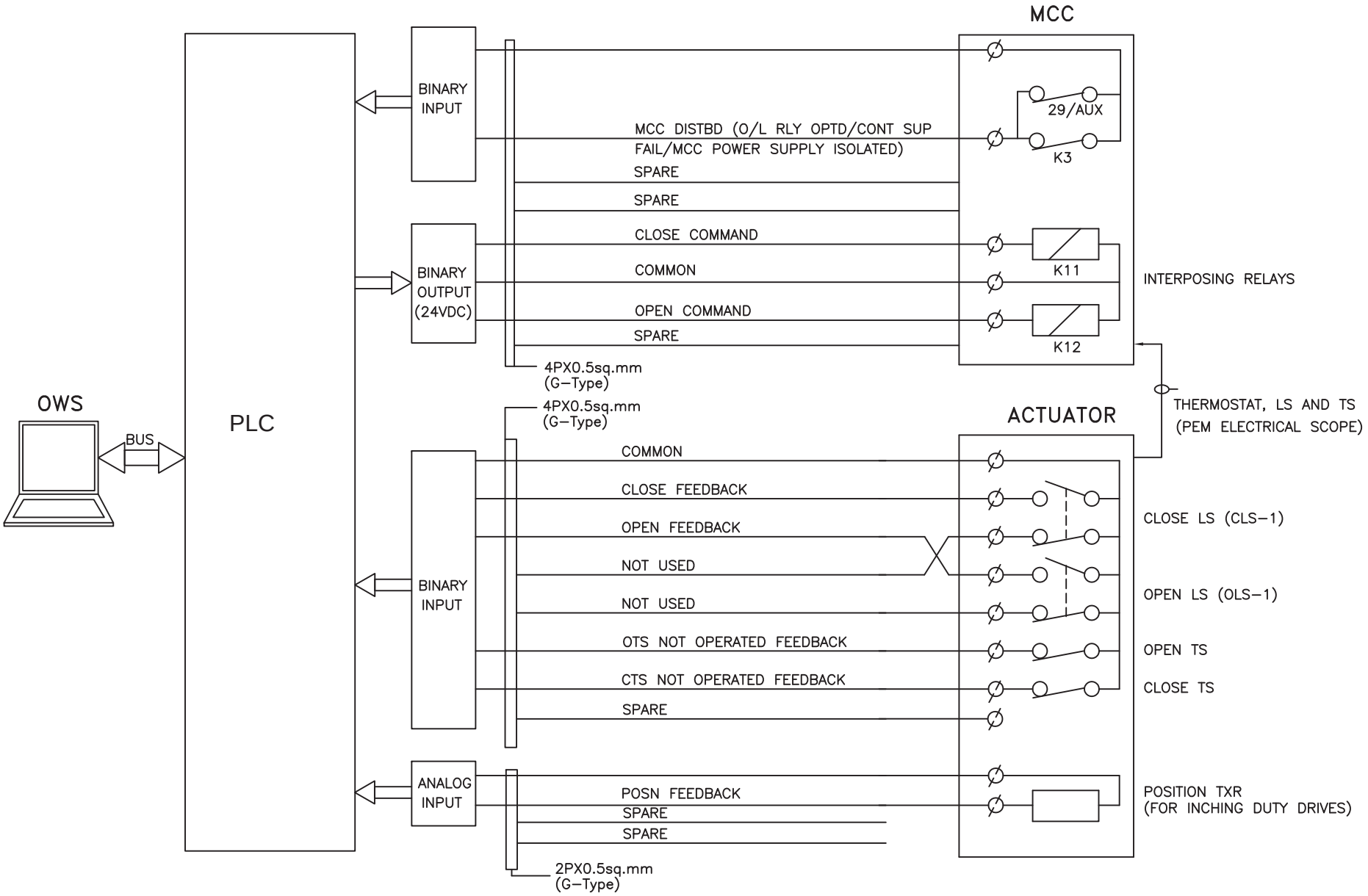


NOTE:

* DISTURBED= Loss of Power supply (1 Phase/3 Phase)/
Loss of control supply/ Motor thermostat trip/
Thermal over load/
Local/Off/Remote Sel. switch in local or off mode/
Stop PB optd.

BHEL	PROJECT:	DRG.NO.	PE–SD–999–145–I002
		DATE	12.02.2013
	TITLE DDCMIS INTERFACE FOR BIDIRECTIONAL DRIVE	REV.NO.	03
		SHT	7 OF 12

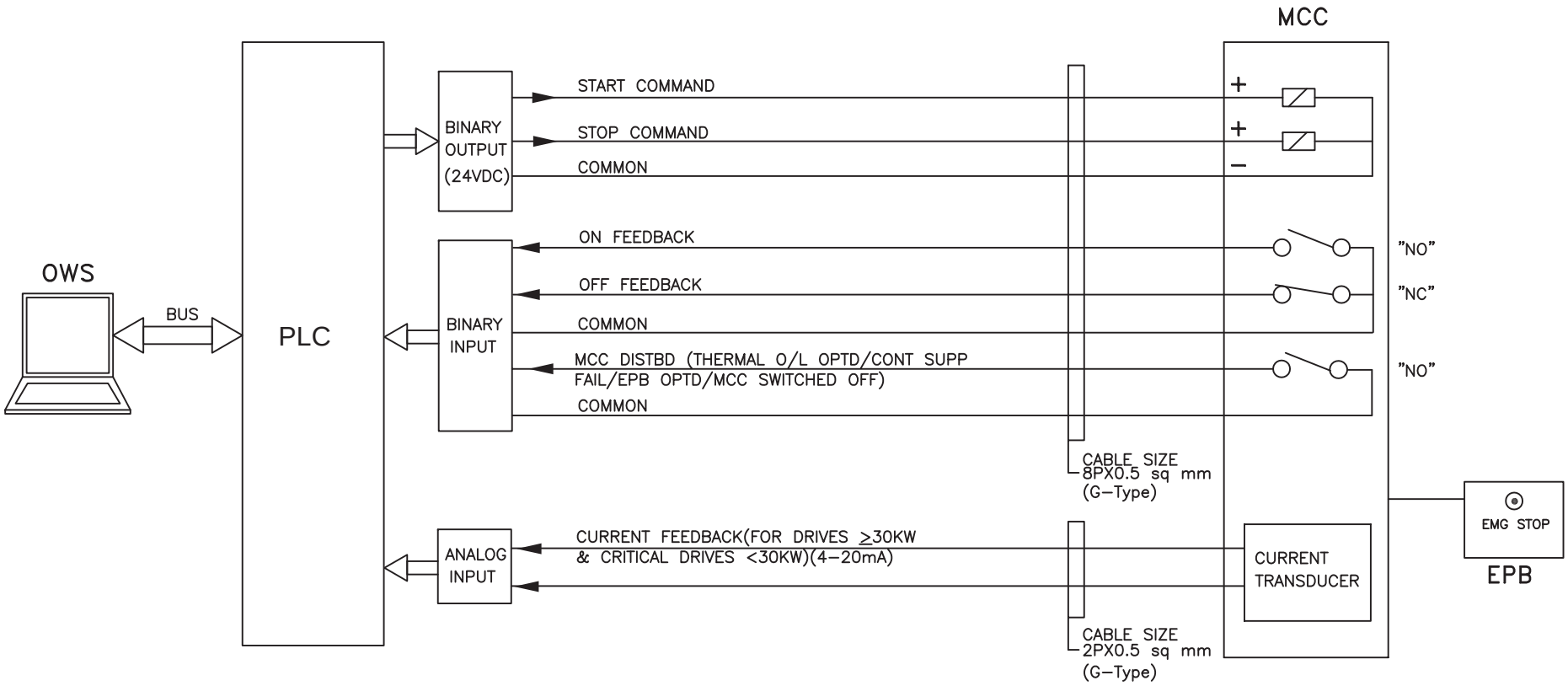
ANNEXURE–A PLC INTERFACE FOR BIDIRECTIONAL DRIVE(WITH MCC)



BHEL	PROJECT:	DRG.NO.	PE–SD–999–145–I002
		DATE	07.02.2013
	TITLE DDCMIS INTERFACE FOR BIDIRECTIONAL DRIVE	REV.NO.	03
		SHT	7 OF 12

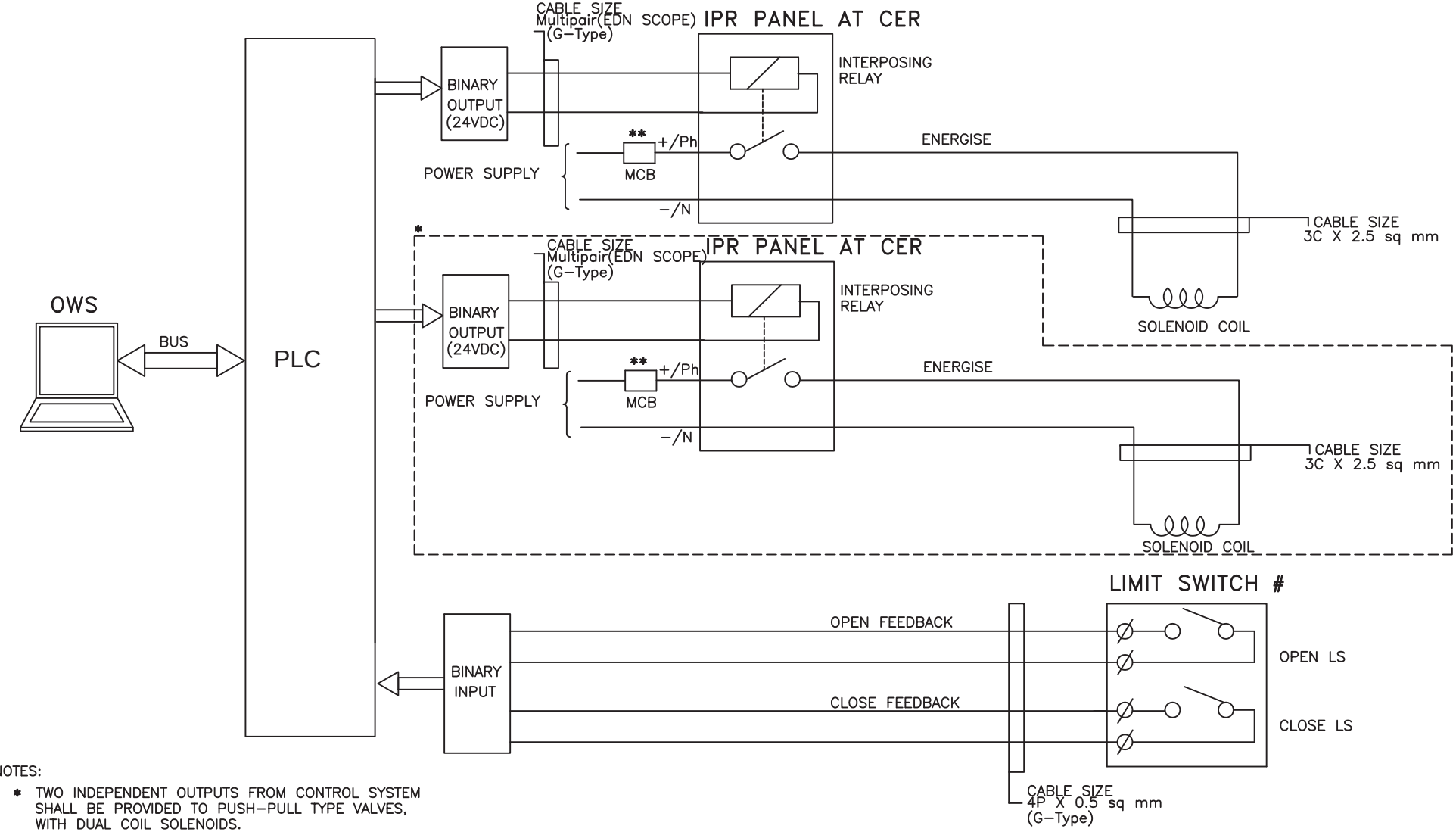
L16

PLC INTERFACE FOR UNIDIRECTIONAL LT DRIVE



BHEL	PROJECT:	DRG.NO.	PE-SD-999-145-I002
		DATE	12.02.2013
	TITLE: DDCMIS INTERFACE FOR UNIDIRECTIONAL LT DRIVE	REV.NO.	03
		SHT	8 OF 12

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

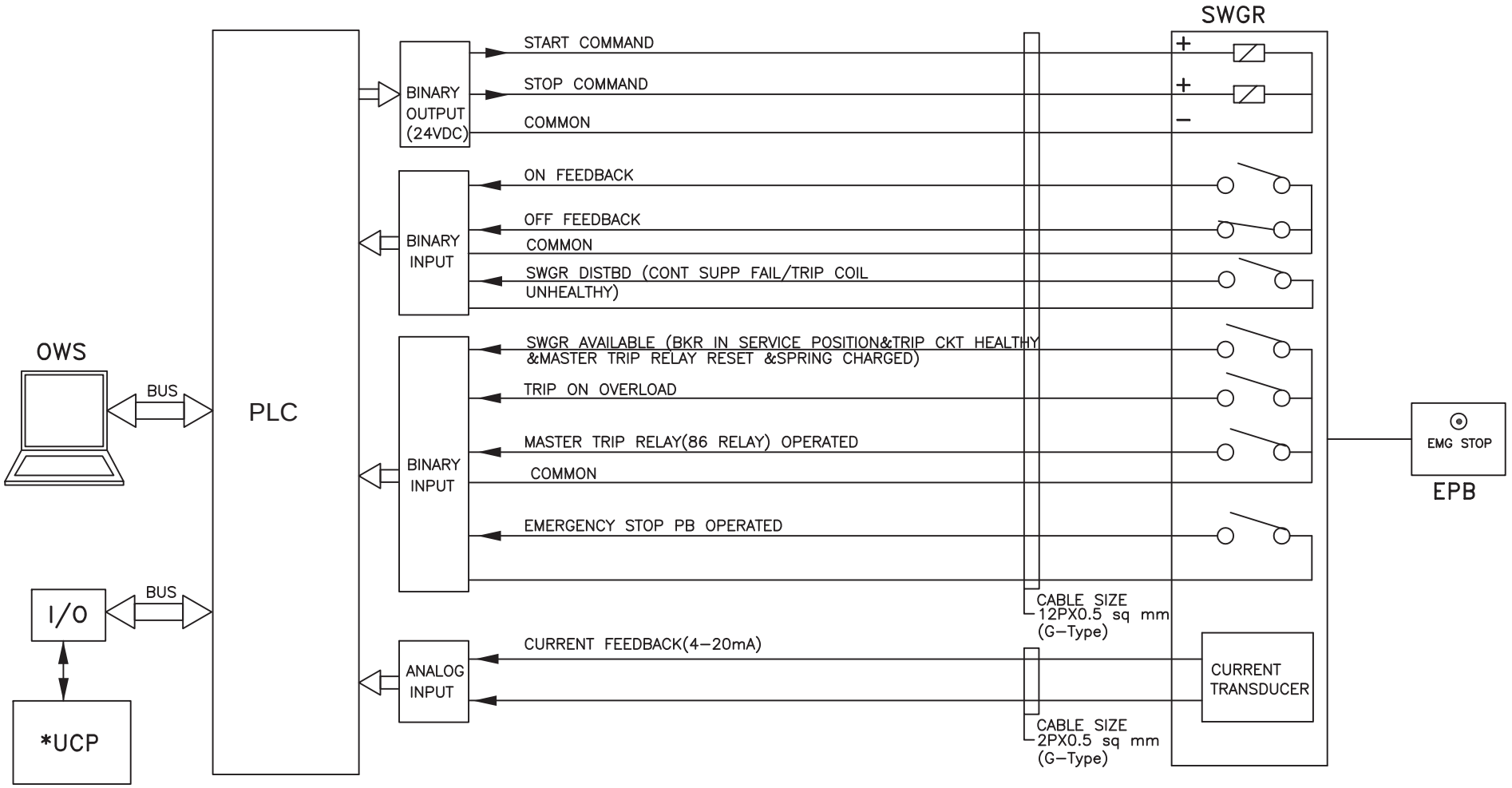


NOTES:

- * 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.

BHEL	PROJECT:	DRG.NO.	PE–SD–999–145–I002
		DATE	12.02.2013
	TITLE DDCMIS INTERFACE FOR SOLENOID DRIVE	REV.NO.	03
		SHT	9 OF 12

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

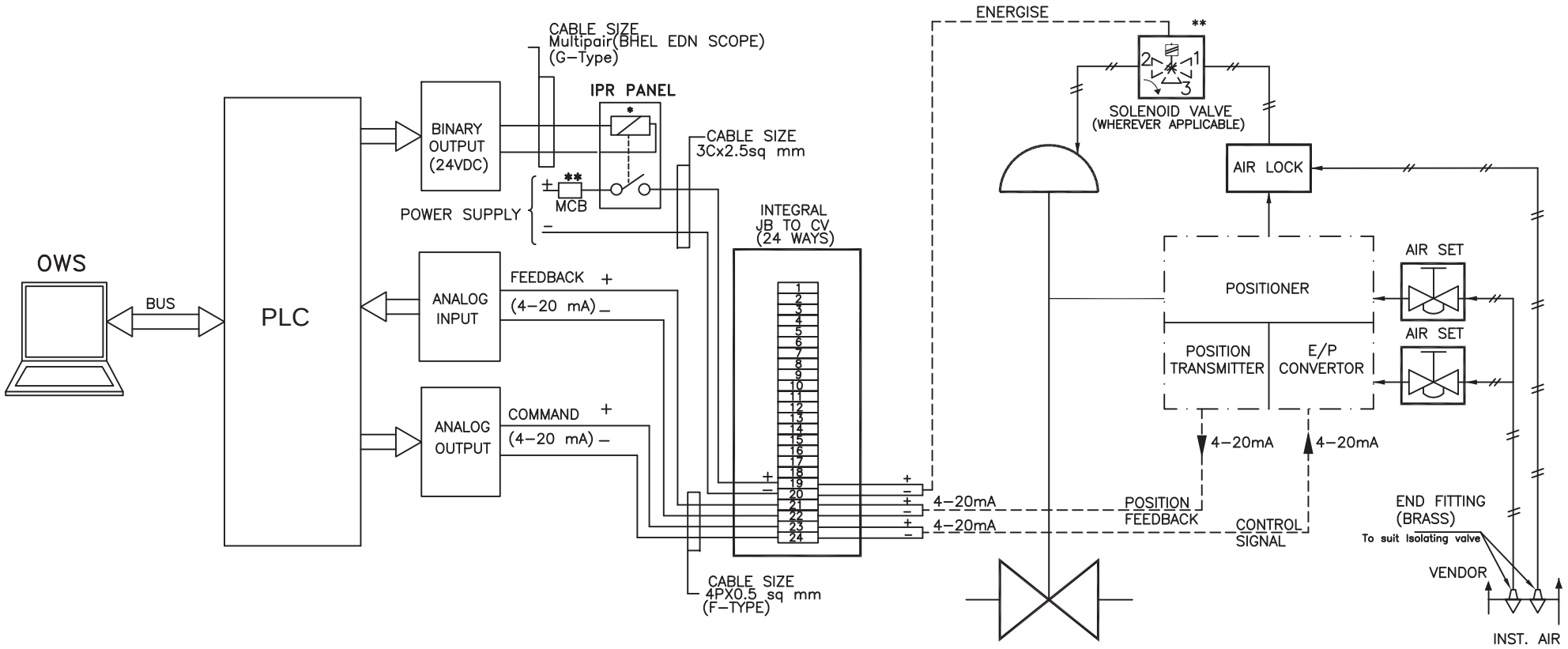


NOTE:

*WHEREVER APPLICABLE

BHEL	PROJECT:	DRG.NO.	PE-SD-999-145-I002
		DATE	12.02.2013
	TITLE: DDCMIS INTERFACE FOR UNIDIRECTIONAL HT DRIVE	REV.NO.	03
		SHT	10 OF 12

PLC INTERFACE FOR ANALOG DRIVE



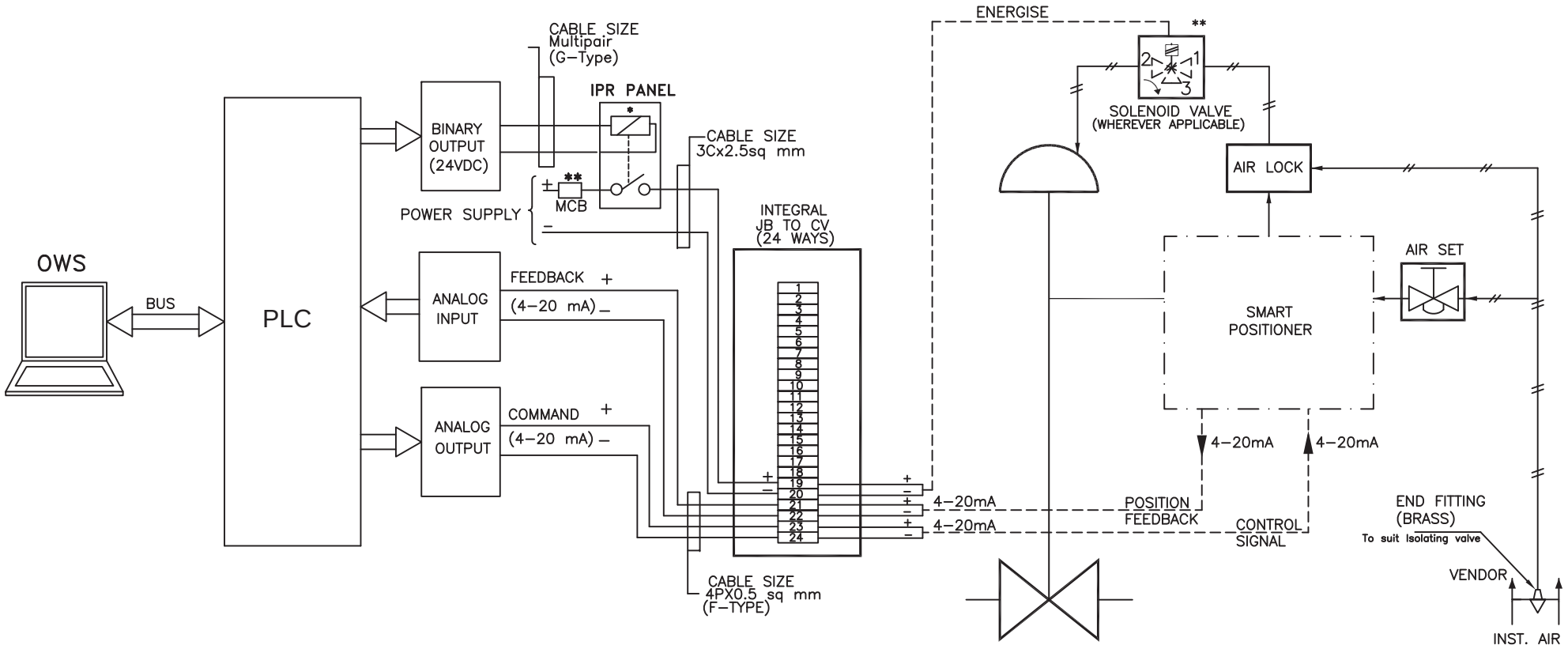
NOTES:

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

** MCB SHALL BE PROVIDED FOR EACH SOLENOID

BHEL	PROJECT:	DRG.NO.	PE–SD–999–145–I002
		DATE	12.02.2013
	TITLE: TYPICAL HOOK–UP DIAGRAM ANALOG DRIVE	REV.NO.	03
		SHT	11 OF 12

