

		QUALITY PLAN		CUSTOMER :			PROJECT TITLE :		SPECIFICATION NO. :			
				BIDDER/ VENDOR :			STANDARD QP NO. : PE-QP-999-507-E006, REV. 0		SPECIFICATION TITLE:			
		SHEET 1 OF 2		SYSTEM CABLING			ITEM : CABLE TRAY SUPPORT MATERIAL (WELDED TYPE)		DOC. NO. :			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
1.0	RAW MATERIAL											
1.1	MILD STEEL SECTIONS (CHANNEL & ANGLES) AS PER SPECIFICATION	1.CHEMICAL & PHY. PROPERTIES	MA	VERIFICATION OF TC'S	100%	IS -2062	IS -2062	MILL TC	3	-	1/2	Steel shall be procured from SAIL/TISCO/RINL/BHUSAN/JINDAL STEEL/JINDAL ISPAT/ESSAR/LLOYD/ IISCO/ authorised SAIL Re Rollers.
		2.DIMENSIONS	MA	MEASUREMENT	100%	IS - 808/ IS - 1852	IS - 808/ IS - 1852	QC RECORD	3/2	-	-	
		3.SURFACE FINISH	MA	VISUAL	100%	IS:2062	IS:2062	QC RECORD	3/2	-	-	
1.2	ZINC	CHEM.COMP.	MA	CHEM. TEST	EACH HEAT	IS-209	IS-209	QC RECORD	3/2	-	1/2	
2.0	IN-PROCESS											
2.1	CUTTING	1.DIMENSIONS	MA	MEASUREMENT	100%	APP. DATA SHEET	APP. DATA SHEET	QC RECORD	2	-	1	
		2. WELDING QUALITY (IF APPLICABLE)	MA	VISUAL	100%	GOOD WELDING PRACTICE	FREE FROM DEFECTS & SLAG	QC RECORD	2	-	1	
		3.SURFACE FINISH	MA	VISUAL	100%	FREE FROM DEFECTS & SLAG	FREE FROM DEFECTS & SLAG	QC RECORD	2	-	1	
2.2	SURFACE PREPARATION	1.CLEANING, PICKLING, RINSING & FLUXING	MA	VISUAL	PERIODIC IN EACH SHIFT	IS:2629	IS:2629	QC RECORD	2	-	-	
		2. SURFACE QUALITY	MA	VISUAL	100%	IS-2629	IS-2629	QC RECORD	2	-	-	
2.3	GALVANISING	1.TEMPERATURE OF BATH	MA	TEMPERATURE INDICATOR	CONTINUOUS	IS-2629	IS-2629	QC RECORD	3/2	-	-	If vendor doesn't have his own galvanizing plant duly approved by BHEL PEM; then galvanizing shall be carried out at BHEL-PEM approved other galvanizing plants as per Annexure-2.
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

LEGEND : 1 - BHEL/ CUSTOMER 2 - VENDOR 3 - SUB- VENDOR P - PERFORM W - WITNESS V - VERIFICATION

		QUALITY PLAN		CUSTOMER :		PROJECT TITLE :		SPECIFICATION NO. :					
				BIDDER/ VENDOR :		STANDARD QP NO. : PE-QP-999-507-E006, REV. 0		SPECIFICATION TITLE:					
		SHEET 2 OF 2		SYSTEM CABLING		ITEM : CABLE TRAY SUPPORT MATERIAL (WELDED TYPE)		DOC. NO. :					
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS	
1	2	3	4	5	6	7	8	9	10	P	W	V	11
3.0	FINISHED ITEMS	2. DROSS	MA	VISUAL	PERIODIC	IS - 2629	IS - 2629	QC RECORD	3/2	-	-		
		3. RATE OF IMMERSION	MA	VISUAL MEASUREMENT	100%	IS - 2629 / MFR'S PRACTICE	IS - 2629 / MFR'S PRACTICE	QC RECORD	3/2	-	2		