PLC INTERFACE FOR ANALOG DRIVE (WITH SMART POSITIONER)

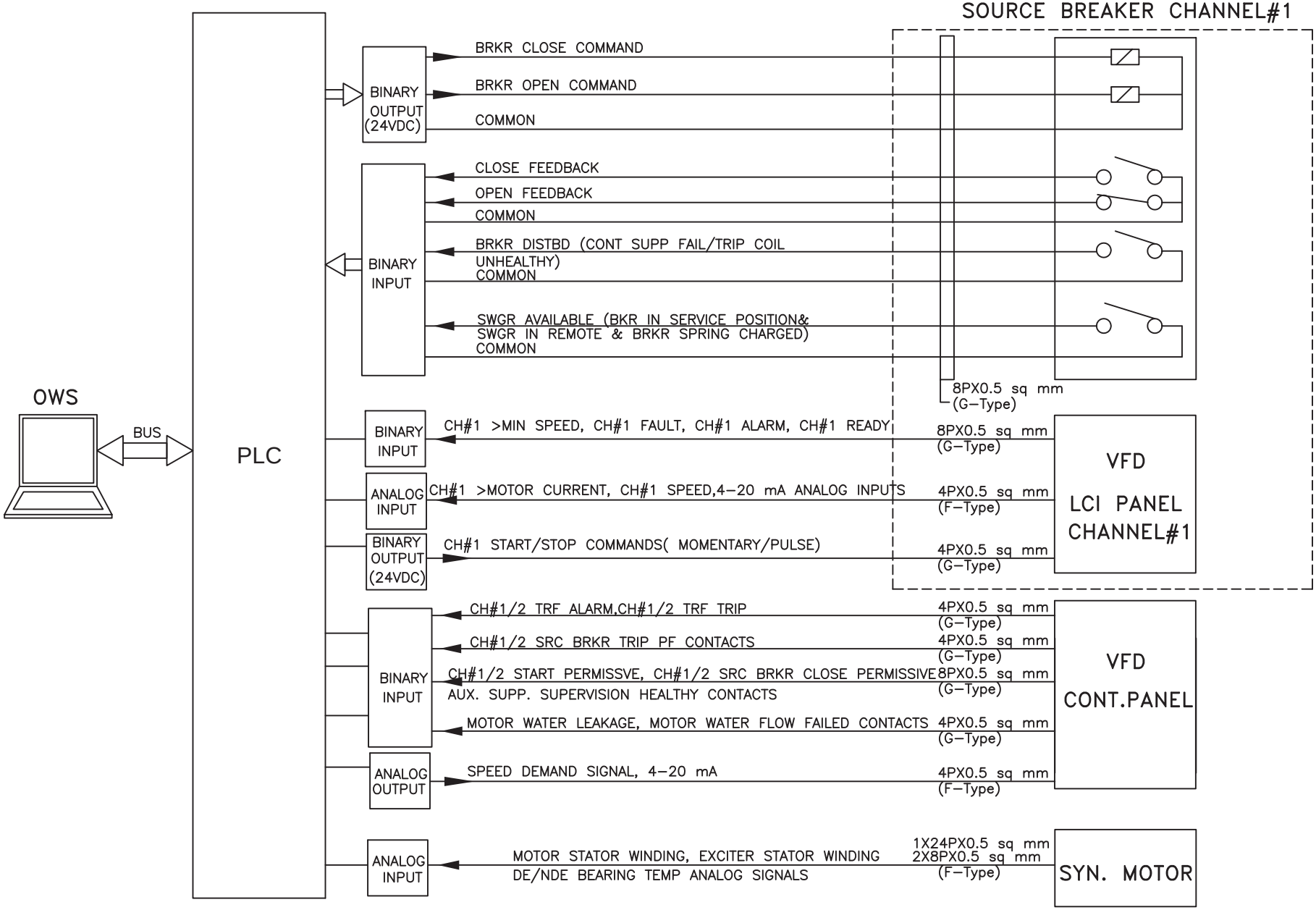


NOTES:

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

BHEL	PROJECT:	DRG.NO.	PE–SD–999–145–I002
		DATE	07.02.13
	TITLE: TYPICAL HOOK–UP DIAGRAM ANALOG DRIVE (WITH SMART POSITIONER)	REV.NO.	03
		SHT	11A OF 12

PLC INTERFACE FOR VFD CONTROL DRIVE



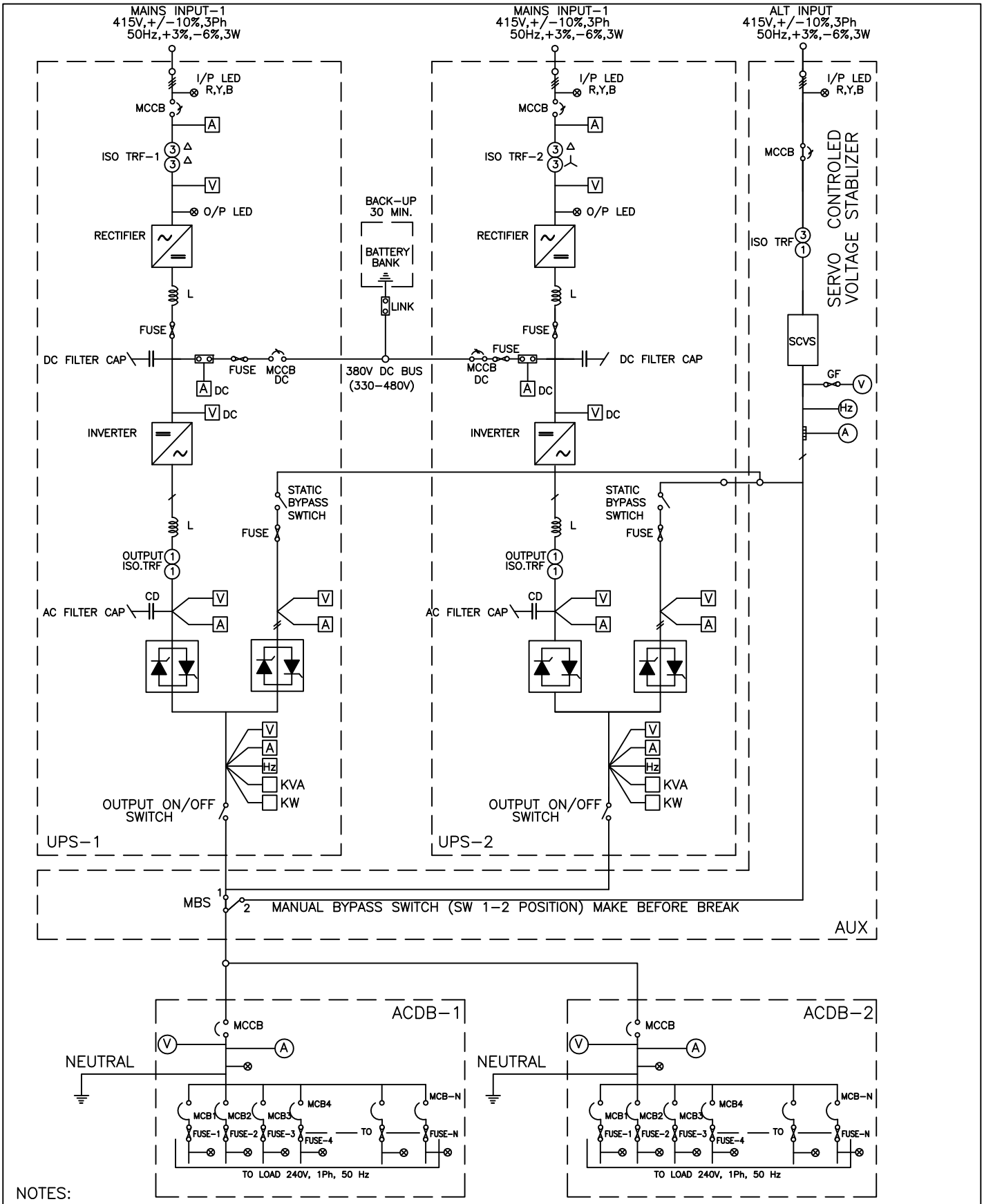
NOTES:

1. SIGNAL INTERFACE FOR CH#2 SRC BRKR AND VFD LCI PANEL SHALL BE IDENTICAL TO CH#1 AS INDICATED IN DOTTED PORTION.

BHEL	PROJECT:	DRG.NO.	PE-SD-999-145-I002
		DATE	07.02.2013
	TITLE DDCMIS INTERFACE FOR VFD DRIVE	REV.NO.	03
		SHT	12 OF 12

STANDARD UPS
SINGLE LINE DIAGRAM

JOB NO. 999					PROJECT	STANDARD					
STATUS STANDARD											
PRINT SCALE 0 2 4 6 8 10 20 30 40 50					BHEL	BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NEW DELHI	DEPT CODE	DRN	NAME GA	SIGN	DATE 30.09.09
REV	DATE	ALTD	CHKD	APPD			I	DESN	VS		30.09.09
								CHD	SSB		30.09.09
								APPD	AK		30.09.09
					TITLE :- STANDARD UPS SINGLE LINE DIAGRAM						
							DEPT.	SCALE	DRAWING/DOC. NO. PE-DG-999-145-I004		
							SIGN				
							DATE		SHEET 1 OF 2		REV. 00



NOTES:

1. ACDB-1&2 NEUTRAL TO BE GROUNDED TO A DEDICATED GROUND.
2. ALL OUTPUT FEEDERS OF ACDB SHALL BE PROVIDED WITH AN LED AFTER THE FUSE FOR FEEDER ON INDICATION WITH FEEDER DESCRIPTION.
3. REDUNDANT FEEDERS SHALL BE LOCATED IN DIFFERENT ACDBs.

BHEL	STANDARD	DRG. No.	PE-DG-999-145-I004
	TITLE:- UPS SINGLE LINE DIAGRAM	REV. No.	00
		DATE	01.10.2009
		SHEET	2 OF 2

L1

INSTRUMENTATION DATA SHEET

FORM NO. PEM-6666-0

	DATA SHEET FOR PRESSURE / DIFFERENTIAL PRESSURE TRANSMITTER	SPECIFICATION NO.:	
		VOLUME	
		SECTION	
		REV. NO.	DATE:
		SHEET 1 OF 4	

TAG No. ……. Qty..... Data Sheet No.: **PES-145-01-DS1-0**

Data Sheet A & B

DATA SHEET-A FOR PRESSURE / DIFFERENTIAL PRESSURE TRANSMITTER (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)

GENERAL	MANUFACTURER		
	MODEL NUMBER		
TECHNICAL	TYPE	☐ INDUCTANCE ☐ CAPACITANCE ☐ STRAIN GAUGE ☐	
	POWER SUPPLY	24V DC	
	TRANSMITTER MEASUREMENT	☐ PRESSURE ☐ DIFF. PRESSURE	
	OUTPUT SIGNAL	4-20MA	
	NO. OF WIRE	TWO	
	ACCURACY	± 0.5% OF SPAN	
	LINEARITY, HYSTERISIS, DEAD BAND AND REPEATABILITY	± 0.1% OF SPAN	
	STABILITY	± 0.25% OF SPAN OR BETTER FOR 6 MONTHS	
	SENSITIVITY	± 0.05% OF SPAN	
	MATERIAL		
	A) BODY	FORGED CARBON STEEL	
	B) ELEMENT	316 SS	
	C) SEAL	TEFLON	
	CONTINUOUSLY ADJUSTABLE SPAN AND ZERO ADJUSTMENT PROVIDED	☐ YES ☐ NO	
	MOUNTING	☐ WALL/PIPE STAND ☐ TRANSMITTER RACK	
	ENCLOSURE	☐ NEMA-4 ☐ NEMA-7	
	TURN DOWN RATIO	TO BE SPECIFIED BY BIDDER	
	INSULATION RESISTANCE	TO BE SPECIFIED BY BIDDER	
	ZERO SUPPRESSION RANGE	TO BE SPECIFIED BY BIDDER	
	ZERO ELEVATION RANGE	TO BE SPECIFIED BY BIDDER	
	INTEGRAL INDICATOR	☐ YES ☐ NO	

	DATA SHEET FOR PRESSURE / DIFFERENTIAL PRESSURE TRANSMITTER	SPECIFICATION NO.:	
		VOLUME	
		SECTION	
		REV. NO.	DATE:
		SHEET 2 OF 4	

TAG No. ……. Qty..... Data Sheet No.: **PES-145-01-DS1-0**

Data Sheet A & B

DATA SHEET-A FOR PRESSURE / DIFFERENTIAL PRESSURE TRANSMITTER (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)

	TRANSMITTER SHALL BE ABLE TO DRIVE OUTPUT IMPEDANCE OF 500 OHMS.	YES	
	ZERO DRIFT	< 0.1%	
	SPAN DRIFT	< 0.1%	
	MANIFOLD		
	a) PRESSURE MEASUREMENT	3 WAY	
	B) DIFFERENTIAL PRESSURE MEASUREMENT	5 WAY	
	CABLE ENTRY DETAIL	SUITABLE FOR DIA OF 17.5 mm	

	PREPARED BY	CHECKED BY	APPROVED BY	COMPANY SEAL
NAME				NAME
SIGNATURE				SIGNATURE
DATE				DATE

FORM NO. PEM-6666-0

	DATA SHEET FOR TEMPERATURE ELEMENT (WITH THERMOWELL)	SPECIFICATION NO.:
		VOLUME
		SECTION
		REV. NO. / DATE:
		SHEET 1 OF 2

TAG No. ……. Qty..... Data Sheet No.: **PES-145-03-DS1-0**

Data Sheet A & B

DATA SHEET-A FOR TEMPERATURE ELEMENT (WITH THERMOWELL) (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)

GENERAL	MANUFACTURER		
	MODEL NUMBER		
TECHNICAL	ELEMENT TYPE	☐ RTD (3 WIRE) ☐ T / C	
	T / C GROUNDED	☐ YES ☐ NO	
	ELEMENT THICKNESS (AWG)		
	LIMIT OF ERROR		
	INSULATION RESISTANCE	MORE THAN 5M OHM AT 100V DC	
	TIME CONSTANT		
	MOUNTING THREAD SIZE		
	CONDUIT THREAD SIZE		
	EXTENSION WIRE TYPE		
	THERMOWELL	☐ YES ☐ NO	
	THERMOWELL LENGTH		
	LINE SIZE		
	PRESSURE RATING		
	TEMPERATURE RATING		

NAME				NAME
SIGNATURE				SIGNATURE
DATE				DATE

FORM NO. PEM-6666-0

BHEL	**DATA SHEET FOR LEVEL TRANSMITTER (DISPLACEMENT TYPE)**	SPECIFICATION NO.:	
		VOLUME	
		SECTION	
		REV. NO. 00	DATE: 19.12.95
		SHEET 1 OF 1	

TAG No. ……. Qty..... Data Sheet No.: **PES-145-08-DS1-0**

Data Sheet A & B

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

GENERAL	MANUFACTURER		
	MODEL NUMBER		
	SERVICE		
	OPERATING PRESSURE & TEMP.		
	LEVEL RANGE		
	B) MAX. OPERATING TEMPERATURE		
	RANGE		
TECHNICAL	TYPE	☐ DIRECT ☐ REVERSE	
	POWER SUPPLY	24V DC	
	OUTPUT SIGNAL	4-20mA	
	NO. OF WIRE	TWO	
	ACCURACY	± 1% OF SPAN AT SP. GR. OF 1	
	LINEARITY AND HYSTERISIS	± 1.0 %	
	REPEATABILITY	± 5.0 %	
	GLASS TUBE / GLASS PLATE	BOROSILLICATE TOUGHENED	
	MATERIAL:		
	A) CAGE	☐ FORGED CARBON STEEL ☐ 316 SS	
	B) DISPLACER	☐ 304 SS ☐ 316 SS	
	C) LINKAGE & TORQUE TUBE	☐ SS-316	
	CONTINUOUS ADJUSTABLE SPAN AND ZERO ADJUSTMENT PROVIDED	YES	
	ZERO & SPAN ADJUSTMENT ARE INDEPENDENT & NON INTERACTIVE	YES	
	MOUNTING	☐ TOP & BOTTOM ☐ SIDE & SIDE ☐ TOP & SIDE ☐ BOTTOM & SIDE	
	END CONNECTION	CENTRE TO CENTRE DISTANCE: CONNECTION FLANCE SIZE: ANSI CLASS: MATERIAL:	
	ENCLOSURE	IP-65	
	OUTPUT INDICATOR	☐ YES ☐ NO	
	BODY RATING	ANSI CLASS :	
	ACCESSORIES	MATING FLANGE WITH NUTS & BOLTS AND GASKET	
	CABLE ENTRY DETAILS	SUITABLE GLAND (DOUBLE COMPRESSION) FOR MAXIMUM CABLE DIA OF 17.5mm	

NAME				NAME
SIGNATURE				SIGNATURE
DATE				DATE

FORM NO. PEM-6666-0

BHEL	**DATA SHEET FOR LEVEL SWITCHES (FLOAT / DISPLACER TYPE)**	SPECIFICATION NO.:
		VOLUME
		SECTION
		REV. NO. / DATE:
		SHEET 1 OF 1

TAG No. ……. Data Sheet No.: **PES-145-33-DS1-0**

Data Sheet A&B

DESCRIPTION		Data Sheet-A (To be filled in by Purchaser)	Data Sheet-B (To be filled in by bidder)
GENERAL	MANUFACTURER		
	MODEL NUMBER		
TECHNICAL	TYPE	☐ TOP MOUNTED ☐ SIDE MOUNTED (with/without external chamber) ☐ DISPLACER TYPE ☐ FLOAT OPERATED ☐ EXTERNAL CHAMBER	
	MATERIAL	FLOAT ASSEMBLY SS ANSI 316	
	DISPLACER	AISI 316	
	WIRE ROPE	AISI 316	
	SLEEVE PIPE	AISI 316	
	EXTERNAL CHAMBER	☐ CS WELDED CONST. ☐ SS WELDED CONST. ☐ AS WELDED CONST.	
	SWITCH HOUSING GASKET	☐ AISI 304 SS ☐ DIE C AST ALUMINIUM ☐ NEOPRENE ☐ TEFLON	
	ENCLOSURE	☐ SWITCH HOUSING NEMA-4 ☐ FUEL GAS HAZARDOUS APPL. EXPL. PROOF	
	TYPE OF SWITCH	SNAP ACTING MEGNETICALLY OPERATED	
	CONTACT RATING	☐ YES ☐ CHAMBER DRAIN ½" NPT PLUG	
	ISOLATION VALVE	☐ YES ☐ NO	
	SP. GR. OF FLUID	0.70 TO 1.2	
	DIFF. BETWEEN MAKE & BREAK OF SWITCH	☐ 12 ±2 mm (SIDE MOUNTED) ☐ 35 ±3 mm (TOP MOUNTED) ☐ ADJUSTABLE	
	MAXIMUM PRESSURE RATING		
	MAXIMUM TEMPERATURE RATING		
PERFORMANCE	REPEATABILITY	±1mm	
CONNECTION	EXT. CHAMBER CONNECTION	1" NB SOCKET WELD (TOP AND BOTTOM)	
	ELECT.	COMPLETE WITH CABLE GLAND TO SUIT CABLE WITH MAXIMUM 17.5mm O.D.	
ACCESSORIES	INSTALLATION ACCESSORIES	AS REQUIRED.	

NAME				NAME
SIGNATURE				SIGNATURE
DATE				DATE

	SPECIFICATION FOR TEMPERATURE GAUGE	SPECIFICATION NO.: PES – 145 – 027	
		VOLUME II B	
		SECTION D	
		REV. NO. 00	DATE : 23-04-2010
		SHEET 1	OF 3

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 of Temperature Gauge for use in Utility/Captive Power Station/Combined Cycle Station.

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 The Design and Materials used for the components shall also comply with the relevant National and International standards.

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

Enclosure	-	ISA: RP:8.1
Thermowell	-	ASME : PTC-19.3

3.0 TECHNICAL REQUIREMENTS

3.1 General

The thermometers shall be suitable for an ambient temperature of 0-55°C and relative humidity of 0-95%.

3.2 Bourdon tube and movement

Bourdon shall be made of suitable AISI 316 and the movement shall conform to AISI 304.

3.3 Case

Shall be made of Die cast aluminium and painted with Black stoving enamel paint over a suitable etch primer.

3.4 Bezel Ring

Shall be made of anodised aluminium with anti corrosive finish.

3.5 Dial and Scale

The dial shall be made of suitable material with anti corrosive finish.

The scale shall be concentric and graduated in degrees centigrade. The markings shall be in black on a non-reflective white background.

The pointer deflection angle shall be 270 degrees.

The unit of measurement Deg.C shall also be marked on the dial.

3.6 Pointer

Shall be made of suitable metal with black finish. The pointer shall be provided with suitable mechanism for zero adjustment without opening the case.

3.7 Bulb and Stem

Bulb and stem shall be made of stainless steel AISI 316. The bulb O.D. shall be 12 $\pm$0.1 mm. The process connection shall be adjustable gland type. The immersion length shall be adjustable between 100mm to 300mm. The material of the adjustable gland is AISI 316. The stem shall be flexible suitable for bending.

3.8 Temperature compensation

The thermometer shall be provided with compensating arrangement for ambient temperature changes.

3.9 Capillary

Capillary shall be SS-316 and 1.5mm dia, covered with 4.5mm dia of SS Spiral Sheath.

3.10 Accuracy

± 1% of the full-scale deflection.

3.11 Mounting & Connection

Flush Mounting, back connection, clamp fixing, Direct mounting bottom connection.

3.12 Thermowell

Gauge shall be supplied along with the thermowell. The thermowell shall be of AISI 316 SS/Cr.Mo. Steel and shall be designed to suit the process conditions. For details of the thermowell see enclosed drawings for Thermowell.

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 The following test shall be conducted as a minimum requirement.

a) Routine Tests

i) Accuracy test.
ii) Overload test
iii) Response time test

b) Type Tests

i) Ambient temperature compensation test.
ii) Weather proof water tight and dust tight tests.

4.3 Inspection will be conducted by BHEL and/or their authorised representatives as per the agreed inspection schedule. The inspection schedule will be submitted by the bidder for BHEL's approval at contract stage. The cost of all tests and inspections will be deemed to have been included in the bid. For all the type tests covered under 4.3 (b), "Type Test Certificates" as per agreed Quality Plan shall be furnished. In the absence of the same, such Type Tests shall be arranged at the Vendor's works in the presence of BHEL and/or their authorised representatives or in independent Test House / Laboratory approved by BHEL.

4.4 The Standard QP is included in this specification to enable bidder to understand the extent of inspection and testing requirements to execute this job. The successful bidder has to follow the agreed QP, taking care of customer requirements mentioned in Sec-C and submit QP for final approval by BHEL / Customer.

5.0 SPARES AND CONSUMABLES

5.1 Recommended Spares

The bidder shall furnish a list of Recommended Spares alongwith 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 seperate order later, if required.

6.0 DRAWINGS AND DOCUMENTS

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

6.1.1 Data sheet-B, completely filled-up alongwith all enclosures.

6.1.2 Quality Plan.

6.1.3 Catalogs with detailed technical information.

6.1.4 Bar-chart to indicate the time schedule for procurement, manufacture, testing and despatch.

6.2 The successful bidder shall furnish the following documents in required number of copies during the contract stage :

6.2.1 For approval

i) Dimensional/Installation drawings.

ii) Data sheet-C, completely filled-up alongwith all the enclosures.

iii) Quality Plan of vendor/sub-vendor.

iv) Test Certificates.