		4. SURFACE QUALITY	MA	VISUAL	100%	IS - 2629	FREE FROM BURRS ROUGHNESS, SLAG, FLUX, STAIN, ETC.	QC RECORD	3/2	-	-		
		1.DIMENSIONS	MA	MEASUREMENT	IS 2500 (PART 1) LEVEL S-4	APP. DATA SHEET	APP. DATA SHEET	INSP. REPORT	2	1	-		
		2. SURFACE FINISH	MA	VISUAL	IS 2500 (PART 1) LEVEL S-4	FREE FROM BURRS, SLAG, ROUGHNESS, FLUX, STAIN, ETC.	FREE FROM BURRS, SLAG, ROUGHNESS, FLUX, STAIN, ETC.	INSP. REPORT	2	1	-		
		3.MASS OF ZINC COATING	MA	CHEM. TEST	IS - 4759	IS-6745 / APP. DATA SHEET	APP. DATA SHEET	INSP. REPORT	2	1	-		
		4.UNIFORMITY OF ZINC COATING	MA	CHEM. TEST	IS - 4759	IS-2633	IS-2633	INSP. REPORT	2	1	-		
		5.THICKNESS OF ZINC COATING	MA	ELCOMETER	IS - 4759	APP. DATA SHEET	APP. DATA SHEET	INSP. REPORT	2	1	-		
		6.ADHESION	MA	MECH.TEST	IS-4759	IS-2629	IS-2629	INSP. REPORT	2	1	-		
		BHEL			PARTICULARS		BIDDER/VENDOR						
			NAME										
			SIGNATURE										
			DATE										
BIDDER'S/VENDORS COMPANY SEAL													

LEGEND : 1 - BHEL/ CUSTOMER 2 - VENDOR 3 - SUB- VENDOR P - PERFORM W - WITNESS V - VERIFICATION

		QUALITY PLAN (FOR LT SWGR)		CUSTOMER		PROJECT		SPECIFICATION NUMBER				
		BIDDER/VENDOR		QUALITY PLAN NUMBER		PED-506-00-Q-002, REV. 03		SPECIFICATION TITLE				
		WORKS ADDRESS		ITEM		LV SWITCHGEAR		SECTION				
Sl. No.	COMPONENT/ OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	10	11	12	
	BOUGHT-OUT ITEMS											
1.1	MATERIAL a) SECTIONS b) HARDWARES c) FLATS d) ANGLES e) CHANNELS f) SHEET STEEL FOR FABRICATION (CRCA)	1. DIMENSIONS	MA	MEASUREMENT	SAMPLE	IS-513 (94), IS-1079 (94), IS-2062 (2006)	BHEL TECH. SPEC./ APPD. DRGS / DATASHEETS	QC RECORD	3/2	-	2	
		2. SURFACE FINISH & CHECK FOR WAVINESS/ FLATNESS	MA	VISUAL	100%	-do-	NO VISUAL DEFECTS	-do-	3/2	-	2	TC FOR PLATING QUALITY TO BE PROVIDED
		3. BENDING TEST	CR	MECHANICAL	SAMPLE	-do-	IS-513 (94), IS-1079 (94), IS-2062 (2006)	TEST CERTIFICATE	3/2	-	2	
1.2	BUSBARS	1) DIMENSION	MA	MEASUREMENT	SAMPLE	BHEL SPEC./ APPD. DRGS./ IS 5082 (98) FOR AL, IS 1897 (83) & 613 (2000) FOR COPPER	BHEL SPEC./ APPD. DRGS./ IS 5082 (98) FOR AL, IS 1897 (83) & 613 (2000) FOR COPPER	QC Records	2	-	-	
		2) SURFACE FINISH	MA	VISUAL	100%	BHEL SPEC./ APPD. DRGS. IS 5082 (98) FOR AL, IS 1897 (83) & 613 (2000) FOR COPPER	BHEL SPEC./ APPD. DRGS. IS 5082 (98) FOR AL, IS 1897 (83) & 613 (2000) FOR COPPER	QC Records	2	-	-	