6.2.2 Final/As-built Drawings

Final / As-built drawings / CDs in required number of copies shall be submitted.

6.3 Operation & Maintenance Manuals

O&M Manuals in required number of copies shall be submitted. O&M Manuals shall also contain storage & commissioning instructions.

7.0 MARKING AND PACKING

7.1 Marking

A stainless steel name-plate shall be permanently fixed on each equipment giving its Tag Number and technical specifications.

7.2 Packing

All equipment/materials shall be suitably packed and protected for the entire period of dispatch, storage and erection against impact, abrasion, corrosion, incidental damage due 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

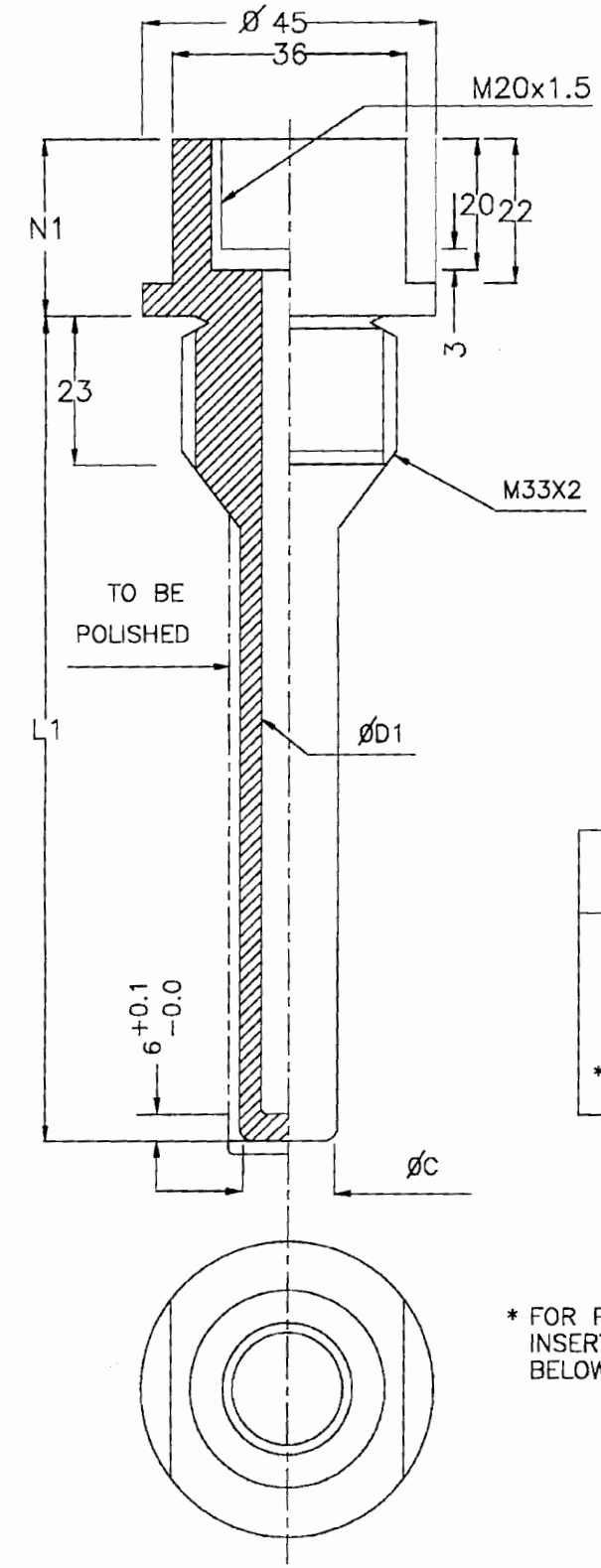
This document shall be read with one or more of the following data sheet forms :

- Data sheet A&B for Temperature Gauge : Data sheet no. PES-145-27-DS1-1
- Data sheet C for Temperature Gauge : Data sheet no. PES-145-27-DS2-1

FORM NO. PEM – 6666–0

THERMOWELL MEDIUM PRESSURE (40 Kgf/Cm2)

SPECIFICATION NO	PES–145–27
VOLUME	IIB
SECTION	D
REV. NO. 02	DATE 16-5-2007
SHEET 4	OF 8



PIPE O.D.	INSERTION LENGTH (L1)
Ø 509 & ABOVE	325
Ø 506 TO 369	250
Ø 368 TO 274	175
*Ø 273 BELOW	150

* FOR PIPE O.Ds UP TO 159mm THE THERMOWELL INSERTION WILL BE STRAIGHT. FOR PIPE O.Ds BELOW 159mm, THE INSERTION SHALL BE SLANT.

Fig.1

FORM NO. PEM – 8666–0

	THERMOWELL–HIGH PRESSURE (250 Kgf/Cm2)	SPECIFICATION NO. PES–145–27 VOLUME IIB SECTION D REV. NO. 02 DATE 16-5-2007 SHEET 5 OF 8

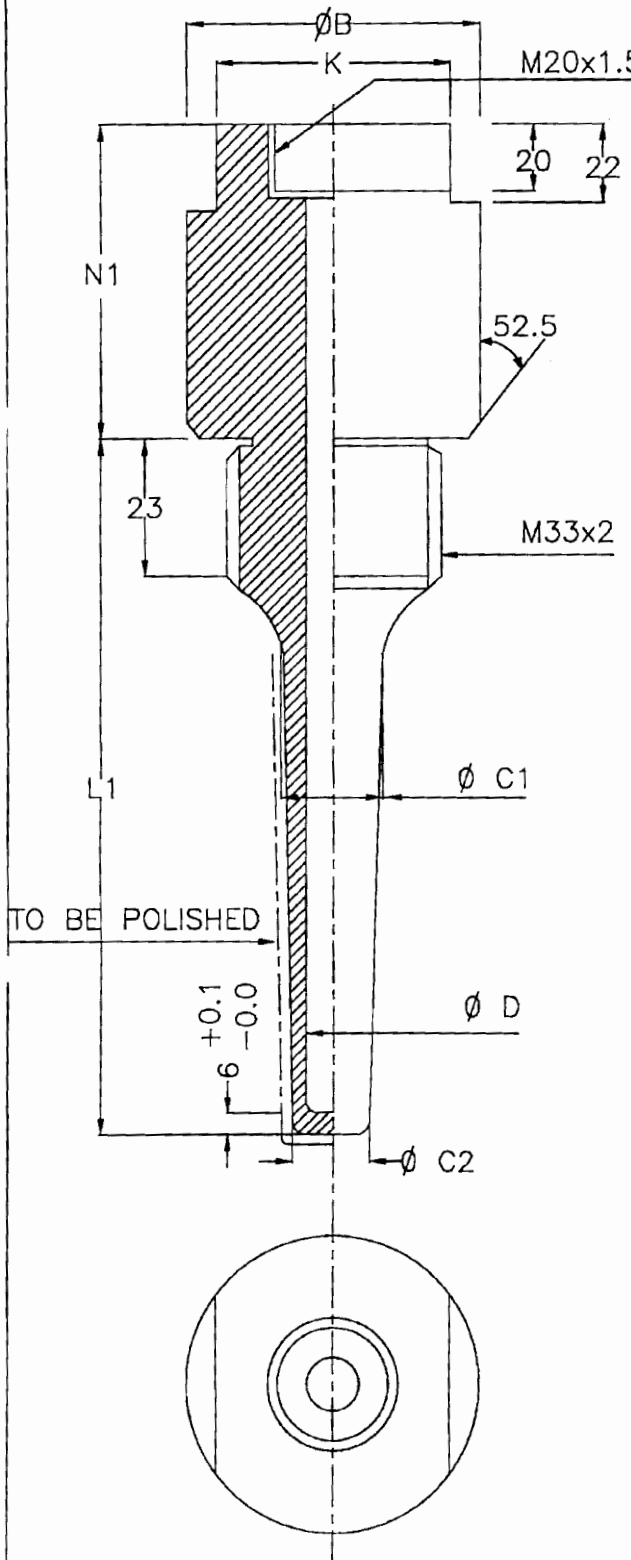


Fig. 2

PIPE O.D.	INSERTION LENGTH L1
Ø 509 & ABOVE	325
Ø 508 TO 368	250
Ø 367 TO Ø274	175
Ø 273 BELOW	150

NOTE :–

1. THE CORRESPONDING ELEMENT ELEMENT LENGTHS ARE GIVEN FOR INFORMATION ONLY. THE ELEMENT LENGTHS ARE WORKOUT AS PER THE FORMULA L=L1+N1–6.

2. FOR PIPE OD'S UPTO 159mm, THE THERMOWELL INSERTION WILL BE STRAIGHT. FOR PIPE OD'S BELOW 159mm, THE INSERTION SHALL BE SLANT.

FORMAT NO. - 6666-0

बीएचईएल BHEL	**SPECIFICATION FOR TEMPERATURE GAUGE**	SPECIFICATION NO. : PES - 145 - 27 VOLUME II B SECTION D REV. NO. 02 DATE 16-5-2007 SHEET 6 OF 8

ALL DIMENSIONS IN mm

Instrument stem dia D+0.0 -0.1	DIA D1 +0.2 0	DIA C	Insertion Length L1	Extention element length N1	Corres ponding element length(L)
12	12.5	19	150	27	171
				75	219
				100	244
			175	27	196
				75	244
				100	269
			250	27	271
				75	319
				100	344
			325	27	346
				75	394
				100	419
14	14.5	21	150	27	171
				75	219
				100	244
			175	27	196
				75	244
				100	269
			250	27	271
				75	319
				100	344
			325	27	346
				75	394
				100	419

NOTE: The corresponding element lenghts are given for information only. The elements lengths are worked out as per the formula :

$$L = L1 + N1 - 6$$

FORMAT NO. - 6666-0

	SPECIFICATION FOR TEMPERATURE GAUGE	SPECIFICATION NO. : PES - 145 - 27
		VOLUME II B
		SECTION D
		REV. NO. 02 DATE 16-5-2007
		SHEET 7 OF 8

THERMOWELL-MEDIUM PRESSURE
(40 KG/CM2)

ALL DIMENSIONS IN mm

Instrument stem dia D+0.0 -0.1	DIA D1 +0.2 0	DIA C	Insertion Length L1	Extention element length N1	Corres ponding element length(L)
6	6,5	12.5	150	27	171
				75	219
				100	244
			175	27	196
				75	244
				100	269
			250	27	271
				75	319
				100	344
			325	27	346
				75	394
				100	419
8	8.5	15	150	27	171
				75	219
				100	244
			175	27	196
				75	244
				100	269
			250	27	271
				75	319
				100	344
			325	27	346
				75	394
				100	419

	THERMOWELL HIGH PRESSURE (250 KGf/Cm²)	SPECIFICATION NO. : PES - 145 - 27 VOLUME II B SECTION D REV. NO. 02 DATE 16-5-2007 SHEET 8 OF 8

ALL DIMENSIONS IN mm

Instrument stem dia D (+0.0 -0.1)	DIA D1 (+0.2 0.0)	DIA C1	DIA C2	K	DIA B	Insertion Length L1	Extention Length N1	Corresponding Element Length (L)
6	6.5	19	12.5	36	45	150	27 75 100	171 219 244
						250	27 75 100	271 319 344
8	8.5	21.5	15	36	45	150	27 75 100	171 219 244
						250	27 75 100	271 319 344
12	12.5	25.5	19	36	45	150	27 75 100	171 219 244
						250	27 75 100	271 319 344
14	14.5	27.5	21	36	45	150	27 75 100	171 219 244
						250	27 75 100	271 319 344
16	16.5	29	23	46	55	150	27 75 100	171 219 244
						250	27 75 100	271 319 344

FORM NO. PEM-6666-0

BHEL	**TECHNICAL REQUIREMENT FOR TEMPERATURE GAUGE**	SPECIFICATION NO.: VOLUME SECTION REV. NO. / DATE: SHEET 1 OF 1

TAG No. ……. Qty……. Data Sheet No.: **PE-DC-326-145-I027-1**

Data Sheet A & B

DATA SHEET-A FOR TEMPERATURE GAUGE (TO BE FILLED BY PURCHASER)			DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
GENERAL	MANUFACTURER		
	MODEL NUMBER		
	STANDARD TO BE FOLLOWED	■ ISA:RP:8.1 (ENCLOSURE) ■ ASME: PTC-19.3 (THERMOWELL)	
TECHNICAL	TYPE	MERCURRY FILLED (FOR <450 DEG C) INERT GAS ACTUATED (FOR >450 DEG C)	
	PRESSURE ELEMENT	BOURDON	
	MATERIAL	PRESSURE ELEMENT: ■ SS 316 (FOR Hg IN STEEL) CASE: ■ DIE CAST AL ■ SS BULB & CAPILLARY: SS 316 MOVEMENT: SS 304	
	DIAL	SIZE: 150 MM COLOR: WHITE NUMERALS: BLACK SCALE: LINEAR, 270° ARC GRADUATED IN DEG C	
	CASE	COLOUR : BLACK (IN CASE OF DIE CAST AL CASING)	
	ENCLOSURE	CLASS: ■ IP 55 PAINT: ■ EPOXY (IN CASE OF DIE CAST AL CASING)	
	MOUNTING	■ LOCAL ■ PANEL OR RACK	
	ZERO ADJUSTMENT	REQUIRED	
	RANGE SELECTION	SHOULD COVER 125% OF OPERATING PARAMETER	
	OVER RANGE PROTECTION	125% OF FSD FOR RANGE UPTO 400 Deg C 110% OF FSD FOR RANGE BETWEEN 400 TO 500 Deg C	
	COMPENSATION	CASE COMPENSATION TO BE PROVIDED AS PER BS 5235 FOR 0 TO 60 °C.	
	CAPILLARY MATERIAL	SS 316, 1.5 MM DIA COVERED WITH SS SPIRAL SHEATH OF 4.5 MM DIA	
	CAPILLARY LENGTH	5 MTR FOR LOCAL MOUNTED	
PERFORMANCE	ACCURACY	± 0.5% / ± 1% OR BETTER OF FULL SCALE DEFLECTION	
	RESPONSE TIME (WITHOUT THERMOWELL)	AS PER ASME PTC 19.3	
CONNECTION	CONNECTION WITH THERMOWELL	■ M20 x 1.5 (M) ■ 3/4" NPT (M) ■ ½" NPT(M)	
	LOCATION	BOTTOM / BACK	
THERMOWELL	MATERIAL (BAR STOCK)	■ SS 316	
	TYPE	■ SCREWED ■ WELDED ■ FLANGED	
	PROCESS CONNECTION	■ M33X2 ■ 150 RF ■ R 1 ■ R 1½	
	IMMERSION LENGTH (L1)	½ ID OF PIPE SUBJECT TO CONFORMANCE WITH ASME PTC 19.3	
	EXTENSION LENGTH (N1)	INSULATION THICKNESS - STUB HEIGHT + 25 MM	

FORM NO. PEM-6666-0

BHEL	**TECHNICAL REQUIREMENT FOR TEMPERATURE GAUGE**	SPECIFICATION NO.: VOLUME SECTION REV. NO. DATE: SHEET 2 OF 1

TAG No. ……. Qty……. Data Sheet No.: **PE-DC-326-145-I027-1**

Data Sheet A & B

DATA SHEET-A FOR TEMPERATURE GAUGE (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)

ACCESSORIES	NAME PLATE / METAL TAG	ENGRAVED WITH SERVICE LEGEND OR PHINOLIC NAME PLATE		
OTHER REQUIREMENT	1. AMBIENT TEMPERATURE 0-55 DEG C, RH 0-95%. 2. BULB O.D. 12 ± 0.1 MM 3. BEZEL RING SHALL BE OF ANODIZED ALUMINIUM / ABS PLASTIC INCASE OF DIE CAST AL CASING 4. ADJUSTABLE GLAND (BETWEEN 100 MM TO 300 MM) OF SS316 TO BE PROVIDED FOR CONNECTION OF STEM WITH THERMOWELL			
	PREPARED BY	CHECKED BY	APPROVED BY	COMPANY SEAL
NAME				NAME
SIGNATURE/DATE				SIGNATURE /DATE

FORM NO. PEM-6666-0

BHEL	**DATA SHEET FOR PRESSURE / DIFFERENTIAL PRESSURE GAUGE**	SPECIFICATION NO.:
		VOLUME
		SECTION
		REV. NO. / DATE:
		SHEET 1 OF 1

TAG No. ……. Qty..... Data Sheet No.: **PE-DC-999-145-I026-1**

Data Sheet A & B

DATA SHEET-A FOR PRESSURE / DIFFERENTIAL PRESSURE GAUGE (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)

GENERAL	MANUFACTURER		
	MODEL NUMBER		
TECHNICAL	PRESSURE ELEMENT	☐ BOURDON ☐ DIAPHRAGM ☐ BELLOW	
	MATERIAL	SENSING ELEMENT – AISI 316 SS MOVEMENT – AISI 304 SS CASING – ☐ DIE CAST AL ☐ SS	
	ENCLOSURE	☐ INDOOR MOUNTED IP-55 ☐ OUTDOOR MOUNTED IP-67 ☐ FUEL GAS HAZARDOUS APPL. EXPL. PROOF	
	DIAL	SIZE: ☐ 100MM ☐ 150MM COLOR: WHITE NUMERALS: BLACK SCALE: ☐ LINEAR ☐ SQUARE ROOT	
	CASE	COLOUR : BLACK	
	ADJUSTMENT	☐ EXT. MICROMETER SCREW ☐ INT. MICRO SCREW	
	MOUNTING	☐ LOCAL ☐ PANEL OR RACK	
	OVER RANGE PROTECTION	115% ABOVE 150 KG/CM2 FSD 125% ABOVE 150 KG/CM2 FSD	
	BLOW OUT DISC	REQUIRED	
	SWITCHING FACILITY	☐ YES ☐ NO	
	TYPE	☐ MICRO SWITCH ☐ OTHER	
	NO. / TYPE OF CONTACTS	2 NOS. SPDT	
	CONTACT RATING	5A 230V AC, 0.25A 220V DC	
	SETTING RANGE	FIELD ADJUSTABLE OVER FULL RANGE	
	REPEATABILITY	± 1% OF FSR	
	POWER SUPPLY	230V AC (if required)	
PERFORMANCE	ACCURACY	± 1% OR BETTER OF FULL SCALE DEFLECTION	
CONNECTION	PROCESS	M20 x 1.5 (M)	
	LOCATION	☐ BACK ☐ BOTTOM	
ACCESSORIES	NAME PLATE / METAL TAG	SS	
	MOUNTING	☐ WALL ☐ PIPE – U CLAMPS & BOLTS ☐ PANEL / RACK	
	OTHER	AS PER ENCLOSED DIAGRAM	

NAME				NAME
SIGNATURE				SIGNATURE
DATE				DATE

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 of Pressure/Differential Pressure Gauge for use in Utility/Captive Power Station/Combined Cycle Station.

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 The Design and Materials used for the components shall also comply with the relevant National and International standards.

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

Pressure and vacuum gauges	-	IS-3624
Enclosure	-	IS-12063

3.0 TECHNICAL REQUIREMENTS

3.1 General

The gauges shall be suitable for an ambient temperature of 0-55°C and relative humidity of 0-95%.

3.2 Bourdon tube, Movement & Shank

Bourdon shall be made of stainless steel to AISI 316 and the teeth shall be polished to have frictionless movement without backlash. Movement material shall be AISI 304.l

3.3 Case

Shall be made of die cast ~~aluminium~~aluminum and painted with black stoving enamel paint over a suitable primer. The case shall be provided with a blowout disc, to safeguard the window glass.

3.4 Bezel Ring

Shall be made of anodized ~~aluminium~~aluminum with anti corrosive finish.

3.5 Dial & Scale

The dial shall be made of a suitable material with anti corrosive finish, meeting the requirements of IS-3624.

The scale shall be concentric and graduated in kg/sq.cm. in the pressure gauge. MM of Hg on vacuum side and kg/sq.cm on pressure side in case of vacuum / compound gauges. The marking shall be black on a ~~non-reflecting~~non-reflecting white background. The pointer deflection angle shall be 270 Deg.

The unit of measurement shall also be marked on the dial.

3.6 Pointer

Shall be made of suitable metal with black finish. The pointer shall be provided with suitable mechanism for zero adjustment without opening the case.

3.7 Switch device

Switch device shall be snap acting micro switch. The rating of contact shall be 5 A 230 V AC, 0.25 A 220 V DC. Setting range shall be field adjustable over the full range.

3.8 Accuracy

±1% of the full scale deflection.

3.9 Mounting & connection

Flush mounting, back connection, clamp fixing. Direct mounting bottom connection.

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 The bidder shall strictly follow the Quality Plan (s) included in Volume-IIB.

4.3 The following tests shall be conducted as a minimum requirement:

a) Routine Tests

i) Accuracy Test.
ii) Overload test.
iii) Hysteresis
iv) Contact Rating (for switch)
v) Repeatability (for switch)
vi) HV / IR (for switch)

b) Type tests

i) Blow out disc
ii) Weatherproof, water tight and Dust tight tests.

4.4 Inspection will be conducted by BHEL and/or their authorised representatives as per the agreed inspection schedule. The inspection schedule will be submitted by the bidder for BHEL's approval at contract stage. The cost of all tests and inspections will be deemed to have been included in the bid. For all the type tests covered under 4.3 (b), "Type Test Certificates" as per Quality Plan shall be furnished. In the absence of the same, such Type Tests shall be arranged at the Vendor's works in the presence of BHEL and/or their authorised representatives or in independent Test House/ Laboratory approved by BHEL.

4.5 The Standard QP is included in this specification to enable bidder to understand the extent of inspection and testing requirements to execute this job. The successful bidder has to follow the agreed QP, taking care of customer requirements mentioned in Sec-C and submit QP for final approval by BHEL / Customer.

5.0 SPARES AND CONSUMABLES

5.1 Recommended Spares

The bidder shall furnish a list of Recommended Spares along with the normal service expectancy period and frequency of replacement; quantities recommended for 3 years operation along with 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 :

6.1.1 Data sheet-B, completely filled-up along with all enclosures.

6.1.2 Quality Plan.

6.1.3 Catalogues with detailed technical information.

6.1.4 Bar-chart to indicate the time schedule for procurement, manufacture, testing and ~~despatch~~dispatch.

6.2 The successful bidder shall furnish the following documents in required number of copies during the contract stage :

6.2.1 For approval

i) Dimensional/installation drawings.

ii) Data sheet-C, completely filled-up along with all the enclosures.

iii) Quality Plan of vendor/sub-vendor.

iv) Test Certificates.

6.2.2 Final/As-built Drawings

Final / As-built drawings / ~~RTFs~~ CDs in required number of copies shall be submitted.

6.3.0 Operation & Maintenance Manuals

O&M Manuals in required number of copies shall be submitted. O&M Manuals shall also contain storage & commissioning instructions.

7.0 MARKING AND PACKING

7.1 Marking

A stainless steel name-~~plate shall~~plate shall be permanently fixed on each equipment giving its Tag Number and technical specifications.