		3) MATERIAL GRADE	MA	VERIFICATION OF TC	1/LOT	-do-	-do-	TEST CERTIFICATE	2	-	1	
		4) CONDUCTIVITY	CR	ELECT. TEST	-do-	IS 5082 (98) FOR AL, IS 1897 (83) & 613 (2000) FOR COPPER	IS 5082 (98) FOR AL, IS 1897 (83) & 613 (2000) FOR COPPER	TEST CERTIFICATE	2	-	1	
1.3	SWITCHGEAR COMPONENTS											
	a) AIR BREAK SWITCH/ SFUs	1) MAKE, TYPE & RATING	MA	VISUAL	100%	IS-13947 Part 3 (93), APPD. DRGS/ APPD. DATASHEET	IS-13947 Part 3 (93), APPD. DRGS/ APPD. DATASHEET	QC Records	3/2	-	-	
		2) ROUTINE TESTS	MA	ELECTRICAL	100%	IS-13947 Part 3 (93)	IS-13947 Part 3 (93)	TEST CERTIFICATE	3/2	-	2	
LEGENDS P : PERFORM W : WITNESS V : VERIFICATION MA : MAJOR CR : CRITICAL			3 : SUB-VENDOR 2 : MAIN VENDOR 1 : BHEL/CUSTOMER		NAME OF THE REPRESENTATIVE : SIGNATURE : DATE :							
BHEL			BIDDER/VENDOR'S PARTICULARS						BIDDER/VENDOR'S COMPANY SEAL			

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				WORKS ADDRESS		ITEM		LV SWITCHGEAR		SECTION		
SI. No.	COMPONENT/ OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
	b) CT/ PT	1) OVERALL DIMENSIONS & MOUNTING ARRANGEMENT	MA	MEASUREMENT	100%	MFR. STD.	MFR. STD.	QC Records	3/2	-	-	
		2) MAKE, TYPE & RATING	MA	VISUAL	100%	BHEL SPEC./ APPD. DRGS/ IS-2705 (92)	BHEL SPEC./ APPD. DRGS/ IS-2705 (92)	QC Records	2	-	-	
		3) ROUTINE TESTS	CR	ELECTRICAL	100%	IS-2705 (92), APPD. DRGS/ APPD. DATASHEET	IS-2705 (92), APPD. DRGS/ APPD. DATASHEET	TEST CERTIFICATE	3	-	2,1	
	c) HRC FUSES	1) MAKE, TYPE & RATING	MA	VISUAL	100%	BHEL SPEC./ APPD. DRGS/ IS-13703 (93)	BHEL SPEC./ APPD. DRGS/ IS-13703 (93)	QC Records	2	-	-	
	d) AC/ DC POWER & AUXILIARY CONTACTORS	1) MAKE, TYPE & RATING	MA	VISUAL	100%	BHEL SPEC./ APPD. DRGS/ IS-13947 Part 4 sec 1 (93)	BHEL SPEC./ APPD. DRGS/ IS-13947 Part 4 sec 1 (93)	QC Records	2	-	-	
		2) ROUTINE TESTS	MA	ELECTRICAL	100%	IS-13947 Part 4 sec 1 (93)	IS-13947 Part 4 sec 1 (93)	TEST CERTIFICATE	3/2	-	2,1	
	e) AIR CIRCUIT BREAKER	1) MAKE, TYPE & RATING	MA	VISUAL	100%	BHEL SPEC./ APPD. DRGS/ IS-13947 Part 2 (93)	BHEL SPEC./ APPD. DRGS/ IS-13947 Part 2 (93)	QC Records	2	-	-	
		2) ROUTINE TESTS	CR	TEST	100%	IS-13947 Part 2 (93)	IS-13947 Part 2 (93)	TEST CERTIFICATE	3/2	-	2,1	
	f) RELAYS - NUMERICAL	1) PHYSICAL CONDITION	MA	VISUAL	100%	NO BREAKAGES/ DAMAGES	NO BREAKAGES/ DAMAGES	QC Record	2	-	-	
		2) MAKE, TYPE & RATING	MA	VISUAL	100%	BHEL SPEC./ APPD. DRGS	BHEL SPEC./ APPD. DRGS	QC Records	3/2	-	-	
3) ROUTINE TESTS		MA	ELECTRICAL	100%	IEC 60255-5 (2000), IEC 60255-6 (2001), IEC 60255-11 (79), IEC 61850	IEC 60255-5 (2000), IEC 60255-6 (2001), IEC 60255-11 (79), IEC 61850	TEST CERTIFICATE	3/2	-	2,1		
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			BHEL		BIDDER/VENDOR'S PARTICULARS							BIDDER/VENDOR'S COMPANY SEAL

		CUSTOMER		PROJECT		SPECIFICATION NUMBER			
		BIDDER/VENDOR		QUALITY PLAN NUMBER		PED-506-00-Q-002, REV. 03		SPECIFICATION TITLE	
		WORKS ADDRESS		ITEM		LV SWITCHGEAR		SECTION	

SI. No.	COMPONENT/ OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
	g) RELAYS - STATIC/ ELECTROMAGNETIC	1) PHYSICAL CONDITION	MA	VISUAL	100%	NO BREAKAGES/ DAMAGES	NO BREAKAGES/ DAMAGES	QC Record	2	-	-	
		2) MAKE, TYPE & RATING	MA	VISUAL	100%	BHEL SPEC./ APPD. DRGS/DATASHEET	BHEL SPEC./ APPD. DRGS/DATASHEET	QC Records	2	-	-	
		3) ROUTINE TESTS	MA	ELECTRICAL	100%	IS 3231 (83)/ IS 8686 (77)/ RELAY MFR. SPEC.	IS 3231 (83)/ IS 8686 (77)/ RELAY MFR. SPEC.	TEST CERTIFICATE	3/2	-	2.1 *	* For BHEL/Customer, the extent of check shall be 10%.
	h) INDICATING INSTRUMENTS	1) MAKE, TYPE & RATING	MA	VISUAL	10% of each type of rating per lot	BHEL SPEC./ APPD. DRGS/DATASHEET	BHEL SPEC./ APPD. DRGS/DATASHEET	QC Records	2	-	-	
		2) ROUTINE TESTS	MA	ELECTRICAL	10% of each type of rating per lot	IS 1248 (2003)/ BHEL SPEC./ APPD. DRGS/DATASHEET	IS 1248 (2003)/ BHEL SPEC./ APPD. DRGS/DATASHEET	TEST CERTIFICATE	3/2	-	2.1	include calibration & accuracy test reports
	i) PUSH BUTTONS	1) MAKE, TYPE, COLOR & RATING	MA	VISUAL	5 samples of each type & rating per lot	IS 13947 Part 5 sec 1 (2004)/ BHEL SPEC./ APPD. DRGS/DATASHEET	IS 13947 Part 5 sec 1 (2004)/ BHEL SPEC./ APPD. DRGS/DATASHEET	QC Records	2	-	-	
		2) ROUTINE TESTS	MA	ELECTRICAL	5 samples of each type & rating per lot	IS 13947 Part 5 sec 1 (2004)/ BHEL SPEC./ APPD. DRGS/DATASHEET	IS 13947 Part 5 sec 1 (2004)/ BHEL SPEC./ APPD. DRGS/DATASHEET	TEST CERTIFICATE	3/2	-	2	
	j) CONTROL & SELECTOR SWITCHES	1) MAKE, TYPE & RATING	MA	VISUAL	5 samples of each type & rating per lot	IS 13947 Part 5 sec 1 (2004)/ BHEL SPEC./ APPD. DRGS/DATASHEET	IS 13947 Part 5 sec 1 (2004)/ BHEL SPEC./ APPD. DRGS/DATASHEET	QC Records	2	-	-	
		2) CONTACT CONFIGURATION CHECK	MA	VISUAL	-do-	-do-	-do-	QC Records	2	-	-	
		3) ROUTINE TESTS	MA	ELECTRICAL	-do-	-do-	-do-	QC Records	3/2	-	2	