7.2 Packing

All equipment/materials shall be suitably packed and protected for the entire period of ~~despatch~~dispatch, storage and erection against impact, abrasion, corrosion, incidental damage due 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 and C for Pressure / Differential Pressure Gauge
(Data sheet no. PE-DC-999-145-I026-1)

FORM NO. PEM-6666-0

BHEL	**DATA SHEET FOR PRESSURE / DIFFERENTIAL PRESSURE SWITCH**	SPECIFICATION NO.:
		VOLUME
		SECTION
		REV. NO. / DATE:
		SHEET 1 OF 1

TAG No. …… Qty..... Data Sheet No.: **PES-145-31-DS1-0**

Data Sheet A & B

DATA SHEET-A FOR PRESSURE / DIFFERENTIAL PRESSURE SWITCH (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)

GENERAL	MANUFACTURER		
	MODEL NUMBER		
TECHNICAL	TYPE OF ELEMENT	☐ DIAPHRAGM ☐ BELLOW (for low range) ☐ PISTON ☐ BOURDON (for high range)	
	MATERIAL	ELEMENT: ☐ AISI 316 SS ☐ Ph. Br. CASING : DIE CAST AL	
	ENCLOSURE	☐ INDOOR MOUNTED IP-55 ☐ OUTDOOR MOUNTED IP-65 ☐ IP-67 ☐ FUEL GAS HAZARDOUS APPL. EXPL. PROOF	
	SWITCH TYPE	☐ MICRO ☐ ENCLOSURE HERMETICALLY SEALED	
	SWITCH CONTACT	TWO NOS. SPDT	
	SWITCH RATING	☐ 5A 230V AC ☐ 0.25A 220V DC	
	SETTING & DEAD BAND	ADJUSTABLE	
	MOUNTING	☐ DIRECT ☐ PANEL OR RACK	
	OVER RANGE PROTECTION	115% ABOVE 150 Kg/Cm2 125% BELOW 150 Kg/Cm2	
PERFORMANCE	ACCURACY (SCALE)	± 1%	
	REPEATABILITY	± 0.5%	
CONNECTION	PRESSURE CONNECTION	¼" NPT (F) AT BOTTOM	
	ELECTRICAL	WITH GLAND TO SUIT CABLE OF MAXIMUM O.D. 17.5 MM.	
INSTALLATION ACCESSORIES	AS PER ENCLOSED DRAWING		

	PREPARED BY	**CHECKED BY**	**APPROVED BY**	COMPANY SEAL
NAME				NAME
SIGNATURE				SIGNATURE
DATE				DATE

FORM NO. PEM-6666-0

	DATA SHEET FOR PRESSURE / DIFFERENTIAL PRESSURE SWITCH	SPECIFICATION NO.:
		VOLUME
		SECTION
		REV. NO. / DATE:
		SHEET 1 OF 1

TAG No. ……. Qty..... Data Sheet No.: **PES-145-31-DS2-0**

Data Sheet C

DATA SHEET-C FOR PRESSURE / DIFFERENTIAL PRESSURE SWITCH
(TO BE FILLED BY CONTRACTOR AFTER AWARD OF CONTRACT)

GENERAL	MANUFACTURER	
	MODEL NUMBER	
TECHNICAL	TYPE OF ELEMENT	
	MATERIAL	
	ENCLOSURE	
	SWITCH TYPE	
	SWITCH CONTACT	
	SWITCH RATING	
	SETTING & DEAD BAND	
	MOUNTING	
	OVER RANGE PROTECTION	
PERFORMANCE	ACCURACY (SCALE)	
	REPEATABILITY	
CONNECTION	PROCESS	
	ELECTRICAL	
INSTALLATION ACCESSORIES	AS PER DRG. ENCLOSED.	

	PREPARED BY	**CHECKED BY**	**APPROVED BY**	COMPANY SEAL
NAME				NAME
SIGNATURE				SIGNATURE
DATE				DATE

	SPECIFICATION FOR PRESSURE / DIFFERENTIAL PRESSURE SWITCH	SPECIFICATION NO.: PES – 145 – 031	
		VOLUME II B	
		SECTION D	
		REV. NO. 03	DATE : 16-05-2007
		SHEET 1	OF 3

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 of Pressure/Differential Pressure Switch for use in Utility/Captive Power Station/Combined Cycle Station.

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 The Design and Materials used for the components shall also comply with the relevant National and International standards.

2.3 As a minimum requirement, the following standards shall be complied with :
Enclosure : ISA:RP:8.1

3.0 TECHNICAL REQUIREMENTS

3.1 General

The pressure switches shall be suitable for an ambient temperature of 0-55°C and Relative Humidity of 0-95%.

3.2 Housing

Weather proof and dust tight housing made of Die-cast aluminium alloy. The external surface of the housing shall have a finish of light grey epoxy enamel.

3.3 Pressure Element

The pressure element shall be seamless hydraulically formed DIAPHRAGM/BELLOWS in Stainless steel/Phosphor Bronze for low pressure applications and stainless steel bourdon/piston for high pressure applications.

3.4 Switching differential

The switching differential shall be adjustable. The set point adjuster for the differential setting shall be inside the housing and shall be adjustable against a calibrated scale.

3.5 Pressure Connection

The pressure connection shall be at bottom. Size shall be 1/4" NPT (F) and material shall be stainless steel.

3.6 Electrical entry

Cable gland with Neoprene gourmet to suit PVC cable up to 17.5mm outside diameter.

3.7 Accuracy

$\pm$1% of scale range.

3.8 Micro-switch data

Micro-switch for AC/DC, single pole double throw, contacts having ratings 5 Amps at 230V AC, 0.25 Amps at 220V DC.

3.9 Over pressure range

The pressure switch shall function without any deterioration in the accuracy as specified in clause 3.8 when subjected to an over pressure of 25% above the ranges.

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 The bidder shall furnish the Quality Plan in the format enclosed in volume-III. In case the Quality Plan(s) is/are included in volume-IIB, the bidder shall furnish his Quality Plan strictly in line with the same. The Quality Plan shall be discussed and finalised with the technically accepted bidders before opening the price bid. The stages where the purchaser would like to be associated for witnessing or verification would be indicated by the purchaser in the Quality Plan before approval.

4.3 The following test shall be conducted as a minimum requirement.

a) Routine Tests

i) Repeatability.

ii) Over load.

iii) Contact Rating.

b) Type Tests

i) Enclosure Class (Weatherproof, water tight & dust tight test).

4.4 Inspection will be conducted by BHEL and/or their authorised representatives as per the agreed inspection schedule. The inspection schedule will be submitted by the bidder for BHEL's approval at contract stage. The cost of all tests and inspections will be deemed to have been included in the bid. For all the type tests covered under 4.3 (b), "Type Test Certificates" as per agreed Quality Plan shall be furnished. In the absence of the same, such Type Tests shall be arranged at the Vendor's works in the presence of BHEL and/or their authorised representatives or in independent Test House /Laboratory approved by BHEL.

4.5 The Standard QP is included in this specification to enable bidder to understand the extent of inspection and testing requirements to execute this job. The successful bidder has to follow the agreed QP, taking care of customer requirements mentioned in Sec-C and submit QP for final approval by BHEL / Customer.

5.0 SPARES AND CONSUMABLES

5.1 Recommended Spares

The bidder shall furnish a list of Recommended Spares alongwith 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.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 alongwith the bid :

6.1.1 Data sheet-B, completely filled-up alongwith all enclosures.

6.1.2 Quality Plan.

6.1.3 Catalogs wtih detailed technical information.

6.1.4 Bar-chart to indicate the time schedule for procurement, manufacture, testing and dispatch.

6.2 The successful bidder shall furnish the following documents in required number of copies during the contract stage :

6.2.1 For approval

i) Dimensional/Installation drawings.
ii) Data sheet-C, completely filled-up alongwith all the enclosures.
iii) Quality Plan of vendor/sub-vendor.
iv) Test Certificates.

6.2.2 Final/As-built Drawings

Final / As-built drawings / CD in required number of copies shall be submitted.

6.3 Operation & Maintenance Manuals

O&M Manuals in required number of copies shall be submitted. O&M Manuals shall also contain storage & commissioning instructions.

7.0 MARKING AND PACKING

7.1 Marking

A stainless steel name-plate shall be permanently fixed on each equipment giving its Tag Number and technical specifications.

7.2 Packing

All equipment/materials shall be suitably packed and protected for the entire period of dispatch, storage and erection against impact, abrasion, corrosion, incidental damage due 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 Pressure/Differential Pressure Switch : Data sheet no. PES-145-31-DS1-0
- Data sheet C Pressure/Differential Pressure Switch : Data sheet no. PES-145-31-DS2-0

BHEL	**SPECIFICATION FOR LEVEL TRANSMITTER (DISPLACEMENT TYPE)**	SPECIFICATION NO.: PES – 145 - 08	
		VOLUME II B	
		SECTION D	
		REV. NO. 01	DATE : 19.12.95
		SHEET 1 OF 4	

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 of Level Transmitter (Displacement Type) for use in Vacuum and low pressure services in Utility/Captive Power Station/Combined Cycle Station.

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 The Design and Materials used for the components shall also comply with the relevant National and International standards.

3.0 TECHNICAL REQUIREMENTS

3.1 General

The level transmitter shall be suitable for an ambient temperature 0-55°C & RH 0-95% and shall be equipped with all accessories required for specific service condition. Transmitters shall produce electric current output of 4-20mA proportional to the changes in liquid level.

3.2 Principle of operation

The operation of the Level Transmitter depends upon the movement of displacer due to level variation inside the vessel. The movement is converted into rotary movement by torque element and fed to a Rotary Variable Differential Transformer (RVDT) to obtain 4-20mA DC signal.

3.3 Output Signal

4-20mA DC two wire system.

3.4 Material

Cage (Displacer Chamber)	:	Forged carbon steel/Stainless Steel.
Displacer	:	SS 304/316 SS
Linkage & Torque Tube	:	316 SS

3.5 Rating of Body, Cage & End Connection:

Rating of Body, Cage & End Connection shall be as per Data Sheet.

3.6 Enclosure (Case & Cover)

The transmitter enclosure shall be as per IP-65 unless otherwise specified.

3.7 Zero and Span Adjustment

The transmitter zero and span shall be continuously adjustable through simple devices. The span and zero adjustments shall be independent and non interactive. Each transmitter shall be factory callibrated to the range specified in instrument data sheet.

3.8 Connection

The transmitter shall be supplied with flanged connection. Mating flanges with gasket & nut bolts shall be supplied.

3.9 Mounting

The level transmitter cage shall be mounted on the vessel through suitable flanged connection at top, bottom or side as specified in the Data Sheet.

3.10 Power Supply

The transmitter shall be suitable for 24V DC.

3.11 Signal Grounding

The design of transmitter electronic shall be such that grounding of any of the output wires will not damage the transmitter.

3.12 Cable Entry

Cable gland complete with neoprene gromet suitable for PVC cables with maximum diameter of 11.5mm shall be provided for cable entry. The actual size of the cable shall be indicated during contract stage.

3.13 Terminal Box

A Terminal Box shall be provided for the signal/supply and test terminals.

3.14 Performance Data

3.14.1	Linearity	:	± 1.0% of span or better.
3.14.2	Hysterisis	:	± 1.0% of span or better.
3.14.3	Repeatability	:	<0.5% of span or better.
3.14.4	Accuracy	:	± 1.0% of span or better.
3.14.5	Supply voltage variation effect	:	± 0.05% of span or better per volt.
3.14.6	Sp. gravity range	:	0.2 - 1.4
3.14.7	Action	:	Direct or reverse (As per Data Sheet)
3.14.8	Ambient temp. limits	:	80°C

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 The Quality Plan shall be discussed and finalised with the technically accepted bidders before opening the price bid. The stages where the purchaser would like to be associated for witnessing or verification would be indicated by the purchaser in the Quality Plan before approval.

4.3 The following test shall be conducted as a minimum requirement.

a) Calibration test to confirm compliance with clauses 3.14.1 to 3.14.10 of this specification.

b) IP 65 Enclosure (Type Test).

c) Over range pressure test to confirm compliance with clause 3.5 of this specification.

d) Hydraulic Test for the Cage & Transmitter Body with Displacer as per ANSI B16.34.1988.

4.4 Inspection will be conducted by BHEL and/or their authorised representatives as per the agreed inspection schedule. The inspection schedule will be submitted by the bidder for BHEL's approval at contract stage. The cost of all tests and inspections will be deemed to have been included in the bid. For all the items, "Type Test Certificates" as per agreed Quality Plan shall be furnished. In the absence of the same, such Type Tests shall be arranged at the Vendor's works in the presence of BHEL and/or their authorised representatives or in independent Test House/Laboratory approved by BHEL.

5.0 SPARES AND CONSUMABLES

5.1 Commissioning Spares and consumables

As part of the main equipment supply, the bidder shall supply all commissioning spares and consumables required during Start-up, commissioning and Trial-runs of the plant on as required basis.

5.2 Mandatory Spares

The bidder shall offer along with main offer 5% (Maximum 2 Nos.) transmitters of all types, range and model no. (for the measurement of Pressure, Diff. Pressure, Flow level etc.) . 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 along with the normal service expectancy period and frequency of replacement; quantities recommended for 3 years operation along with 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 :

6.1.1 Data sheet-B, completely filled-up along with all enclosures.

6.2 The successful bidder shall furnish the following documents in required number of copies during the contract stage :

6.2.1 For approval

i) Dimensional/Installation drawings.

ii) Data sheet-C, completely filled-up alongwith all the enclosures.

iii) Quality Plan of vendor/sub-vendor.

iv) Test Certificates.

6.2.2 Final/As-built Drawings

Final/As-built drawings/RTFs in required number of copies shall be submitted.

6.3 Operation & Maintenance Manuals

O&M Manuals in required number of copies shall be submitted. O&M Manuals shall also contain storage & commissioning instructions.

7.0 MARKING AND PACKING

7.1 Marking

A stainless steel name-plate shall be permanently fixed on each equipment giving its Tag Number and technical specifications.

7.2 Packing

All equipment/materials shall be suitably packed and protected for the entire period of despatch, storage and erection against impact, abrasion, corrosion, incidental damage due 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 Level Transmitter : Data sheet no. PES-145-08-DS1-0
- Data sheet C for Level Transmitter : Data sheet no. PES-145-08-DS2-0

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 of Pressure/Differential Pressure Transmitter for use in Utility/Captive Power Station/Combined Cycle Station.

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 The Design and Materials used for the components shall also comply with the relevant National and International standards.

3.0 TECHNICAL REQUIREMENTS

3.1 General

The transmitter shall be suitable for ambient temperature 0-55°C. and Relative humidity 0-95%. Transmitters shall be equiped with all accessories required for specific service conditions. Syphons shall be provided for steam service applications. Pulsation dampeners shall be provided for unstable process media such as discharge of pump. Diaphragm seals shall be used where the sensing element comes in contact with corrosive or dirty process fluid. The transmitter measurement for viscous process fluid shall be filled system type with separate Capillary and other required accessories. The transmitters shall be provided with suitable drain & vent points.

3.2 Principle of operation

The electronic differential pressure & pressure transmitters shall be as specified in the data sheet.

3.3 Output Signal

4-20mA DC two wire system unless otherwise specified.

3.4 Material

- Body : Forged Carbon Steel.
- Diaphragm : 316 SS
- Capsule : 316 SS
- Bellow : 316 SS
- Bourdon : 316 SS
- Measurement seal element : Teflon

3.5 Body Rating

Transmitter Body and measuring element (other than electronic housing shall be atleast 1.5 times the maximum process fluid pressure.

3.6 Zero and Span Adjustment

The transmitter zero and span shall be continuously adjustable through a simple field adjustment. The span and zero adjustment shall not interfere with each other. The ratio of maximum span to minimum span shall be atleast five (5) Each transmitter shall be factory callibrated to the range specified in instrument data sheet.

3.7 Zero Elevation or Supression

Zero Elevation or Supression for level measurement shall be provided as standard feature. The continuously adjustable zero elevation device wherever required by the operating range of the transmitter (range specified in data sheet) shall be supplied.

3.8 Working temperature of the cell body shall not be less than 100°C.

3.9 Process Connection

The transmitter shall be supplied fitted with 3/5 way valve manifolds having 1/2" NPT (F) connection for Process.

3.10 Mounting

The transmitter shall be suitable both for wall and pipe/stand mounting. Necessary mounting brackets, clamps, bolts and nuts shall be supplied along with transmitter as standard feature. The actual mounting requirement i.e. wall or pipe stand is indicated in the instrument data sheet.

3.11 Power Supply

The transmitter supply shall be 12 to 48V DC (4-20mA/0-20mA output).

3.12 Load Limit

The load limit shall be 500 Ohms at 24V DC and 1500 Ohms at 48V DC.

3.13 Reverse Polarity Protection

For reverse polarity connection of the power supply, there shall cause no damage to transmitter. Reverse current should be limited to 1 mA.

3.14 Signal Grounding

The design of transmitter electronic shall be such that either of the output wires may be grounded, causing no damage to transmitter.

3.15 Cable Entry

Cable gland complete with neoprene gromet suitable for PVC cables with maximum diameter of 17.5mm shall be provided for cable entry. The actual size of the cable shall be indicated during contract stage. Any other satisfactory arrangement for cable entry with proper sealing at entry shall also be acceptable.

3.16 Enclosure

The transmitter enclosure shall be as per NEMA-4 unless otherwise specified. Explosion proof enclosures shall be as per NEMA-7.

3.17 Terminal Box

A terminal unit accessible without exposing the transmitter mechanism shall be provided for signal/supply cable terminations and for test terminals.

3.18 Performance Data

3.18.1	Linearity	:	± 0.1% of span or better.
3.18.2	Hysterisis	:	± 0.1% of span or better.
3.18.3	Dead Band	:	± 0.1% of span or better.
3.18.4	Repeatability	:	± 0.1% of span or better.
3.18.5	Accuracy	:	± 0.5% of span or better.
3.18.6	Sensitivity	:	± 0.05% of span or better.
3.18.7	Stability	:	± 0.25% of span or better for six months.
3.18.8	Supply voltage variation effect	:	± 0.05% of span or better per volt.
3.18.9	Load resistance	:	± 0.0005% of span or better variation per ohm.
3.18.10	Vibration effect	:	Mechanical vibration in 3 mutually perpendicular planes with 0.07 mm amplitude from 10 to 60 Hz and 10m/sec2 acceleration from 60 to 150 Hz. shifts at 50% input shall be <0.01% of span.
3.18.11	Temperature variation effect	:	± 0.5% of span or better per deg.C.
3.18.12	EMI effect	:	DC magnetic field effect at 0% and 100% input upto 50 gauses. - On Zero : Less than 0.1%. - On Span : Less than 0.1%.
3.18.13	RFI effect	:	Radio frequency interference (upto 500 MHz), with field strength of 5 V/M shall not deviate the accuracy by more than 0.1%.

3.18.14 Damping : Damping shall be step or continuously adjustable so that time constant varies from 0-3s or 0-6s.

3.18.15 Static pressure : Zero shift < 0.5% of span for effect pressure change up to static pressure limit.

3.19 Accessories

3.19.1 Valve Manifolds

All differential pressure and pressure transmitters shall be supplied with 5 way and 3 way valve manifold respectively.

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 The bidder shall furnish the Quality Plan in the format enclosed in volume-III. In case the Quality Plan(s) is/are included in volume-IIB, the bidder shall furnish his Quality Plan strictly in line with the same. The Quality Plan shall be discussed and finalised with the technically accepted bidders before opening the price bid. The stages where the purchaser would like to be associated for witnessing or verification would be indicated by the purchaser in the Quality Plan before approval.

4.3 The following tests shall be conducted as a minimum requirement:

a) Calibration test to confirm compliance with clauses 3.18.1 to 3.18.5 of this specification.

b) Enclosure as specified in data sheet (Type Test).

c) Over range pressure test to confirm compliance with clause 3.5 of this specification.

4.4 Inspection will be conducted by BHEL and/or their authorised representatives as per the agreed inspection schedule. The inspection schedule will be submitted by the bidder for BHEL's approval at contract stage. The cost of all tests and inspections will be deemed to have been included in the bid. For all the items, "Type Test Certificates" as per agreed Quality Plan shall be furnished. In the absence of the same, such Type Tests shall be arranged at the Vendor's works in the presence of BHEL and/or their authorised representatives or in independent Test House/Laboratory approved by BHEL.

5.0 SPARES AND CONSUMABLES

5.1 Commissioning Spares and consumables

As part of the main equipment supply, the bidder shall supply all commissioning spares and consumables required during Start-up, commissioning and Trial-runs of the plant on as required basis.

5.2 Mandatory Spares

The bidder shall offer alongwith main offer, the Mandatory Spares as specified in Volume IIB Section C of 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 alongwith 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 seperate order later, if required.

6.0 DRAWINGS AND DOCUMENTS

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

6.1.1 Data sheet-B, completely filled-up alongwith all enclosures.

6.1.2 Quality Plan.

6.1.3 Catalogues with detailed technical information.

6.1.4 Bar-chart to indicate the time schedule for procurement, manufacture, testing and despatch.

6.2 The successful bidder shall furnish the following documents in required number of copies during the contract stage :

6.2.1 For approval

i) Dimensional/installation drawings.

ii) Data sheet-C, completely filled-up along with all the enclosures.

iii) Quality Plan of vendor/sub-vendor.

iv) Test Certificates.

6.2.2 Final/As-built Drawings

Final/As-built drawings/RTFs in required number of copies shall be submitted.

6.3.0 Operation & Maintenance Manuals

O&M Manuals in required number of copies shall be submitted. O&M Manuals shall also contain storage & commissioning instructions.

7.0 MARKING AND PACKING

7.1 Marking

A stainless steel name-plate shall be permanently fixed on each equipment giving its Tag Number and technical specifications.

7.2 Packing

All equipment/materials shall be suitably packed and protected for the entire period of despatch, storage and erection against impact, abrasion, corrosion, incidental damage due 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 and C for Pressure/Differential Pressure Transmitter	:	Data sheet no. PES-145-01-DS1-0
Data sheet C for Pressure/Differential Pressure Transmitter	:	Data sheet no. PES-145-01-DS2-0

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 of Temperature Element (with Thermowell) for use in Utility/Captive Power Station/Combined Cycle Station.

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 The Design and Materials used for the components shall also comply with the relevant National and International standards.

3.0 TECHNICAL REQUIREMENTS

3.1 General

The temperature sensor elements shall be duplex type, either thermocouple (T/C) or resistance temperature detector (RTD). Unless otherwise specified in the data sheet, the type of sensors for different applications shall be as follows:

i) Chromel - Alumel T/C medium temp. range (250˚C to 600˚C)

ii) Platinum-Rhodium Platinum High temp. range (600˚C and above). Type S/R/B.

iii) Platinum RTD Low temperature & high accuracy (-50˚C to 250˚C).

3.2 Process Parameters

Process parameters such as line size, pressure, temperature, fluid medium are given in the instrument data sheet.

3.3 Thermocouple Wire Size

The thermocouple wire size for a given temperature application shall be as per table – 3.1A of ASME PTC 19.3 – 1974.

3.4 Sensor Grounding

Thermocouple junction shall be generally ungrounded type unless specified otherwise in the data sheet for the thermocouple.

3.5 Sensor Protective Sheath & Wire Insulation

The sensor protective sheath shall be 8mm OD 316 SS seamless tube using compacted magnesium oxide packing/porcelain for insulation.

3.6 Sensor Characteristics

Thermocouple calibration characteristics i.e. temperature vs. milli volt or resistance shall be as per the applicable Indian Standards (IS-2054 for thermocouple 'K' type, IS-2055 for Pt.Rd.Pt.), RTD type of sensor calibration i.e. temperature vs. resistance shall be as per the applicable Indian Standard (IS-2848).

3.7 Sensor Accuracy Limits

T/C sensor limiting accuracy shall be as per table 3.2A of ASME PTC 19.3 – 1974. RTD sensor accuracy shall be as per table 9.1 of ASME PTC – 19.3 – 74.

3.8 Insulation Resistance

Insulation resistance of RTD leads w.r.t. body shall be more than 5 mega ohms at 100V DC.

3.9 End Connection

The sensor assemblies shall have screwed M33 x 2 end connection. Specific design requirements of pressure, temperature and end connection type for a given application are indicated in the instrument data sheet.

3.10 Terminal Head

Terminal head cover shall be screwed type design having gasket with small flexible chain attached between fixed portion and head cover.

3.10.1 Terminal Head Enclosure

The terminal head enclosure shall be dust, weather proof and water proof as per NEMA-4 classification unless specified otherwise.

3.10.2 Terminals

The terminal head shall have provision of screwed terminal of 1.5 mm^2 size for external connection. The terminals shall be suitably marked '+ve' & '-ve' for thermocouple and 'Lo', 'Hi' and 'C' for three wire RTD.

3.11 Cable Entry

Cable gland complete with neoprene gromet suitable for PVC cable with maximum diameter of 17.5mm shall be provided for cable entry. The actual size of cable shall be indicated during the contract stage. Separate cable entry and cable glands shall be provided for both the elements.

3.12 Thermowell

Temperature element shall be supplied along with the thermowell. The thermowell shall be of tungstion carbide for mill air temperature and for rest of the applications of AISI 316SS forged bar stock shall be designed to suit the process conditions. For detail of the thermowell, see enclosed drawing.

3.12.1 Thermowell Extension Length

Temperature sensor assemblies shall have extension length as specified in tables so that the terminal head clears the pipe line insulation. The extra extension length requirement if any, special applications shall be indicated in the data sheet.

3.12.2 Material of Thermowell Assemblies

Material of thermowell assemblies as indicated in clause 3.12 unless specified otherwise. The thermowell shall be machined out of solid bar stock. The surface of thermowell over working length portion shall be polished. Thermowell shall be with taper profile. For details of the thermowell see Fig. (1) & Fig. (2).

3.12.3 Internal Construction

Sensor assemblies shall preferably be metal sheathed with spring load on to the thermowell tip for better response. The sheathed sensor assembly shall be replaceable (in-situ) type without removal of thermowell.

3.12.4 Compensating cable should be used for connecting elements to secondary Instruments/Device unless there is specific requirement for cold junction compensation. Field mounted cold junction compensation box as per NEMA-4 shall be provided for all thermocouples. The CJC box shall have automatic temperature control at reference junction temperature of 60 Deg. C. Each CJC box shall be provided with duplex RTD for remote monitoring.

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 The bidder shall furnish the Quality Plan in the format enclosed in volume-III. In case the Quality Plan(s) is/are included in volume-IIB, the bidder shall furnish his Quality Plan strictly in line with the same. The Quality Plan shall be discussed and finalised with all the technically accepted bidders before opening the price bid. The stages where the purchaser would like to be associated for witnessing or verification would be indicated by the purchaser in the Quality Plan before approval.

4.3 The following routine tests shall be conducted as a minimum requirement :-

4.3.1 Physical dimension of the sensor assemblies as per approved drawing.

4.3.2 Electrical characteristic of sensor such as continuity of the thermocouple wires, and insulation resistance of the RTD leads w.r.t. body.

4.3.3 Temperature vs. Resistance / milli volt for the sensor assemblies shall be tested with reference to standard resistance thermometer by comparison method. This test may be carried out once for the T/C or RTD sensor wires for each batch production.

4.3.4 Each type of high pressure thermowell assembly with thread end connection shall be tested against hydrostatic test pressure of one & a half times the maximum working pressure for any leakage. However dimensional checks and thread conformity with gauges shall be checked for each sensor assembly.

4.4 Inspection will be conducted by BHEL and/or their authorised representatives as per the agreed inspection schedule. The inspection schedule will be submitted by the bidder for BHEL's approval at contract stage. The cost of all tests and inspections will be deemed to have been included in the bid. For all the items, "Type Test Certificates" as per agreed Quality Plan shall be furnished. In the absence of the same, such Type Tests shall be arranged at the Vendor's works in the presence of BHEL and/or their authorised representatives or in independent Test House / Laboratory approved by BHEL.

5.0 SPARES AND CONSUMABLES

5.1 Commissioning Spares and consumables

Nil.

5.2 Mandatory Spares

Nil.

5.3 Recommended Spares

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

5.4 Special Tools & Tackles

Nil.

6.0 DRAWINGS AND DOCUMENTS

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

6.1.1 Data sheet-B, completely filled-up along with all enclosures.

6.1.2 Quality Plan of bidder.

6.1.3 Catalogs with detailed technical information.

6.1.4 Bar-chart to indicate the time schedule for manufacture testing and despatch.

6.1.5 Schedule for manufacturing, testing and dispatch (Enclosed in Vol.-II B).

6.2 The successful bidder shall furnish the following documents in required number of copies to BHEL during the contract stage :

6.2.1 For approval

i) Dimensional drawings.

ii) Installation drawings with overall dimensions of the completed equipment and clearances for operation and maintenance.

iii) Data sheet-C, completely filled-up along with all the enclosures.

iv) Quality Plan of vendor/sub-vendor.

v) Test Certificates.

6.2.2 For information

i) Storage instructions.

ii) Commissioning instructions.

6.2.3 Final/As-built Drawings

Final/As-built drawings/RTFs in required number of copies shall be submitted.

6.3 Operation & Maintenance Manuals

O&M Manuals in required number of copies shall be submitted.

7.0 MARKING AND PACKING

7.1 Marking

A metal name-plate should be permanently fixed on each equipment giving its Tag Number and technical specifications.

7.2 Packing

All equipment / materials shall be suitably packed and protected for the entire period of despatch, storage and erection against impact, abrasion, corrosion, incidental damage due to vermin, sunlight, high temperature, rain moisture, humidity, dust, sea-water spray (where applicable) as well as rough handling and delays in transmit and storage is 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 Temperature Element (With Thermowell) : Data sheet no. PES-145-03-DS1-0

- Data sheet C for Temperature Element (With Thermowell) : Data sheet no. PES-145-03-DS2-0

	SPECIFICATION FOR LEVEL SWITCH	SPECIFICATION NO.: PES – 145 – 033	
		VOLUME II B	
		SECTION D	
		REV. NO. 01	DATE : 27.07.94
		SHEET 1	OF 3

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 of Level Switch (Float type/displacer type) for use in Utility/Captive Power Station/Combined Cycle Station.

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 The Design and Materials used for the components shall also comply with the relevant National and International standards.

3.0 TECHNICAL REQUIREMENTS

3.1 General

The switches shall be magnetically operated, glandless type, suitable for tropical climate for operation at 0-55°C and Relative Humidity 0-95%. The switch shall be suitable for top mounting or side mounting with external chamber.

3.2 Housing

The switch housing shall be of die cast Aluminium/SS-304, weather proof, drain tight, water tight and dust tight as per NEMA 4.

3.3 Float Assembly/Displacer

The float assembly/displacer shall be made of stainless steel to AISI:316. Wire rope, spring housing, sleeve pipe shall also be of AISI:316.

3.4 External Chamber

The material for external chamber for side mounted level switches shall be as per data sheet and shall be of suitable thickness.

A drain plug shall be provided in the external chamber to facilitate testing.

The external chamber and the float assembly shall be arranged from the Level Switch supplier and not fabricated at site.

3.5 Mounting

The switch shall be suitable for direct mounting on the vessel at top or side mounted on an external chamber connected to the vessel.

3.6 Switching Data

The switch shall be single pole double throw (SPDT) or Double Pole Double Throw (DPDT) as specified in the data sheet.

The switch contacts shall be suitable for current rating 5A at 230V AC and 0.25A at 220V DC.

3.7 Differential

The differential between make and break shall be 12 ±2 mm for side mounted and 35 $\pm$3 mm for top mounted. Other adjustable range to suit the specific requirement shall also be acceptable.

3.8 Specific gravity of the fluid

Specific gravity of the fluid shall be 0.7 to 1.2.

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 The bidder shall furnish the Quality Plan in the format enclosed in volume-III. In case the Quality Plan(s) is/are included in volume-IIB, the bidder shall furnish his Quality Plan strictly in line with the same. The Quality Plan shall be discussed and finalised with the technically accepted bidders before opening the price bid. The stages where the purchaser would like to be associated for witnessing or verification would be indicated by the purchaser in the Quality Plan before approval.

4.3 The following test shall be conducted as a minimum requirement.

a) Routine Tests

i) Repeatability Test.

ii) Contact Rating Test.

b) Type Tests

Weatherproof, water tight & dust tight test.

4.4 Inspection will be conducted by BHEL and/or their authorised representatives as per the agreed inspection schedule. The inspection schedule will be submitted by the bidder for BHEL's approval at contract stage. The cost of all tests and inspections will be deemed to have been included in the bid. For all the type tests covered under 4.3 (b), "Type Test Certificates" as per agreed Quality Plan shall be furnished. In the absence of the same, such Type Tests shall be arranged at the Vendor's works in the presence of BHEL and/or their authorised representatives or in independent Test House /Laboratory approved by BHEL.

5.0 SPARES AND CONSUMABLES

5.1 Commissioning Spares

The bidder shall supply all commissioning spares along with the equipment.

5.2 Recommended Spares

The bidder shall furnish a list of Recommended Spares along with the normal service expectancy period and frequency of replacement; quantities recommended for 3 years operation along with 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:

6.1.1 Data sheet-B, completely filled-up along with all enclosures.

6.1.2 Quality Plan.

6.1.3 Catalogs with detailed technical information.

6.1.4 Bar-chart to indicate the time schedule for procurement, manufacture, testing and despatch.

6.2 The successful bidder shall furnish the following documents in required number of copies during the contract stage:

6.2.1 For approval

i) Dimensional/Installation drawings.
ii) Data sheet-C, completely filled-up along with all the enclosures
iii) Quality Plan of vendor/sub-vendor.
iv) Test Certificates.

6.2.2 Final/As-built Drawings

Final/As-built drawings/RTFs in required number of copies shall be submitted.

6.3 Operation & Maintenance Manuals

O&M Manuals in required number of copies shall be submitted. O&M Manuals shall also contain storage & commissioning instructions.

7.0 MARKING AND PACKING

7.1 Marking

A stainless steel name-plate shall be permanently fixed on each equipment giving its Tag Number and technical specifications.

7.2 Packing

All equipment/materials shall be suitably packed and protected for the entire period of despatch, storage and erection against impact, abrasion, corrosion, incidental damage due 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 Level Switch (Float/Displacer type) : Data sheet no. PES-145-33-DS1-0

- Data sheet C for Level Switch (Float/Displacer type) : Data sheet no. PES-145-33-DS2-0

	SPECIFICATION FOR LEVEL TRANSMITTER (CAPACITANCE TYPE)	SPECIFICATION NO.: **PE-SS-999-145-I011**
		VOLUME II B
		SECTION D
		REV. NO. 00 DATE : 15.09.10
		SHEET 1 OF 8

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 of Level Transmitter (Capacitance Type) for use in the tanks/chambers for oil applications.

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 The Design and Materials used for the components shall also comply with the relevant National and International standards.

2.3 This specification is based on BHEL experience.

3.0 TECHNICAL REQUIREMENTS

The transmitter shall be complete with sensor, preamplifier, amplifier, plug receptacle connector, connecting cables etc. as per detail below.

The basic measurement function shall be based on variable capacitance principle.

3.1 SENSORS:

The sensor shall be based on variable capacitance principle consisting of rod probe with ground tube of SS-316 as per dimensions given in Fig. 1

The probe and the ground tube form a capacitor whose capacitance changes on the change in level due to difference in the dielectric constant of the liquid media and that of air.

3.2 PREAMPLIFIER

The preamplifier shall convert the change in the capacitance to a suitable electrical signal for transmission to an amplifier which is located away to a safer distance.

The preamplifier shall be mounted on the sensor head as per mounting and connection arrangement shown in fig 2. The protection class shall be IP65 (minimum) as per IS: 13947 (part 1) and ambient temperature should be 0 degree C to +60 degree C

3.3 AMPLIFIER

The output signal from the preamplifier shall be amplified and processed for the desired output. The amplifier shall have provision of adjustment and calibration. The measuring range shall be adjustable so that output can be calibrated for any range between 0-50% to 0-100% of the span L1 (Ref fig 1). Provision shall be made to shift the range above or below so as to cover the entire length of the probe.

The other requirements are given below:

3.3.1 Measuring Range (Ref fig 1) : Equal to the length of the probe

3.3.2 Output :4-20 mill ampere Galvanically isolated DC for Upto 500 ohm for any range as specified at Cl 3.3

3.3.3	Power Supply	: 24 VDC or 240VAC, 50 Hz
3.3.4	Accuracy	: +/-2.0% of full span or better
3.3.5	Protection Class	: IP65 (minimum) OR better
3.3.6	Housing	: Die Cast Aluminum stoving enamel painted, Weather proof, projection mounting
3.3.7	Ambient Temperature	: 0 degree C to + 60 degree C

3.3.8 Amplifier can be separately mounted or head mounted. For head mounted type refer fig 4

4.0 ELECTRICAL CONNECTIONS

All cables from sensor to preamplifier and/or to amplifier shall be in bidder's scope.

All connections will be plug in connections.

5.0 SURFACE PROTECTION OF AMPLIFIER AND PROBE HEAD

The external surface shall be so treated that it can withstand a sustained environment of phosphoric fume at 60 degree C and/or medium turbine oil at 60 degree C

6.0 MARKING AND PACKING

6.1 Marking

Following details shall be marked on the packing case.

a) Manufacturer's name or trade mark
b) BHEL Order No.

Each instrument shall have a stainless steel name plate marked on it the following

a) Tag No.
b) Technical Specifications
c) Manufacturer's name or trade mark
d) Type of the instrument
e) Model number of the manufacturer
f) Range of measurement
g) Accuracy

A name-plate shall be permanently fixed on each equipment giving its Tag Number and technical

specifications.

6.2 Packing

All equipment/materials shall be suitably packed and protected for the entire period of dispatch, storage and erection against impact, abrasion, corrosion, incidental damage due 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.

Each instrument with dehydrating agent shall be sealed individually in polythene sheets and packed jn a thermocole box. Such Boxes shall be packed in a carton or case with adequate cushioning material to withstand normal transit risk.

7.0 TESTING AND INSPECTION

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

7.2 The following test shall be conducted by supplier as a minimum requirement on each piece of sensor and indicator/amplifier.

7.2.1 ROUTINE TESTS

a) Visual Inspection and dimensional check

b) Functional Test for adjustable range

c) Accuracy Tests

d) Burn in test for amplifier electronics

7.2.2 Type Tests

Type test reports (not more than 5 years old) shall be furnished for the following additional tests on amplifier electronics as per IEC 60068

a) Damp Heat Test
b) Temperature Cycle Test
c) Dry Heat Test
d) Vibration Test
e) Protection Class

Inspection will be conducted by BHEL and/or their authorized representatives as per the agreed inspection schedule. The inspection schedule will be submitted by the bidder for BHEL's approval at contract stage. The cost of all tests and inspections will be deemed to have been included in the bid. For all the items, "Type Test Certificates" as per agreed Quality Plan shall be furnished. In the absence of the same, such Type Tests shall be arranged at the Vendor's works in the presence of BHEL and/or their authorized representatives or in independent Test House/Laboratory approved by BHEL at their cost.

8.0 TEST CERTIFICATES

Each piece of sensor/preamplifier/amplifier shall accompany with three copies of test certificates with:

a) Name of the instrument
b) Name of the manufacturer
c) Serial No and model no. of the instrument
d) Date of testing

Results of the test detailed in clause 6.0

9.0 GUARANTEE CERTIFICATE

Each piece of sensor/preamplifier/amplifier shall accompany a guarantee certificate for trouble free performance for 24 months from the date of shipment or 12 months from the date of commissioning whichever is earlier.

10.0 QUALITY PLAN

Detail quality plan for the tests and checks to be carried out during material induction, manufacturing and at final stage shall be submitted in BHEL's format along with in-house standard procedures/normal for BHEL's approval.

11.0 SPARES AND CONSUMABLES

11.1 Commissioning Spares and consumables

As part of the main equipment supply, the bidder shall supply all commissioning spares and consumables required during Start-up, commissioning and Trial-runs of the plant on as required basis.

11.2 Mandatory Spares:

The Mandatory Spares offered shall be of the same make and type as the main equipment.

11.3 Recommended Spares

The bidder shall furnish a list of Recommended Spares along with the normal service expectancy period and frequency of replacement; quantities recommended for 5 years operation along with unit rate against each item to enable BHEL/BHEL's Customer to place a separate order later, if required.

12.0 DRAWINGS AND DOCUMENTS

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

12.1.1 Technical literatures including drawings and Data sheet-B, completely filled-up along with all enclosures.

12.2 The successful bidder shall furnish the following documents in required number of copies during the contract stage:

12.2.1 for approval

i) Dimensional/Installation drawings.

ii) Data sheet-C, completely filled-up along with all the enclosures.

iii) Quality Plan of vendor/sub-vendor.

iv) Test Certificates.

12.2.2 Final/As-built Drawings

Final/As-built drawings/RTFs in required number of copies shall be submitted.

12.3 Operation & Maintenance Manuals

O&M Manuals in Hard Copy and soft form (1CDROM) in required number of copies shall be submitted. O&M Manuals shall also contain storage & commissioning instructions.

13.0 APPLICABLE DATA SHEET FORMS

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

- Data sheet A for Level Transmitter(capacitance type)
- Data sheet C for Level Transmitter(capacitance type)

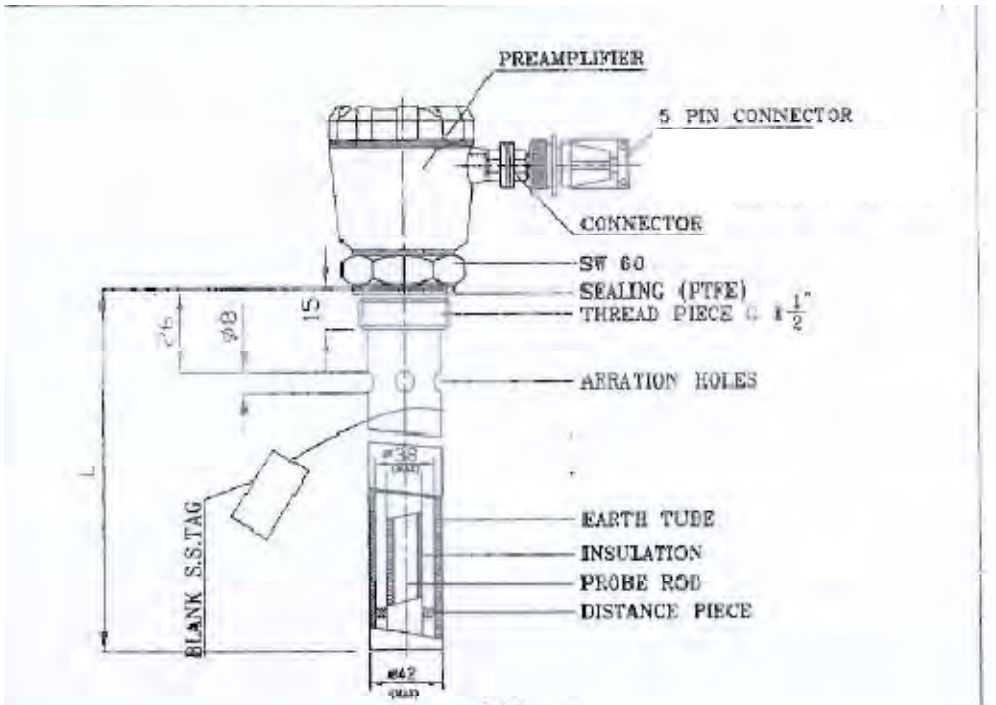


FIG. 1

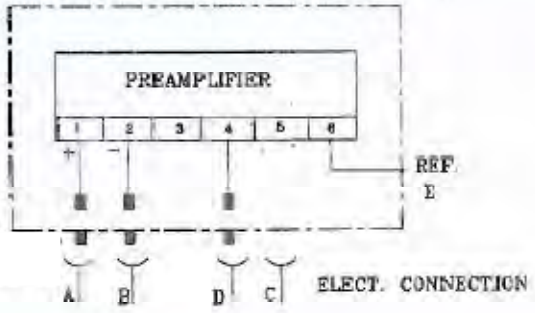


FIG 2

Pls Note: Shape of the instrument shown is typical .Actual shape may vary with make.