k) OLR WITH SPPR & HEAVY DUTY OLR	1) MAKE, TYPE & RATING	MA	VISUAL	10% of each type of rating per lot	IS-3231 Part 2 Sec 3 (87) / BHEL SPEC./ APPD. DRGS/DATASHEET	IS-3231 Part 2 Sec 3 (87) / BHEL SPEC./ APPD. DRGS/DATASHEET	QC Records	2	-	-		
	2) ROUTINE TESTS	MA	ELECTRICAL	10% of each type of rating per lot	-do-	-do-	TEST CERTIFICATE	3/2	-	2		
LEGENDS P : PERFORM W : WITNESS V : VERIFICATION MA : MAJOR CR : CRITICAL 3 : SUB-VENDOR 2 : MAIN VENDOR 1 : BHEL/CUSTOMER			NAME OF THE REPRESENTATIVE : SIGNATURE : DATE :		BIDDER/VENDOR'S PARTICULARS		BIDDER/VENDOR'S COMPANY SEAL					
			BHEL									

	QUALITY PLAN (FOR LT SWGR)	CUSTOMER			PROJECT			SPECIFICATION NUMBER		
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									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
	i) COUPLING (INTERPOSING) RELAYS [IF APPLICABLE]	1) MAKE, TYPE & RATING	MA	VISUAL	10% of each type of rating per lot	IS-3231 (87)/ BHEL SPEC./ APPD. DRGS/DATASHEET	IS-3231 (87)/ BHEL SPEC./ APPD. DRGS/DATASHEET	QC Records	2	-	-	
		2) ROUTINE TESTS	MA	ELECTRICAL	10% of each type of rating per lot	-do-	-do-	TEST CERTIFICATE	3/2	-	2	
	m) TIMER	1) MAKE, TYPE & RATING	MA	VISUAL	100%	BHEL SPEC./ APPD. DRGS/DATASHEET	BHEL SPEC./ APPD. DRGS/DATASHEET	QC Records	2	-	-	
		2) CONTACT CONFIGURATION	MA	ELECTRICAL	100%	BHEL SPEC./ APPD. DRGS/DATASHEET	BHEL SPEC./ APPD. DRGS/DATASHEET	QC Records	2	-	-	
	n) MCB	1) MAKE, TYPE & RATING	MA	VISUAL	100%	BHEL SPEC./ APPD. DRGS/DATASHEET IS 8828 (96)	BHEL SPEC./ APPD. DRGS/DATASHEET IS 8828 (96)	QC Records	2	-	-	
		2) ROUTINE TESTS	CR	ELECTRICAL	100%	BHEL SPEC./ APPD. DRGS/DATASHEET IS 8828 (96)	BHEL SPEC./ APPD. DRGS/DATASHEET IS 8828 (96)	TEST CERTIFICATE	3/2	-	2	
	o) MCCB	1) MAKE, TYPE & RATING	MA	VISUAL	100%	BHEL SPEC./ APPD. DRGS/DATASHEET IS 13947 PART 2	BHEL SPEC./ APPD. DRGS/DATASHEET IS 13947 PART 2	QC Records	2	-	-	
		2) ROUTINE TESTS	CR	ELECTRICAL	100%	BHEL SPEC./ APPD. DRGS/DATASHEET IS 13947 PART 2	BHEL SPEC./ APPD. DRGS/DATASHEET IS 13947 PART 2	TEST CERTIFICATE	3/2	-	2	
	p) CONTROL TRANSFORMER, TRANSFORMER	1) ROUTINE TESTS	MA	ELECTRICAL	100%	BHEL SPEC./ IS 12021 (87)	BHEL SPEC./ IS 12021 (87)	TEST. CERT.	3	-	2,1	
		2) TEMP. RISE TEST	MA	ELECTRICAL	1/RATING	-do-	-do-	-do-	3	-	2,1	
		3) VOLTAGE RATIO AT NO LOAD	MA	ELECTRICAL	100%	APPD. DRGS/DATASHEET	APPD. DRGS/DATASHEET	QC Records	3	-	2,1	