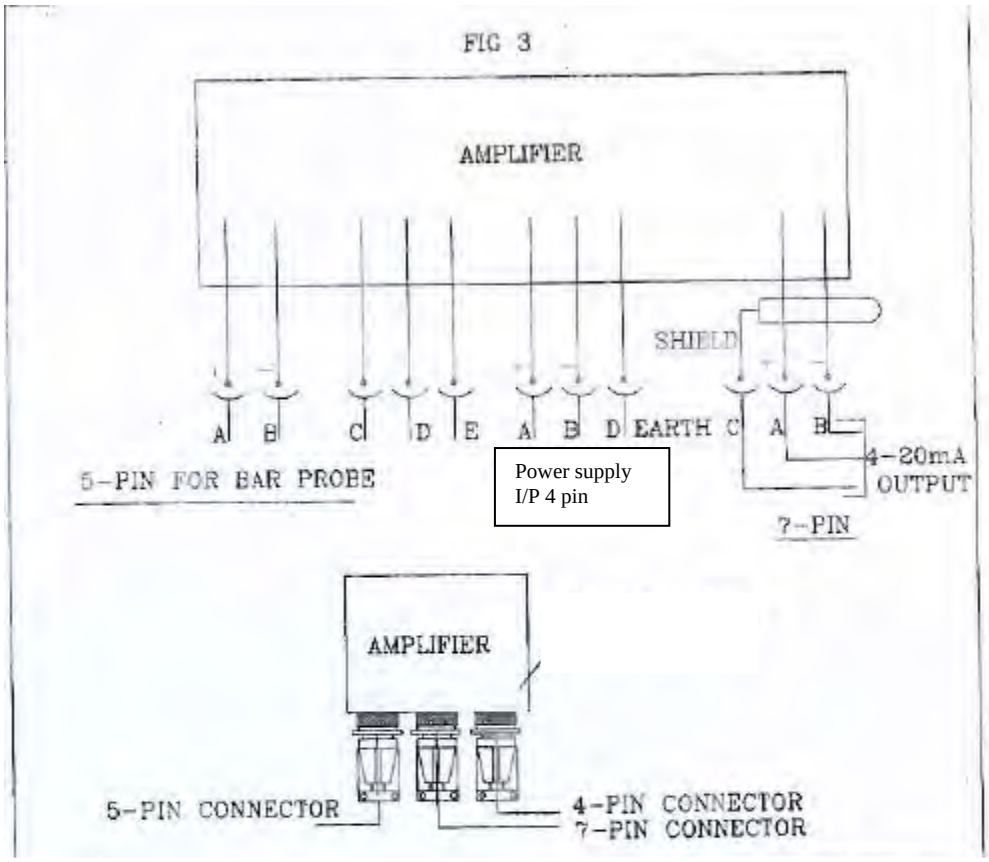
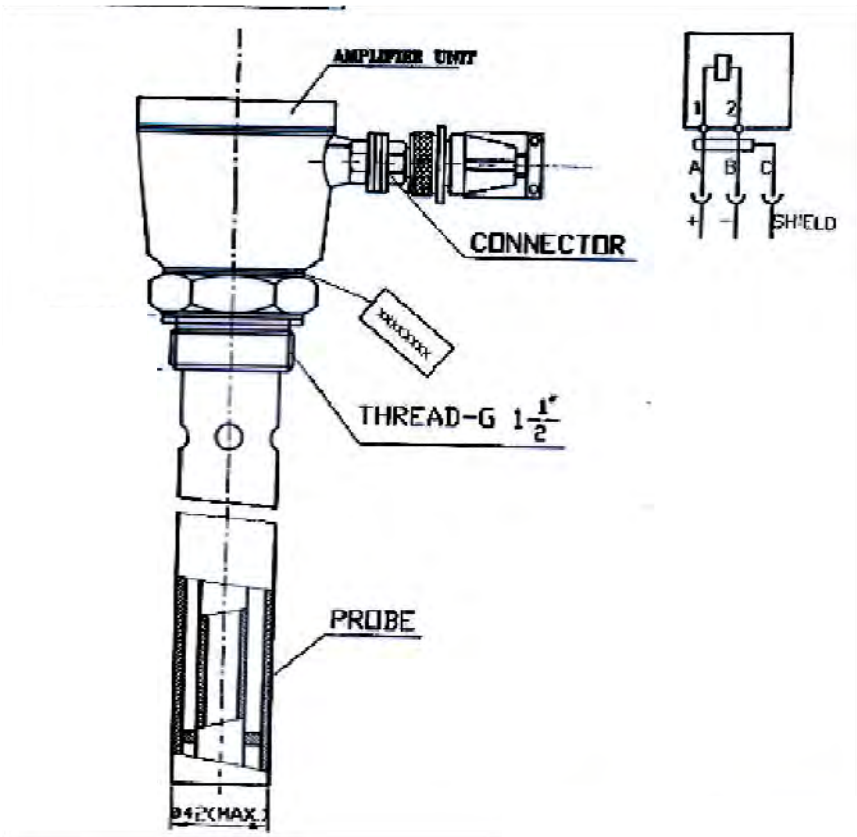


FIG 3
AMPLIFIER
SHIELD
A B C D E A B D EARTH C A B
5-PIN FOR BAR PROBE
Power supply
I/P 4 pin
4-20mA
OUTPUT
7-PIN
AMPLIFIER
5-PIN CONNECTOR
4-PIN CONNECTOR
7-PIN CONNECTOR

FIGURE 4(For Level Tx. With Integral amplifier)



TECH.REQUIREMENTS:-

1. VARIABLE CAPACITANCE TYPE LEVEL TRANSMITTER WITH AMPLIFIER INTEGRAL WITH PROBE HEAD.
2. FOR OTHER DETAILS REF. TECH. SPEC.
3. CONSTRUCTION FEATURES, TEST, TEST CERTIFICATES,GUARANTEE,DOCUMENTS, PACKING AND MARKING SHALL BE AS GIVEN IN STANDARD
4. DRAWING, TEST CERTIFICATES & DATA SHEET TO BE SUBMITTED FOR APPROVAL ALONG WITH THE OFFER.
5. PLUG CONNECTOR 3 PIN FOR POWER SUPPLY AND 4 TO 20 m. a. OUT PUT.
6. BOTH, MALE & FEMALE CONNECTORS SHOULD BE DULY FITTED WITH AMPLIFIER & DULY ASSEMBLED TOGETHER. THIS IS TO BE ENSURED BEFORE DESPATCH.
7. SHAPE OF THE INSTRUMENT SHOWN IS TYPICAL. ACTUAL SHAPE MAY VARY WITH MAKE.

Tag No.

DATA SHEET – A

DATA SHEET – A
(TO BE FILLED BY PURCHASER)

GENERAL	MAKE MODEL NO.	BIDDER TO SPECIFY BIDDER TO SPECIFY
SERVICE	MEDIUM UPPER FLUID TYPE PRESSURE OPERATING / DESIGN. TEMP. OPERATING / DESIGN. AMBIENT TEMPERATURE	LIQUID(OIL) OIL AS PER PROJECT DATA AS PER PROJECT DATA 0 – 60 C
PROCESS CONNECTION	THREADED	1 ½" BSP(M)
PROBE HEAD	ENCLOSURE CLASS CABLE ENTRY SIZE/ NO. HOUSING MATERIAL	IP-65 PLUG IN CABLE 5 PIN (INT) DIE CAST ALUMINIUM
	POWER SUPPLY	240VAC , 50 Hz OR 24VDC

	PRPED BY	CHKD BY	APPD BY
NAME SIGN DATE			

Tag No.

DATA SHEET – A

DATA SHEET – A
(TO BE FILLED BY PURCHASER)

ELECTRODE	ELECTRODE TYPE	ROD
	SENSING ELECTRODE MATERIAL	SS316
	SHEATING COATING	PTFE
	OUTER PIPE SIZE	AS REQUIRED
	OUTER PIPE MATERIAL	SS316
	LENGTH	AS PER PROJECT DATA
	OUTPUT	4 – 20 mA galvanically isolated DC for upto 500ohm
	ACCURACY	+/- 2.0% of full span or better
	ALL CONNECTIONS	AS PER SKETCHES ENCLOSEED

	PRPED BY	**CHKD BY**	**APPD BY**
NAME			
SIGN			
DATE			

NOTE: Amplifier can be head mounted or separately mounted. In case of separately mounted amplifier bidder to supply necessary erection hardware as well as necessary cable from sensor/preamplifier to separately mounted amplifier (approx 10-15 meters)

Tag No.

DATA SHEET – C

DESCRIPTION		DATA SHEET - C (TO BE FILLED BY THE VENDOR AFTER AWARD OF CONTRACT)
GENERAL	MAKE MODEL NO.	
SERVICE	MEDIUM UPPER FLUID TYPE PRESSURE OPERATING / DESIGN. TEMP. OPERATING / DESIGN. AMBIENT TEMPERATURE	
PROCESS CONNECTION	THREADED	
PROBE HEAD	ENCLOSURE CLASS CABLE ENTRY SIZE/ NO. HOUSING MATERIAL	
	POWER SUPPLY	

	PRPED BY	**CHKD BY**	**APPD BY**
NAME SIGN DATE			

Tag No.

DATA SHEET – C

DESCRIPTION		DATA SHEET - C (TO BE FILLED BY THE VENDOR AFTER AWARD OF CONTRACT)
ELECTRODE	ELECTRODE TYPE SENSING ELECTRODE MATERIAL SHEATING COATING OUTER PIPE SIZE OUTER PIPE MATERIAL LENGTH	
	OUTPUT ACUURACY	
	ALL CONNECTIONS	

	PRPED BY	**CHKD BY**	**APPD BY**
NAME SIGN DATE			

NOTE: Amplifier can be head mounted or separately mounted. In case of separately mounted amplifier bidder to supply necessary erection hardware as well as necessary cable from sensor/preamplifier to separately mounted amplifier (approx 10-15 meters)

PEM :: C&I	STANDARD QUALITY PLAN FOR LEVEL TRANSMITTER (CAPACITANCE TYPE)	QP NO.-	PE-QP-999-145-I011
		VOLUME : IIB	SECTION : D
		REV : 00	DATE : 15.09.10

SL NO.	TEST/CHECKS	QUANTUM OF CHECK	REF DOC ACCEPTANCE NORMS	AGENCY			REMARKS
				P	W	V	
1	CHECK FOR TYPE MAKE MODEL NO.	SEE NOTE -1 BELOW	APPROVED SPEC./ DATA SHEET	3/2	2/1	1	ROUTINE TEST
2	FUNCTIONAL TEST	DO	DO	3/2	2/1	1	ROUTINE TEST
3	ACCURACY TEST	DO	DO	3/2	2/1	1	ROUTINE TEST
4	BURN IN TEST	DO	DO	3/2	___	1	ROUTINE TEST
5	DAMP HEAT TEST	DO	DO	3/2	___	1	TYPE TEST
6	TEMP. CYCLE TEST	DO	DO	3/2	___	1	TYPE TEST
7	DRY HEAT TEST	DO	DO	3/2	___	1	TYPE TEST
8	VIBRATION TEST	DO	DO	3/2	___	1	TYPE TEST
9	PROTECTION TEST	DO	DO	3/2	___	1	TYPE TEST

LEGEND:	ALL RECORDS SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR ON QA DOCUMENTATION
	1:BHEL 2:VENDOR 3:SUBVENDOR
	P:PERFORM W:WITNESS V:VERIFICATION

NOTE :	1) QUANTUM OF CHECK SHALL BE AS FOLLOWS :
	100% BY MANUFACTURER
	5% BY BHEL
	NIL BY CUSTOMER
	2) MANUFACTURER TO MAINTAIN CALIBRATED INSTRUMENT HAVING BETTER ACCURACY THAN THE ITEM UNDER TEST.INSPECTING ENGINEER SHALL CHECK THE SAME
	3) TYPE TEST REPORTS SHOULD NOT BE MORE THAN 5 YEARS OLD ELSE VENDOR HAS TO CONDUCT THE SAME AT THEIR OWN COST

Instrumentation Check List

CHECK LIST FOR PRESSURE SWITCH

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	V	V	
	1.1 MODEL NO/TAG NO						
	1.2 RANGE						
	1.3 END CONN						
	1.4 NO. OF CONTACT						
2	CALIBRATION			P	V	V	
	2.1 REPEATABILITY						
	2.2 SET POINT ADJUSTMENT						
	2.3 DIFFERENTIAL						
3	OVER PR & LEAK TEST			P	V	V	
4	ELECT. INSULATION/HV TEST	ONE		P	V	V	
5	REVIEW OF TC FOR MATERIALS OF	FOR LOT		V	V	V	
	5.1 SENSOR						
	5.2 MOVEMENT						
	5.3 PROCESS CONNECTION						
	5.4 HOUSING						
6	REVIEW OF TC FOR DEGREE OF PROTECTION	TYPE TEST		V	V	V	
7	REVIEW OF TC OF MICROSWITCH	FOR LOT		V	V	V	

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL,
P = Perform, W = Witness, V = Verification

Note :

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to carry out ROUTINE TEST on 100 %.
3. Contractor to provide compliance certificate for tests/checks verifid by contractor and the same alongwith test certificates to be verified by BHEL

STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR TRANSMITTER

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECKS FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	VISUAL.						
	MODEL/TAG No						
2	PROCESS CONNECTION			P	W	V	
3	ACCURACY			P	W	V	
4	REPEATABILITY			P	W	V	
5	HYSTERESIS			P	W	V	
6	EFFECT OF TEMP VARIATION ON ACCURACY			P	W	V	
7	SPAN / ZERO ADJUSTMENT	ONE / TYPE		P	W	V	
8	EFFECT OF SUPPLY VOLTAGE VARIATION			P	W	V	
9	EFFECT OF LOADING (500 OHM METERS)			P	W	V	
10	HIGH PRESSURE TEST	SEE NOTE-1 BELOW		P	W	V	
11	BURN-IN TEST	ONE / TYPE		P	W	V	
12	DEGREE OF PROTECTION			P	W	V	
13	ACCESSORIES AS APPLICABLE	SEE NOTE-1 BELOW		V	V	V	

Legend :

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, P = Perform, W = Witness, V = Verification

Note :

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
3. When material corelation are not available manufacturer's compliance to be provided.
4. Contractor to provide compliance certificate for tests/checks verifid by contractor and submit the same alongwith test certificates to be verified by BHEL.

STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR PRESSURE & DP GAUGE

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	SENSOR TYPE						
	DIAL SIZE						
	MODEL NO/TAG NO						
	RANGE/SCALE						
	SWITCH CONTACT RATING & NOS.						
	END CONNECTION						
2	CALIBRATION			P	W	V	
	ACCURACY						
	REPEATABILITY						
	SET POINT ADJUSTMENT						
3	OVER PRESSURE & LEAK TEST			P	W	V	
4	OPERATION OF PRESSURE. RELIEF DEVICE	ONE		P	W	V	
5	REVIEW OF TC FOR	FOR LOT		V	V	V	
	MATERIALS OF SENSOR						
	MOVEMENT						
	PROCESS CONNECTION						
	HOUSING						
6	REVIEW OF TC FOR DEGREE OF PROTECTION	TYPE TEST		V	V	V	
7	ACCESSORIES AS APPLICABLE	SEE NOTE-1 BELOW		V	V	V	

Legend :

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, P = Perform, W = Witness, V = Verification

Note :

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
3. Manufacturer to carry out ROUTINE TEST on 100 %.
4. When material corelation is not available, MFR's compliance to be provided
5. Contractor to provide compliance certificate for tests/checks verifid by contractor and submit the same alongwith test certificates to be verified by BHEL.

STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR LEVEL GAUGE

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS / DRWGS	P	W	V	
	TYPE						
	MODEL/ TAG NO.						
	DAIL SIZE						
	RANGE/SCALE						
	END CONNECTION						
2	DIMENSIONS, PROCESS CONNECTION			P	W	V	
3	ACCURACY			P	W	V	
4	MATERIAL TC FOR	ONE / LOT		P	V	V	
	BODY ISO.						
	VALVE						
	GAUGE GLASS						
5	HYD. TEST	SEE NOTE-1 BELOW		P	W	V	
6	ACCESSORIES AS APPLICABLE			P	W	V	

Legend :

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, P = Perform, W = Witness, V = Verification

Note :

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
3. Manufacturer to carry out ROUTINE TEST on 100 %.
4. Contractor to provide compliance certificate for tests/checks verifid by contractor and submit the same alongwith test certificates to be verified by BHEL.

STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR ANNUNCIATORS

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	TYPE/ MODEL						
	DIMENSIONS OF HARDWARE						
	MODULARITY						
	SEQUENCE						
	FACIA DETAILS						
2	FUNCTIONAL TEST	100%		P	W	V	
3	IMMUNE TO STEP VARIATIONS IN THE POWER SUPPLY	SEE NOTE-1 BELOW		P	W	V	
4	DEGREE OF PROTECTION FOR ENCLOSURE	TYPE TEST		P	W	V	
5	I/R CHECK	SEE NOTE-1 BELOW		P	W	V	
6	RESPONSE			P	W	V	

Legend :

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, P = Perform, W = Witness, V = Verification

Note :

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
3. Manufacturer to carry out ROUTINE TEST on 100 %.
4. Contractor to provide compliance certificate for tests/checks verifid by contractor and submit the same alongwith test certificates to be verified by BHEL.

LCP & JUNCTION BOXES SPECIFICATION

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 2.5 mm for load bearing sections (Mounted with instruments)
1.6 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.

3.1.7 The class of protection shall be in accordance with IP-42 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

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.

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.

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 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.: PE-SS-999-145-054A
		VOLUME
		SECTION
		REV. NO. 02 DATE: 16.09.2013
		SHEET 1 OF 3

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	
	ENCLOSURE SHEET THICKNESS **(As per Section 8.13,Volume V of contract specification)**	FRONT	☐2.0 mm	
		OTHER	☐ 2.0 mm	
		DOOR	☐ 1.6 mm	
		HEIGHT	☐ 2365 mm for stand alone panels. ☐ Other ……	
		OTHER	☐ Load bearing sheet front shall have 3mm thickness	
TECHNICAL	INPUT POWER SUPPLY * **(As per Electrical specification)** (ANY OTHER POWER REQUIREMENT TO BE DERIVED FROM THIS SUPPLY ONLY)		☐ 240V 50 Hz AC ☐ 220V DC ■ 415V 3 PHASE 3W ☐ 400V 3 PHASE 4W	
	NO. OF FEEDERS **(As per Electrical specification)**		☐ ONE ☐ TWO	
	STARTER WITH MCC		☐ REQUIRED ■ NOT REQUIRED	
	IPR POSITION		■ MCC ☐ RELAY PANEL	
	CONTACT RATING OF RELAY		■ 5 Amp, 230 V AC ■ 0.25 Amp, 220V DC	
	CONTROL SUPPLY		☐ 110V AC ☐ 220V AC ☐ 220V DC ☐ Other. (As per requirement)	
	ALARM ANNUNCIATOR WINDOW (EXCLUDING SPARES)		_____NOS. (AS REQUIRED)	
	TEMP SCANNER (IF REQUIRED –NO. OF CHANNELS TO BE SPECIFIED UNDER SEC-C)		☐ REQUIRED ■ NOT REQUIRED	
	PAINT TYPE **(As per Annex-1,Section 7.6,Voulme IV of contract specification)**		☐ EPOXY ENAMEL ☐ EPOXY POWDER COATED	
	MIMIC (TYPE OF MIMIC- MATERAIL, THICKNESS TO BE SPECIFIED DURING DETAILED ENGG.)		■ REQUIRED ☐ NOT REQUIRED	
	PANEL COLOUR (EXTERNAL) **(As per Annex-1,Section 7.6,Voulme IV of contract specification)**		☐ LIGHT GREY ☐ OPALINE GREEN	
	FINISH (EXTERNAL) **(As per Annex-1, Section 7.6,Voulme IV of contract specification)**		☐ MATT ☐ GLOSSY ☐ SEMI GLOSSY	
	PANEL COLOUR (INTERNAL) **(As per Annex-1,Section 7.6,Voulme IV of contract specification)**		☐ WHITE ☐ CREAM ☐ OFF WHITE	
	FINISH (INTERNAL) **(As per Annex-1,Section 7.6,Voulme IV of contract specification)**		☐ MATT ☐ GLOSSY ☐ SEMI GLOSSY	
	CLASS OF PROTECTION		■ IP-55 (FOR INDOOR SERVICE) ■ IP-67 (FOR OUTDOOR SERVICE) ☐ ANY OTHER	
	CONTROL HARDWARE		■ RELAY BASED	
	FOUNDATION ARRANGEMENT		☐ FOUNDATION BOLTS ☐ ANCHOR FASTENERS	
	WEIGHT OF PANEL (Kg.)		……..(Vendor to specify)	

	DATA SHEET FOR LOCAL PANELS	SPECIFICATION NO.: PE-SS-999-145-054A	
		VOLUME	
		SECTION	
		REV. NO. 02	DATE: 16.09.2013
		SHEET 2 OF 3	

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)

PANEL TYPE	☐ PRESSURISED ☐ UNPRESSURISED As per Requirement	
CABLE GLAND	■ DOUBLE COMPRESSION	
AMMETER (TYPE OF INPUT) *	☐ 1 Amp CT ☐ 4-20 mA	
SCOPE OF SUPERVISION FOR ERECTION & COMMISSIONING	☐ APPLICABLE ■ NA	
* TO BE CO-ORDINATED WITH PEM ELECTRICAL		

	PREPARED BY	CHECKED BY	APPROVED BY	COMPANY SEAL
NAME	AANCHAL CHOUDHARY	SACHIN SRIVASTAVA	MA MANSOORI	NAME:
DESIGNATION	SR.ENGR	DY.MNGR	D. GM	
SIGNATURE				SIGNATURE:
DATE	16.09.2013	16.09.2013	16.09.2013	DATE:

FORM NO. PEM-6666-0

	DATA SHEET FOR LOCAL PANELS	SPECIFICATION NO.: PE-SS-999-145-054A	
		VOLUME	
		SECTION	
		REV. NO. 02	DATE: 16.09.2013
		SHEET 3 OF 3	

TAG No. ……. Qty..... Data Sheet No.: **PES-145A-DS1-0**

Data Sheet C

DATA SHEET-C FOR LOCAL PANEL
(TO BE FILLED BY CONTRACTOR AFTER AWARD OF CONTRACT)

GENERAL	MANUFACTURER			
	CONSTRUCTION		☐ FOLDED ☐ WELDED (As per requirement EDN)	
	ENCLOSURE SHEET THICKNESS	FRONT		
		OTHER		
		DOOR		
		HEIGHT		
		OTHER		
TECHNICAL	INPUT POWER SUPPLY			
	NO. OF FEEDERS			
	CONTACT RATING OF RELAY			
	TEMP SCANNER			
	CONTROL SUPPLY			
	ALARM ANNUNCIATOR WINDOW (EXCLUDING SPARES)			
	PAINT TYPE			
	PANEL COLOUR (EXTERNAL)			
	FINISH (EXTERNAL)			
	TYPE OF MIMIC MATERIAL OF MIMC THICKNESS OF MIMIC			
	PANEL COLOUR (INTERNAL)			
	FINISH (INTERNAL)			
	CLASS OF PROTECTION			
	CONTROL HARDWARE			
	FOUNDATION ARRANGEMENT			
	WEIGHT OF PANEL (Kg.)			

FORM NO. PEM-6666-0

	DATA SHEET FOR LOCAL PANELS	SPECIFICATION NO.: PE-SS-999-145-054A	
		VOLUME	
		SECTION	
		REV. NO. 02	DATE: 16.09.2013
		SHEET 3 OF 3	

TAG No. ……. Qty..... Data Sheet No.: **PES-145A-DS1-0**

Data Sheet C

DATA SHEET-C FOR LOCAL PANEL
(TO BE FILLED BY CONTRACTOR AFTER AWARD OF CONTRACT)

	PANEL TYPE		
	CABLE GLAND		
	AMMETER (TYPE OF INPUT)		
	SCOPE OF SUPERVISION		

	PREPARED BY	**CHECKED BY**	**APPROVED BY**	COMPANY SEAL
NAME	AANCHAL CHOUDHARY	SACHIN SRIVASTYAVA	MA MANSOORI	NAME:
SIGNATURE				SIGNATURE:
DATE	16.09.2013	16.09.2013	16.09.2013	DATE:

LCP Quality Plan

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 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	
	INCOMING											
1.0	Sheet Steel (CRCA & HR)	1. Chemical Composition	MA	Chemical analysis	Sample	Relevant standard	Relevant standard	Test Certificate	3	---	2	
		2. Bend Test	CR	Mech. test	Sample	Relevant standard	Relevant standard	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	Relevant standard	Relevant standard	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%	Relevant standard	Relevant standard	Log Book	2	---	1	
3.0	Cables / Wires	1. Visual / Surface defects	MA	Visual	100%	BHEL Spec. and Relevant standard	BHEL Spec. and Relevant standard	Log Book	2	---	---	
		2. IR and HV	MA	Electrical	100%	BHEL Spec. and Relevant standard	BHEL Spec. and Relevant standard	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

PEM :: C&I

STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

STD QUALITY PLAN NO.:	**PE-QP-999-145-I056**
VOLUME	IIB
SECTION	D
REV. NO.	01 DATE: 22-02-2008
SHEET	2 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $ P	Agency $ W	Agency $ V	Remarks
		3. Conductor a) Resistance b) Size c) Sheet colour	 MA MA MA	 Electrical Measurement Visual	 100% 100% 100%	BHEL Spec. and Relevant standard	BHEL Spec. and Relevant standard	Log Book	2	---	---	
		4. Type / Routine Test Certificates	MA	Verification	100%	BHEL Spec. and Relevant standard	BHEL Spec. and Relevant standard	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 standard	Relevant standard	Log Book	2	---	---	
		3. Operation / Functional check	CR	Electrical	Sample+ 100%@	Relevant standard & Catalogue	Relevant standard & Catalogue	Log Book	2	---	---	+ for relay & contactors only
		4. I.R.	MA	Electrical	100%	Relevant standard & Catalogue	Relevant standard & Catalogue	Log Book	2	---	---	@ for all components except relays & contactors.
		5. H.V.	MA	Electrical	100%	Relevant standard & Catalogue	Relevant standard & Catalogue	Log Book	2	---	---	
		6. Calibration	MA	Electrical	100%	Relevant standard & Catalogue	Relevant standard & Catalogue	Log Book	2	---	1	
		7. Pick up / Drop off Voltage	MA	Electrical	100%	Relevant standard & Catalogue	Relevant standard & Catalogue	Log Book	2	---	---	

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PEM :: C&I

STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

STD QUALITY PLAN NO.:	**PE-QP-999-145-I056**
VOLUME	IIB
SECTION	D
REV. NO.	01 DATE: 22-02-2008
SHEET	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	MA	Visual	Sample	BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue	Log Book	2	---	---	
		2. Surface defects	MA	Visual	Sample	BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue	Log Book	2	---	---	
		3. IR / HV on Terminal Blocks	MA	Electrical	Sample	BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue	Log Book	2	---	---	
	IN PROCESS											
6.0	Blanking / Bending / Forming	1. Dimensions	MI	Measurement	100%	Approved Mfr. drgs.	Approved Mfr. drgs.	Log Book	2	---	---	
		2. Surface defects after bending	MA	Visual	100%	Factory Standard	Factory Standard	Log Book	2	---	---	
7.0	Nibbling / Punching	1. Cutout Sizes	MI	Measurement	100%	Approved Mfr. drgs.	Approved Mfr. drgs.	Log Book	2	---	---	
		2. Deburring	MA	Visual	100%	Approved Mfr. drgs.	Approved Mfr. drgs.	Log Book	2	---	---	
	ASSEMBLY											
8.0	Frame Assembly & Sheet fixing	1. Dimensions	MA	Measurement	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2	
		2. Alignment	MA	Measurement	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2	
		3. Welding Quality	MA	Visual	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2	
		4. Surface defects	MA	Visual	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2	

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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	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 $			Remarks
									P	W	V	
9.0	Pre-treatment and Painting	1. Pretreatment Process	MA	Visual	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1	
		2. Process parameters like bath temp. concentration etc.	MA	Measurement	Periodic	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1	
		3. Dipping / Removal Time	MA	Measurement	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1	
		4. Surface quality after every dip	MA	Visual	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1	
		5. Primer after phosphating	MA	Visual, Thickness	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1	
		6. Putty Application & Rubbing after primer	MA	Visual	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1	
		7. Paint first coat	MA	Visual, Thickness	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1	
		8. Putty Application and Rubbing after first coat of paint	MA	Visual	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1	
		9. Paint second coat	MA	Visual, Thickness, Scratch test Colour adhesion	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1	

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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	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	
		2. Wiring Termination (Crimped Lugs)	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	
		3. Ferrule numbers	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	
		4. Colour of wiring	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	1	
		5. Size of Conductor	MA	Measurement	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	1	
11.	Component Mounting	1. Correct components	MA	Visual	100%	Approved drgs., Specs. & BOM	Approved drgs., Specs. & BOM	Log Book	2	---	---	
		2. Fixing	MA	Visual	100%	Approved drgs., Specs. & BOM	Approved drgs., Specs. & BOM	Log Book	2	---	---	
	FINAL											
12.	Final Inspection	1. Workmanship	MA	Visual	100%	Factory Standard	Factory Standard	Inspection Report	2	1	1	At Random by BHEL, based on 100 % internal test reports by Mfr.
		2. Component layout (neatness, accessibility & safety) Mounting / Proper fixing of all components	MA	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	
		3. Components identification Marking / Name plates	MA	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	

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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 $ P	Agency $ W	Agency $ V	Remarks
		5. Dimensions	MA	Measurement	100%	BHEL approved drg. / Spec., BOM	BHEL approved drg. / Spec., BOM	Inspection Report	2	1	1	
		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	

At Random by BHEL, based on 100 % internal test reports by Mfr.

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STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

STD QUALITY PLAN NO.:	**PE-QP-999-145-I056**
VOLUME	IIB
SECTION	D
REV. NO.	01 DATE: 22-02-2008
SHEET	7 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $			Remarks
									P	W	V	
13.	TYPE TEST	Degree of Protection	CR	Mech. Protection	Sample	BHEL approved spec., drg relevant IEC-60947, IEC-60079	BHEL approved spec., drg relevant IEC-60947, IEC-60079	Type Test Certificate	3	---	1	
14	ROUTINE TEST	IR before & after HV Test	CR	Electrical	100%	BHEL approved spec., drg., BOM & relevant standard	BHEL approved spec., drg., BOM & relevant standard	Test Report	2	1	1	
15	FUCTIONAL TEST	1. Control Logic Operation	CR	Electrical	100%	BHEL approved spec. / drg.	BHEL approved spec. / drg.	Inspection Report	2	1	1	
		2. Instrument Calibratio	CR	Electrical	10%	BHEL approved spec. / drg.	BHEL approved spec. / drg.	Inspection Report	2	1	1	
		3. Temperature rise	CR	Electrical	100%	BHEL approved spec/drg. & relevant standard	BHEL approved spec/drg & relevant standard	Inspection Report	2	1	1	

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SPECIFICATION FOR ELECTRONIC POSITIONER

1.0 Electrical :

Input Signal	4-20mA
Power Supply	Loop Powered from the output card of Control System (12-30 V DC)
Hart Protocol	Compatibility for Remote Calibration & Diagnostic (Super-Imposed HART Signal on Input Signal to positioner (4-20mA)
Valve Position Feedback	4-20mA output signal for Position Feedback is to be provided to control system.

2.0 Environment :

Operating Temperature	(-) 30 To 80 Deg.C
Humidity	0-95%
Protection Class	IP-65 (Minimum)

3.0 Diagnostic Features :

Diagnostic / Test Features (to be available in Smart Positioner and shall be accessible through any HMS software)	**Minimum Diagnostic Features Like** • Measurement of Valve positioning timing, • Detection of actuator leakage, • Display of fault alarm. • Logging of alarms and history. • Valve friction/jamming detection. • Detection of valve wear & tear, • Valve stroke length and timing.
	Advanced Diagnostic Features Like (OPTIONAL, if specified in customer's specification) • On line partial closure test. • Valve signature analysis (online graphical/tabular representation of input signal Vs valve travel). • Step response test.

4.0 Software :

Software (to be supplied alongwith smart positioner)	• Windows based software to meet the requirement for configuration, diagnostics, calibration and testing of Valve and actuator. • Easily up-gradable with same hardware and compatible with any Hart Management Systems (HMS). • Shall be capable to cater to all the tags in the specification at the same time.

5.0 Hardware :

Hardware (As required)	1. PC with software for configuring and accessing diagnostic features of the positioners.
	2. Multiplexers for interfacing smart positioner with PC.
	3. Communication cable for interconnecting multiplexers with PC.
	4. RS232/RS485 converter (if required)

Note : Power supply for Multiplexer shall be arranged by the owner.

6.0 Valve Action :

Valve Action	**Direct & Reverse.** (Same positioner for Single Acting or Double Acting And no separate relays required for changing from Single acting to double).
	During Failure of input Electrical signal (4-20 mA), valve to attain fail Freeze position without any external hardware. (Sol valve, Power Supply etc.)

7.0 Flow Characterization :

Flow Characterization	Possible to fit valve characteristic curve linear & Equal percentage

8.0 Performance:

Characteristic Deviation	<=0.75% of span
Ambient temp effect	<=0.01%/Deg C or better.
Dead Band	Adjustable 0.1 to 10%.
Scan Time	10ms
Resolution	<=0.05%
Sensitivity/Linearity	0.3-0.4% of FS
Repeatability	0.32% of FS

9.0 Test Certificates:

Test Certificates/Test Reports for degree of protection, Accuracy and calibration test (as a minimum) to be submitted as per Manufacture Standard / Relevant Standard.

10.0 EMC & CE compliance

International Standard Like EN/IEC. To EN 50081-2 & EN 50082 or equivalent

11.0 Accessories

In Built Operator Panel	Display with push buttons for Configuration and display on the positioner itself
Hand Held Hart Calibrator (Optional)	Universal Hart Calibrator To Be Provided, One Per Unit.
Press Gauge Block	For Supply & Output Pr., Filter Regulator Other Accessories Shall Be Provided As per Control valve hook-up diagram.
Electrical cable entry	½ - NPT, side or bottom entry to avoid water Ingress.

DRAWING NO. PE-DG-999-145-IXXX

STANDARD

INSTALLATION DIAGRAM

(FOR INSTRUMENTS IN VENDOR SCOPE OF SUPPLY FOR MAUX PACKAGES)

REV.	DATE	ALTD	CHD	APPD

REV.	DATE	ALTD	CHD	APPD

JOB NO. 999
STATUS STANDARD
DISTRIBUTION
TO
No. of

PROJECT: STANDARD

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

DEPT CODE		NAME	SIGN	DATE
I	DESN	KT		05.11.13
	CHD	RV		05.11.13
	APPD	BS		05.11.13

TITLE: INSTALLATION DIAGRAM (FOR MAUX PACKAGES)

DEPT. SIGN DATE

SCALE

DRAWING NO. PE-DG-999-145-IXXX

SHEET 1 OF 9 REV. 00

NOTES :–

1. IMPULSE PIPES SHALL BE OF SEAMLESS AND ANNEALED CONFORMING TO ANSI B36.10 IN LINE WITH THE MAIN PIPE MATERIAL.
2. PIPE FITTINGS SHALL BE OF FORGED MATERIAL CONFORMING TO ANSI B16.11–1991.
3. SNUBBER SHALL BE PROVIDED FOR PUMP DISCHARGE PRESS MEASUREMENTS.
4. IN CASE OF STEAM SERVICE SYPHON SHALL BE MADE BY BENDING THE TUBE OR PIPE.
5. VALVE MANIFOLDS & SNUBBER SHALL BE OF FORGED SS–316.
6. FOR SEA WATER APPLICATION SS316L FITTINGS TO BE PROVIDED.
7. 25NB x 15NB WELDED REDUCER SHALL BE USED FOR ROOT VALVE OF 25NB SIZE.
8. ROOT VALVES SHALL BE AS FOLLOWS:

   i) FOR PRESS <40 ATA & TEMP <425 DEG C, ONE(1) NO. 15Nb, ROOT VALVE OF SUITABLE CLASS SHALL BE USED.
   ii) FOR PRESS >40 ATA & TEMP <425 DEG C, TWO(2) NO. 15Nb, ROOT VALVE OF SUITABLE CLASS SHALL BE USED.
   iii) FOR PRESS >40 ATA & TEMP >425 DEG C, TWO(2) NO. 25Nb, ROOT VALVES OF SUITABLE CLASS SHALL BE USED.

9. HORIZONTAL PIPE RUNS SHOULD HAVE A SLOPE IN THE DIRECTION  SHOWN OF 1:20 AS MINIMUM.
10. FOR PRESSURISED STEAM & WATER SERVICE THE ASSOCIATED INSTRUMENT SHOULD BE MOUNTED BELOW THE TAPPING POINT. FOR VACUUM/AIR/GAS SERVICE, THE ASSOCIATED INSTRUMENT SHOULD BE MOUNTED ABOVE THE TAPPING POINT.
11. SEAMLESS PIPE/SEAMLESS TUBE/CAPILLARY LENGTH SHALL BE SUCH THAT THE GAUGES/TRANSMITTERS/SWITCHES ARE MOUNTED IN ACCESSIBLE AREA.

LEGEND :–

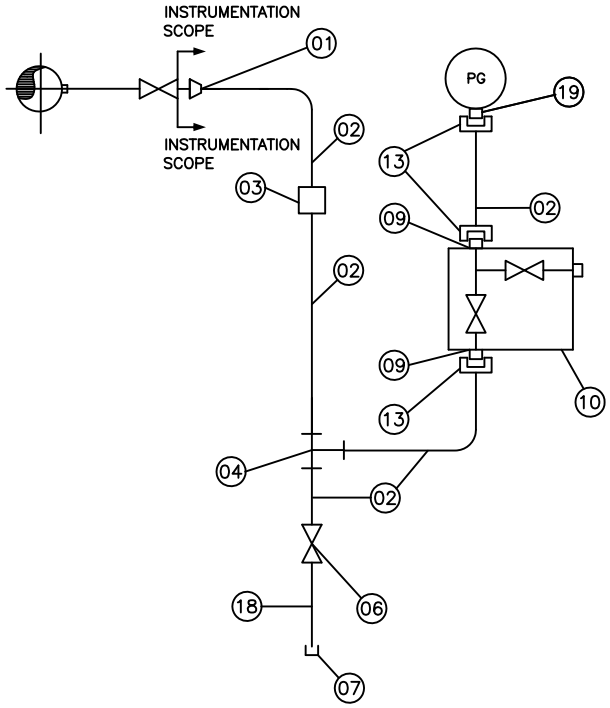
A/R – AS REQUIRED

NPTF – NATIONAL PIPE THREAD FEMALE

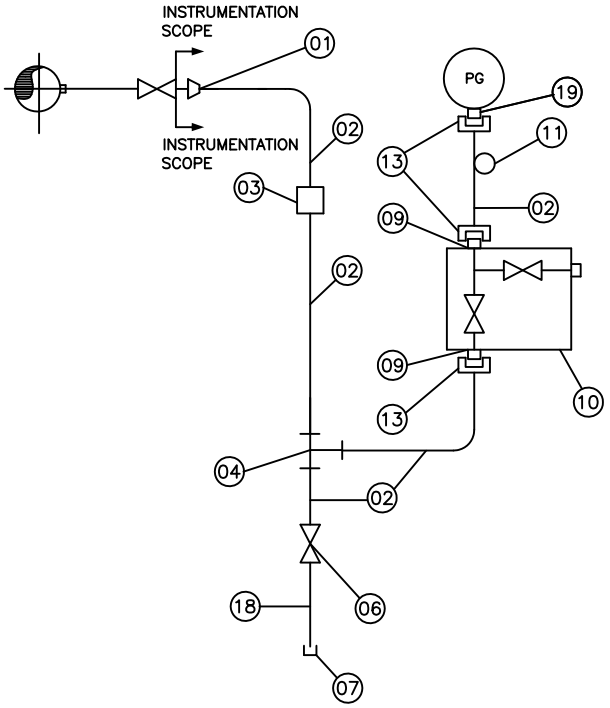
NPTM – NATIONAL PIPE THREAD MALE

SW – SOCKET WELD

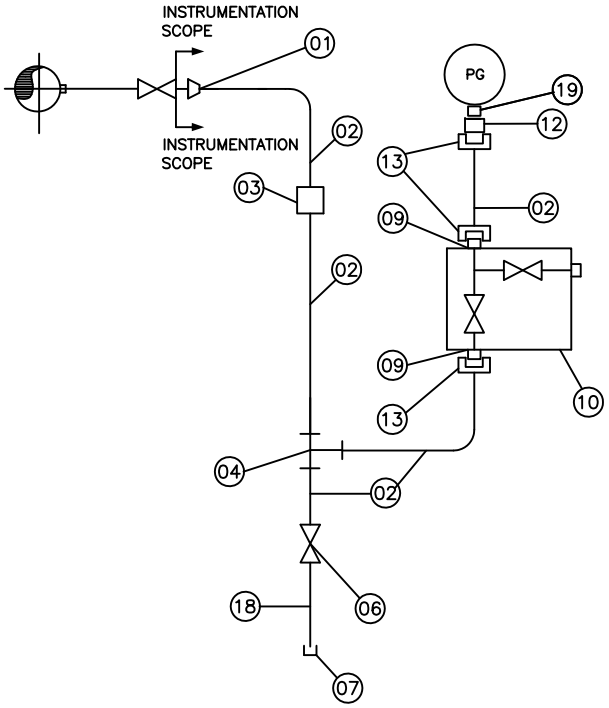
BHEL	TITLE :– INSTRUMENT INSTALLATION DIAGRAM NOTES	DRG. NO.	PE–DG–999–145–IXXX	
		REV. NO.	00	DATE 05.11.13
		SHT	2 OF 9	



WATER SERVICE

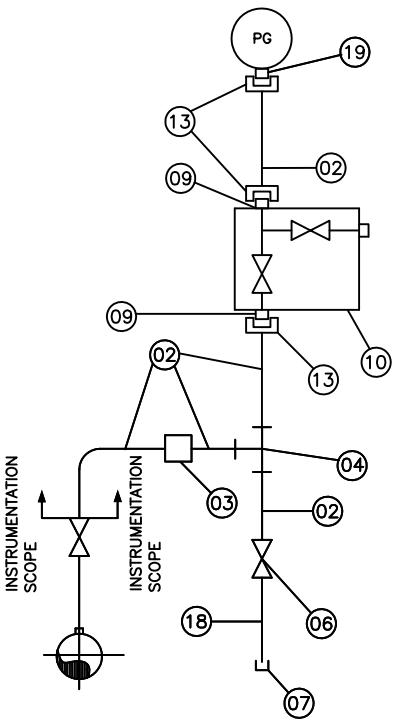


STEAM SERVICE

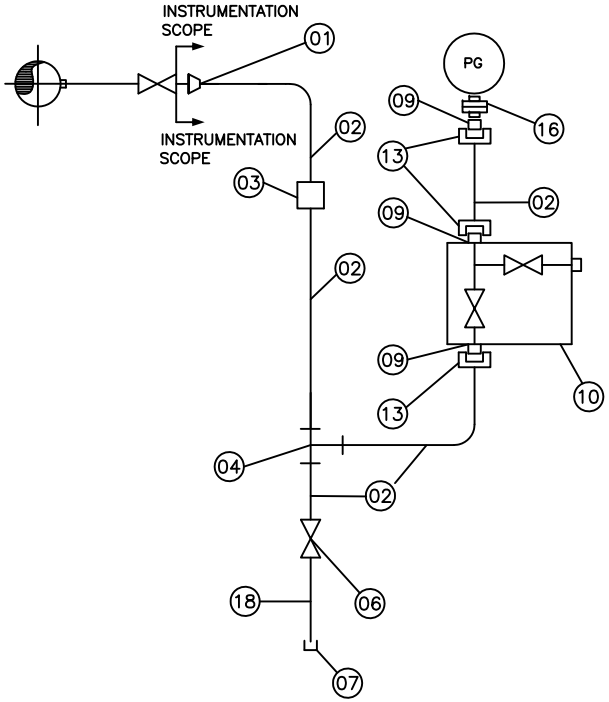


PULSATING SERVICE

TITLE :- INSTRUMENT INSTALLATION DIAGRAM PRESSURE GAUGES	DRG. NO.	PE-DG-999-145-IXXX	
	REV. NO.	00	DATE 05.11.13
	SHT	3 OF 9	



AIR SERVICE

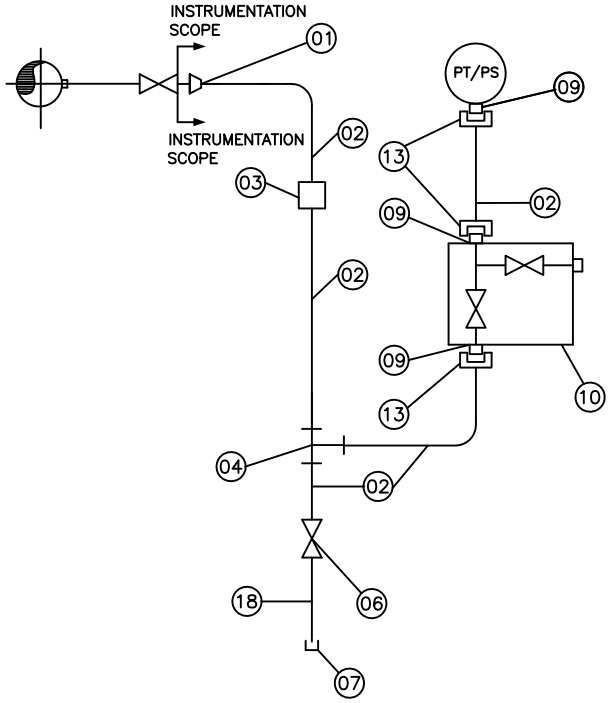


WITH CHEMICAL SEAL

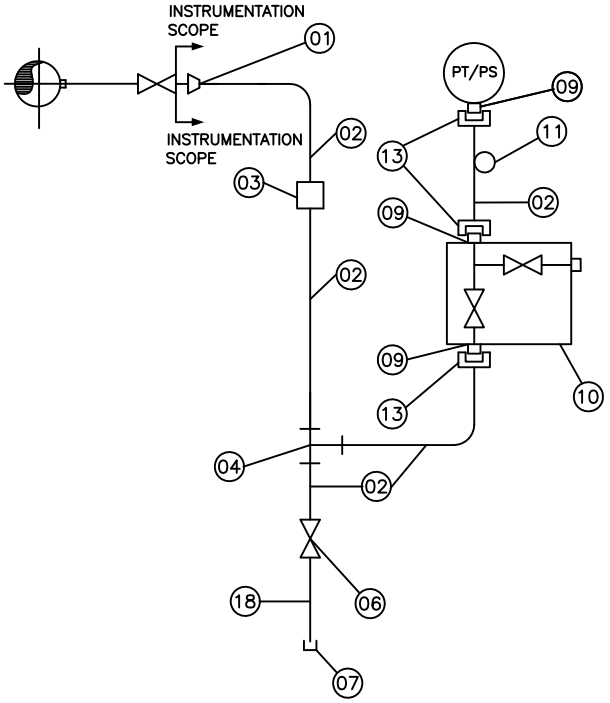
(FOR VISCOUS NON–CORROSIVE FLUID ONLY)

ITEM NO	ITEM/DESCRIPTION	MATERIAL	SIZE	QTY				
				WATER	STEAM	PULSATING	AIR	CHEMICAL
01	REDUCER (IF APPLICABLE)	SAME AS MAIN PIPE	1" X 1/2"SW	01	01	01	00	01
02	SEAMLESS PIPE	SAME AS MAIN PIPE	1/2"	A/R	A/R	A/R	A/R	A/R
03	FORGED COUPLING	SAME AS MAIN PIPE	1/2" SW	A/R	A/R	A/R	A/R	A/R
04	FORGED TEE	SAME AS MAIN PIPE	1/2" SW	01	01	01	01	01
06	FORGED GLOBE VALVE	SAME AS MAIN PIPE	1/2" SW	01	01	01	01	01
07	CAP	SAME AS MAIN PIPE	1/2" NPTF	01	01	01	01	01
09	ADAPTER – M TO M	SS316	M20X1.5M X 1/2" NPTM	02	02	02	02	03
10	TWO VALVE 3 WAY MANIFOLD WITH VENT PLUG	SS316	1/2" NPTF	01	01	01	01	01
11	SYPHON	SS316	1/2" SW	00	01	00	00	00
12	SNUBBER	SS316	M20X1.5M X M20X1.5F	00	00	01	00	00
13	NUT & TAIL PIECE WITH ANNEALED COPPER/SS304 WASHER	SS316	NUT SIZE : M20 X 1.5 WITH 100MM TAIL	03	03	03	03	03
16	CHEMICAL SEAL	SS316	1/2" NPTF X 1/2" NPTF	00	00	00	00	01
18	NIPPLE	SAME AS MAIN PIPE	1/2" NPTM X 1/2" SW	01	01	01	01	01
19	ADAPTER – M TO F	SS316	M20X1.5M X 1/2" NPTF	01	01	01	01	00