	q) INSULATING MATERIALS (FRP, SMC, DMC, ETC.)	1) DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANUFACTURER STD.	MANUFACTURER STD.	QC Records	3/2	-	-	
2) COMPARATIVE TRACKING INDEX CHECK		CR	ELECTRICAL	1/SIZE/LOT	IS 2824 (75)	IS 2824 (75)	TEST CERTIFICATE	3/2	-	1		
3) HV Test		MA	ELECTRICAL	-do-	BS-2782/IS-8623 (93)	2.5 KV for 1 Min	QC Record	3/2	-	2,1		
4) IR Test		MA	ELECTRICAL	-do-	BS-2782/IS-8623 (93)	BS-2782/IS-8623 (93)	QC Record	3/2	-	2,1		

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		SIGNATURE :		
		DATE :		
		BHEL	BIDDER/VENDOR'S PARTICULARS	

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1	2	3	4	5	6	7	8	9	P	W	V	11
		5) FLEXURAL STRENGTH TEST	CR	MECHANICAL	AS PER SUPPLIER STD.	BS-2782	BS-2782	Supplier's TC	3/2	-	2,1	
	r) INSULATING BARRIERS & SHROUDS (FIRE RETARDANT TYPE)	1) DIMENSIONS INCLUDING THICKNESS & HV TEST	MA	ELECTRICAL	5 samples of each type & rating per lot	MFR. DRGS.	MFR. DRGS., 2.5KV FOR 1 MIN.	QC Record	3/2	-	-	
		2) FLAMMABILITY	MA	FLAME TEST	-do-	IS 6746 (94)	IS 6746 (94)	TEST CERTIFICATE	3/2	-	2	
	s) WIRES/ CABLES	1) SIZE, COLOR	MA	VISUAL	1/TYPE/LOT	IS 694 (90)	IS 694 (90)	QC Record	2	-	1	
		2) HV TEST AT 80% OF RATED VOLTAGE	CR	ELECTRICAL	1/SIZE/LOT	IS 694	IS 694	QC Record	3/2	-	2,1	
	t) GASKETS : SYNTHETIC RUBBER/ NEOPRENE RUBBER/ EPDM SPONGE RUBBER	1) MATERIAL TYPE	MA	VISUAL	MFR. STD	IS 11149 (84)	IS 11149 (84)	Supplier's TC	-	-	2,1	TYPE, DIMENSIONS & PROFILE OF THE GASKETS SHOULD BE SAME AS TYPE TESTED PANEL GASKETS
		2) DIMENSION	MA	MEASUREMENT	SAMPLE	MANUFACTURER'S DRGS.	MANUFACTURER'S DRGS.	QC Record	3/2	-	2,1	
		3) SHORE HARDNESS	CR	TEST	-do-	IS 11149 (84)	IS 11149 (84)	Supplier's TC	3/2	-	2,1	
		4) AGEING	MA	TEST	-do-	IS-3400/ BS-2752	IS-3400/ BS-2752	Supplier's TC	3/2	-	2,1	
		5) ELONGATION AT BREAK	MA	TEST	-do-	BHEL SPEC./ IS 11149 (84)	BHEL SPEC./ IS 11149 (84)	Supplier's TC	3/2	-	2,1	
		6) COMPRESSION TEST	CR	TEST	-do-	BHEL SPEC./ IS 11149 (84)	BHEL SPEC./ IS 11149 (84)	Supplier's TC	3/2	-	2,1	
		7) OZONE RESISTANCE TEST	MA	TEST	-do-	BHEL SPEC./ IS 11149 (84)	BHEL SPEC./ IS 11149 (84)	Supplier's TC	3/2	-	2,1	
	u) DIGITAL MULTIFUNCTION METER (KWH METERS) [IF APPLICABLE]	1) MAKE, TYPE & RATING	MA	VISUAL	100%	BHEL SPEC./ APPD. DRGS/ DATASHEET	BHEL SPEC./ APPD. DRGS/ DATASHEET	QC Records	3/2	-	2	