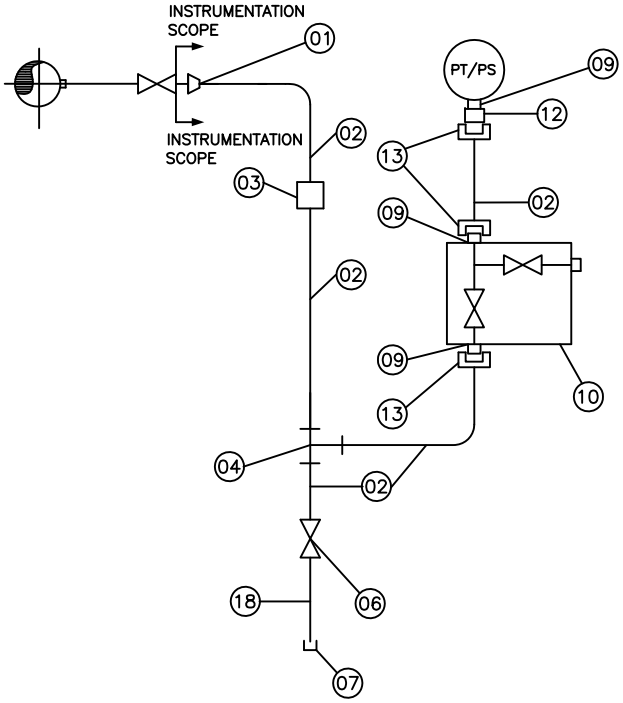
BHEL	TITLE :– INSTRUMENT INSTALLATION DIAGRAM PRESSURE GAUGES	DRG. NO.	PE–DG–999–145–IXXX
		REV. NO.	00 DATE 05.11.13
		SHT	4 OF 9



WATER SERVICE

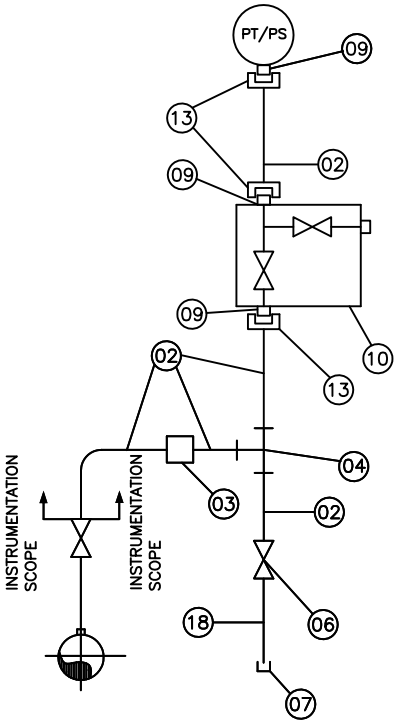


STEAM SERVICE

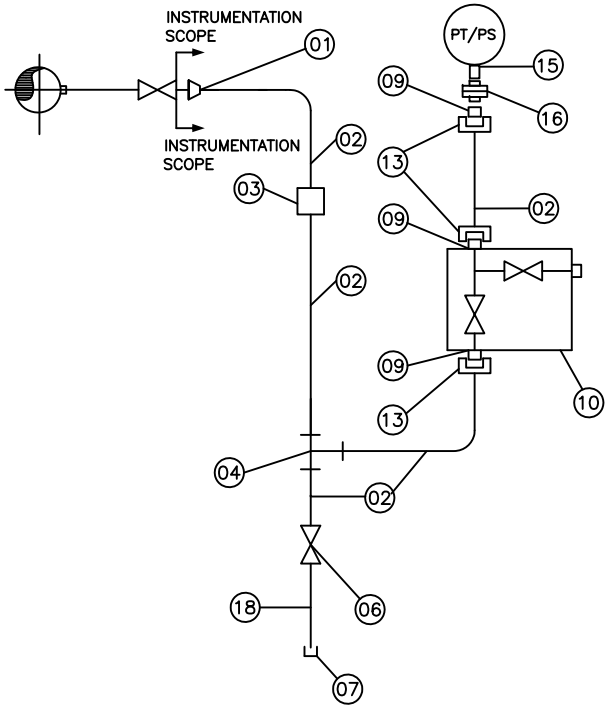


PULSATING SERVICE

TITLE :- INSTRUMENT INSTALLATION DIAGRAM PRESSURE SWITCHES/TRANSMITTERS	DRG. NO.	PE-DG-999-145-IXXX		
	REV. NO.	00	DATE	05.11.13
	SHT	5 OF 9		



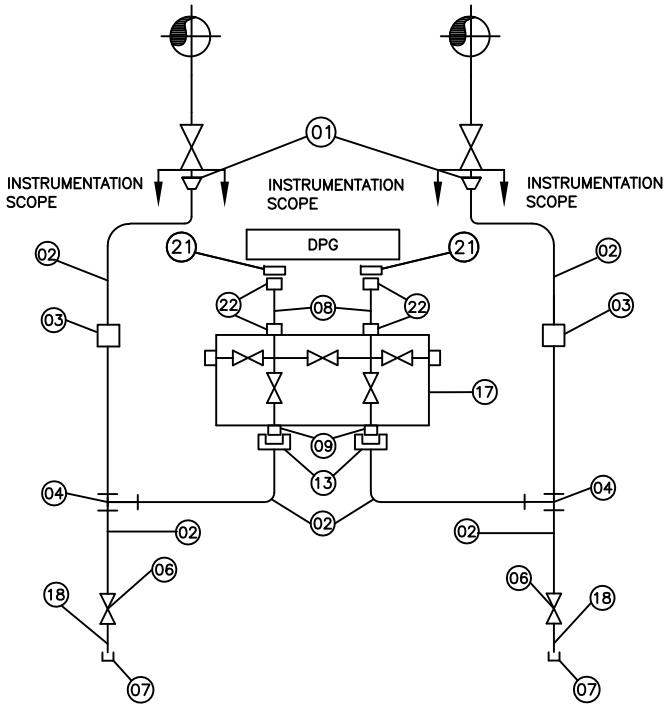
AIR SERVICE



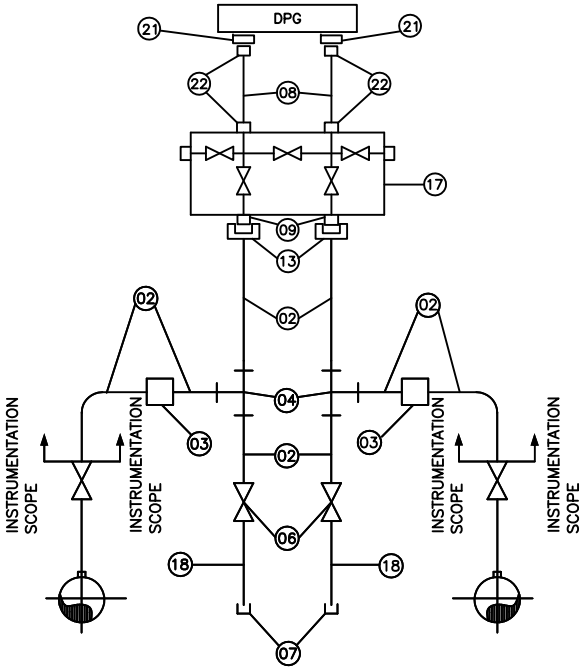
WITH CHEMICAL SEAL
(FOR VISCOUS NON–CORROSIVE FLUID ONLY)

ITEM NO	ITEM/DESCRIPTION	MATERIAL	SIZE	QTY				
				WATER	STEAM	PULSATING	AIR	CHEMICAL
01	REDUCER (IF APPLICABLE)	SAME AS MAIN PIPE	1" X 1/2"SW	01	01	01	00	01
02	SEAMLESS PIPE	SAME AS MAIN PIPE	1/2"	A/R	A/R	A/R	A/R	A/R
03	FORGED COUPLING	SAME AS MAIN PIPE	1/2" SW	A/R	A/R	A/R	A/R	A/R
04	FORGED TEE	SAME AS MAIN PIPE	1/2" SW	01	01	01	01	01
06	FORGED GLOBE VALVE	SAME AS MAIN PIPE	1/2" SW	01	01	01	01	01
07	CAP	SAME AS MAIN PIPE	1/2" NPTF	01	01	01	01	01
09	ADAPTOR – M TO M	SS316	M20X1.5M X 1/2" NPTM	03	03	03	03	03
10	TWO VALVE 3 WAY MANIFOLD WITH VENT PLUG	SS316	1/2" NPTF	01	01	01	01	01
11	SYPHON	CS	1/2" SW	00	01	00	00	00
12	SNUBBER	SS316	M20X1.5M X M20X1.5F	00	00	01	00	00
15	CONNECTOR – M TO M	SS316	1/2" NPTM X 1/2" NPTM	00	00	00	00	01
16	CHEMICAL SEAL	SS316	1/2" NPTF X 1/2" NPTF	00	00	00	00	01
13	NUT & TAIL PIECE WITH ANNEALED COPPER/SS304 WASHER	SS316	NUT SIZE : M20 X 1.5 WITH 100MM TAIL	03	03	03	03	03
18	NIPPLE	SAME AS MAIN PIPE	1/2" NPTM X 1/2" SW	01	01	01	01	01

BHEL	TITLE :– INSTRUMENT INSTALLATION DIAGRAM PRESSURE SWITCHES/TRANSMITTERS	DRG. NO.	PE–DG–999–145–IXXX	
		REV. NO.	00	DATE 05.11.13
		SHT	6 OF 9	



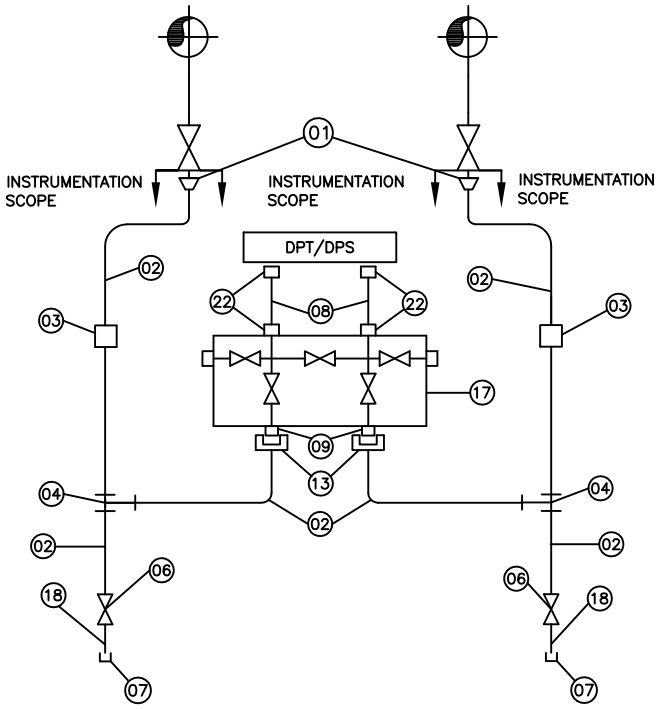
WATER SERVICE



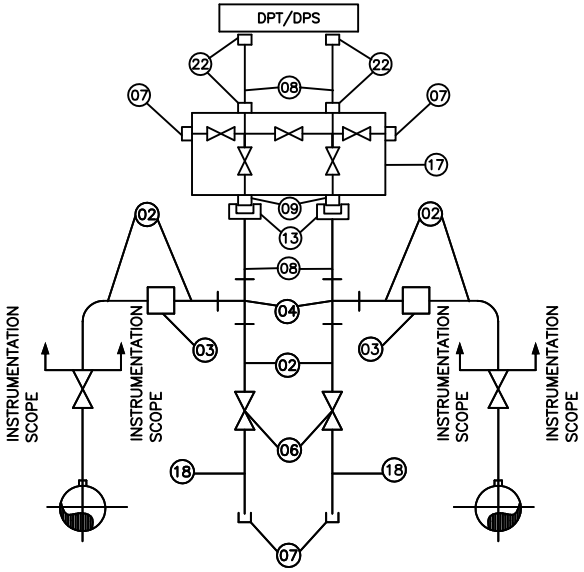
AIR SERVICE

ITEM NO	ITEM/DESCRIPTION	MATERIAL	SIZE	QTY	
				WATER	AIR
01	REDUCER (IF APPLICABLE)	SS316	1" X 1/2"SW	02	00
02	SEAMLESS PIPE	SAME AS MAIN PIPE	1/2"	A/R	A/R
03	FORGED COUPLING	SAME AS MAIN PIPE	1/2" SW	A/R	A/R
04	FORGED TEE	SAME AS MAIN PIPE	1/2" SW	02	02
06	FORGED GLOBE VALVE	SAME AS MAIN PIPE	1/2" SW	02	02
07	CAP	SAME AS MAIN PIPE	1/2" NPTF	02	02
08	SEAMLESS TUBE	SS316	1/2" OD	A/R	A/R
09	ADAPTOR – M TO M	SS316	M20X1.5M X 1/2" NPTM	02	02
17	FIVE VALVE MANIFOLD WITH DRAIN PLUG	SS316	1/2" NPTF	01	01
16	CHEMICAL SEAL	SS316	1/2" NPTF X 1/2" NPTF	00	00
13	NUT & TAIL PIECE WITH ANNEALED COPPER/SS304 WASHER	SS316	NUT SIZE : M20 X 1.5 WITH 100MM TAIL	02	02
18	NIPPLE	SAME AS MAIN PIPE	1/2" NPTM X 1/2" SW	02	02
22	TUBE FITTING DFDC	SS316	1/2" NPTM X 1/2"OD TUBE	04	04
21	CONNECTOR – F TO F	SS316	1/2" NPTF X 1/2" NPTF	02	02

BHEL	TITLE :- INSTRUMENT INSTALLATION DIAGRAM DIFFERENTIAL PRESSURE GAUGES	DRG. NO.	PE-DG-999-145-IXXX	
		REV. NO.	00	DATE 05.11.13
		SHT	7 OF 9	



WATER SERVICE

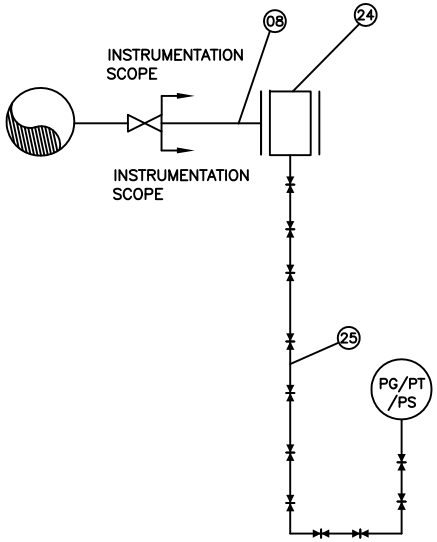


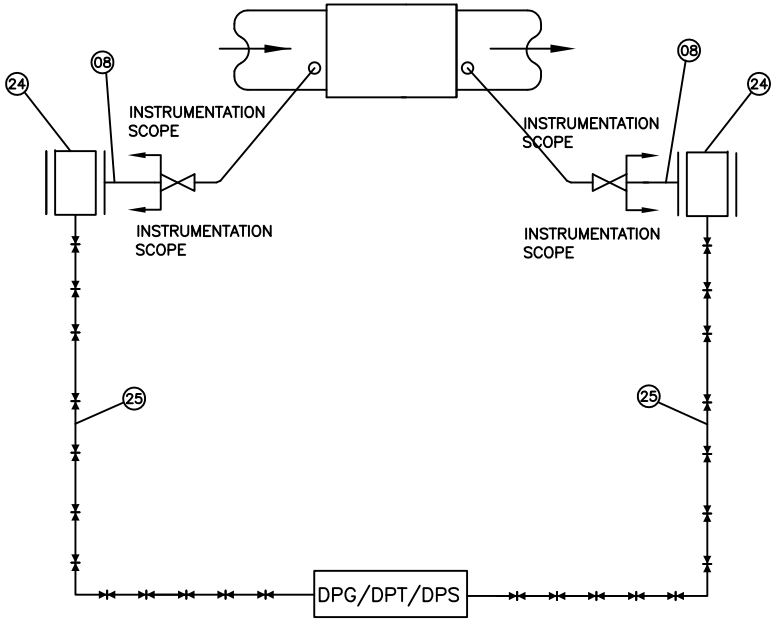
AIR SERVICE

ITEM NO	ITEM/DESCRIPTION	MATERIAL	SIZE	QTY	
				WATER	AIR
01	REDUCER (IF APPLICABLE)	SS316	1" X 1/2"SW	02	00
02	SEAMLESS PIPE	SAME AS MAIN PIPE	1/2"	A/R	A/R
03	FORGED COUPLING	SAME AS MAIN PIPE	1/2" SW	A/R	A/R
04	FORGED TEE	SS316	1/2" SW	02	02
06	FORGED GLOBE VALVE	SS316	1/2" SW	02	02
07	CAP	CS	1/2" NPTF	02	02
08	SEAMLESS TUBE	SS316	1/2" OD	A/R	A/R
09	ADAPTER – M TO M	SS316	M20X1.5M X 1/2" NPTM	02	02
17	FIVE VALVE MANIFOLD WITH DRAIN PLUG	SS316	1/2" NPTF	01	01
16	CHEMICAL SEAL	SS316	1/2" NPTF X 1/2" NPTF	00	00
15	CONNECTOR – M TO M	SS316	1/2" NPTM X 1/2" NPTM	00	00
13	NUT & TAIL PIECE WITH ANNEALED COPPER/SS304 WASHER	SS316	NUT SIZE : M20 X 1.5 WITH 100MM TAIL	02	02
18	NIPPLE	SAME AS MAIN PIPE	1/2" NPTM X 1/2" SW	02	02
21	CONNECTOR – F TO F	SS316	1/2" NPTF X 1/2" NPTF	00	00
22	TUBE FITTING DFDC	SS316	1/2" NPTM X 1/2"OD TUBE	04	04

BHEL	TITLE :- INSTRUMENT INSTALLATION DIAGRAM DIFFERENTIAL PRESSURE SWITCHES/TRANSMITTERS	DRG. NO.	PE-DG-999-145-IXXX	
		REV. NO.	00	DATE 05.11.13
		SHT	8 OF 9	

ITEM NO	ITEM/DESCRIPTION	MATERIAL	SIZE	QTY	
				PG/PS/PT	DPG/DPS/DPT
24	FLANGE SUPPLIED WITH PG/PS PT/DPG/DPS/DPT TO SUIT 1/2" OR 1" NB PIPE	SAME AS MAIN PIPE	1/2" SW	01	02
08	SEAMLESS PIPE	SAME AS MAIN PIPE	1/2"	A/R	A/R
25	SS ARMORED CAPILLARY TUBE (MINIMUM 5M IN LENGTH)	SS316	–	A/R	A/R





BHEL	TITLE :- INSTRUMENT INSTALLATION DIAGRAM WITH CAPILLARY TUBES	DRG. NO.	PE-DG-999-145-IXXX	
		REV. NO.	00	DATE 05.11.13
		SHT	9 OF 9	

PC SPECIFICATION

SPECIFICATION FOR PC

a. CPU

1.	Processor	: Intel core i5 or better, 32 bit
2.	RAM	: 4 GB min. and expandable to 16 GB
3.	Hard Drive	: 500 GB or more
4.	Removable bulk storage	: DVD (R/RW)
5.	Graphic accelerator	: 8MB (minm.)
6.	Graphic Memory	: dedicated 1GB or better
7.	Operating System	: Windows 7 or better
8.	Audio controller	: 16 bit
9.	Communication Port	: 2 serial, one parallel, 8 USB, Dual 100Mbps Ethernet
10.	Expansion Slot	: 3
11.	Cache	: 512 KB Level 2
12.	Video Card	: PCI

b. MONITOR

1.	Type	: LCD COLOUR MONITOR
2.	Screen Diagonal	: 24” (approx.) flat
3.	Display	: XGA or better
4.	Resolution	: 1024 by 768 or better
5.	Degree of Protection	: IP-30
6.	External Controls	: Brightness, contrast, Horizontal/Vertical, amplification & Shift
7.	Version	: To suit Industrial application

c. KEY BOARD & MOUSE

1. Type : Flat spill proof membrane or positive depression type ASCII
2. Life Expectancy : 50 million cycles per key
3. Version : To suit Industrial application
4. Mouse : Optical mouse

d. SOFTWARE

Diagnostic Software, Anti Virus, Microsoft office, Acrobat Adobe Software and other application software.

FURNITURE SPECIFICATION

SPECIFICATION FOR FURNITURE

a) 4 Nos. cushioned revolving, independently adjustable seat and back chairs.

b) Glass top Teak wood / MDF table for mounting Operator Station monitors.

c) Printer tables.

d) Glass top Teak wood / MDT table for System Engineering Room / Engineering stations with drawer at end.

e) Glass top teak wood / MDF table with vertical file mounting arrangement (two layer to house approx. 40 Nos of files and lockable drawers at both end) for System Engineering Room / Engineers.

KKS PHILOSOPHY

KKS NUMBERING PHILOSOPHY

For identifying (tagging) an instrument / equipment in Power plant KKS numbering scheme is used. The purpose is to assign a unique number to every equipment in the power plant. For C&I equipment unique number are to be provided up to the signal level so that a unique number Input / Output exist in DCS for every signal.

Normally KKS number is a 10 digit alpha-numeric code and is typically split into the following:

X	X	X	A	A	Y	Y	B	B	B

First three digits indicate the Sub-System. The Code for the major system are given as per **Annexure-**1.

Fourth and Fifth digits are the **Numerical Keys at System Code Level** and used to distinguish between main systems having same Alpha Codes.

Sixth and Seventh digits are the **Equipment / Apparatus / Measuring Circuit Code**. The code of various Equipment / Apparatus / Measuring Circuit is shown in **Annexure-2**

Eight, Nine and tenth digits are the **Numerical Keys at Equipment / Apparatus / Measuring Circuit Code** and used to distinguish between various instruments in the same sub-group. Numerical keys at System / Equipment / Apparatus / Measuring Circuit is shown in **Annexure-3**.

ANNEXURE-1

List of System / Sub-System Codes used in Power Plant:

1) AC SYSTEM: QKA, QKB, ……upto QKZ

2) VENTILATION SYSTEM: SAA,SAB,……upto SAZ

ANNEXURE-2

Standard Equipment Codes:

AA	Valves including drives, also hand operated
AB	Seclusions, Lock, Gates, Doors
AC	Heat Exchanger
AE	Turning, Driving, Lifting equipment
AF	Continuous conveyors, Feeders
AG	Generator Units
AH	Heating and Cooling Units
AK	Pressing and Packaging equipment
AM	Mixer, Stirrer
AN	Blower, Air Pumps / Fans, Compressor Units
AP	Pump Units
AT	Purification, Drying, Filter
AV	Combustion Equipment e.g. grates

Standard Apparatus Codes:

BB	Vessels and Tank
BF	Foundation
BG	Boiler Heating Surfaces
BN	Injector, Ejector
BP	Flow and throughput limitation equipment (Orifice)
BQ	Holders, Carrying Equipment, Support
BR	Piping, Ducts, Chutes, Compensator
BS	Sound Absorber
BU	Insulations, Sheatings

Standard Measuring Circuits Codes:

CD	Density
CE	Electrical Quantities
CF	Flow, throughput
CG	Distance, Length, Position
CK	Time
CL	Level