		2) ROUTINE TESTS INCLUDING CALIBRATION & ACCURACY TEST	MA	ELECT	100%	IEC 62052-11, IEC 62053-21	IEC 62052-11, IEC 62053-21	TEST CERTIFICATE	3/2	-	2,1	
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SI. No.	COMPONENT/ OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	10	11	12	13
	v) TRANSDUCERS [IF APPLICABLE]	1) MAKE, TYPE & RATING	MA	VISUAL	100%	BHEL SPEC./ APPD. DRGS/ DATASHEET	BHEL SPEC./ APPD. DRGS/ DATASHEET	QC Records	2	-	-	
		2) ROUTINE TESTS INCLUDING CALIBRATION & ACCURACY TEST	MA	ELECT	100%	IS 12784 (89)	IS 12784 (89)	TEST CERTIFICATE	3/2	-	2,1	
	w) SPACE HEATER, THERMOSTAT, 3 PIN SOCKET, HOOTER	1) PHYSICAL CONDITION/ MOUNTING ARRANGEMENT	MA	VISUAL	100%	VOLTAGE/CURRENT/ WATTAGE/ NO BREAKAGE/ DAMAGE	VOLTAGE/CURRENT/ WATTAGE/ NO BREAKAGE/ DAMAGE	QC Records	2	-	-	
		2) MAKE, TYPE & RATING	MA	VISUAL	100%	BHEL SPEC./ APPD. DRGS/DATASHEET	BHEL SPEC./ APPD. DRGS/DATASHEET	QC Records	2	-	-	
		3) FUNCTIONAL	MA	ELECTRICAL	100%	RELEVANT IS	RELEVANT IS	QC Records	2	-	1	
	x) ETHERNET SWITCH [IF APPLICABLE]	1) MAKE & TYPE	MA	VISUAL	1/TYPE/ RATING	BHEL SPEC./ APPD. DRGS/ DATASHEET	BHEL SPEC./ APPD. DRGS/ DATASHEET	TEST CERTIFICATE	2	-	1	
		2) NUMBER OF PORTS	MA	VISUAL	1/TYPE/ RATING	BHEL SPEC./ APPD. DRGS/ DATASHEET	BHEL SPEC./ APPD. DRGS/ DATASHEET	TEST CERTIFICATE	2	-	1	
	y) LAN CABLE [IF APPLICABLE]	1) MAKE	MA	VISUAL	1/TYPE/ RATING	BHEL SPEC./ APPD. DRGS/ DATASHEET	BHEL SPEC./ APPD. DRGS/ DATASHEET	TEST CERTIFICATE	2	-	1	
	z) ACB HANDLING TROLLEY	1) DIMENSIONS	MA	VISUAL	1/TYPE/ RATING	BHEL SPEC./ APPD. DRGS/ DATASHEET	BHEL SPEC./ APPD. DRGS/ DATASHEET	QC Records	3/2	-	2,1	
		2) FUNCTIONAL CHECK	MA	MECHANICAL	1/TYPE/ RATING	-do-	-do-	QC Records	3/2	-	2,1	LOTS WILL BE CLEARED BASED ON COC
	aa) BUSBAR FISH PLATES	1) DIMENSIONS	MA	VISUAL	5/TYPE/ RATING/LOT	MANUFACTURER'S STD.	MANUFACTURER'S STD.	QC Records	2	-	-	
		2) SILVER PLATING THICKNESS [IF APPLICABLE]	MA	MECHANICAL	-do-	-do-	-do-	QC Records	3/2	-	-	
		3) ADHESION	MA	MECHANICAL	-do-	-do-	-do-	QC Records	3/2	-	-	
	ab) TERMINAL BLOCK	1) MAKE, TYPE & RATING	MA	VISUAL	5/TYPE/ RATING/LOT	BHEL SPEC./ APPD. DRGS/DATASHEET	BHEL SPEC./ APPD. DRGS/DATASHEET	QC Records	2	-	-	
	ac) PAINT/ POWDER	1) MAKE, SHELF LIFE	MA	VISUAL	100%	AS PER PAINT MANF. SPECIFICATION	AS PER PAINT MANF. SPECIFICATION	QC Records	2	-	-	SHELF LIFE : 6 MONTHS
LEGENDS P : PERFORM W : WITNESS V : VERIFICATION MA : MAJOR CR : CRITICAL			3 : SUB-VENDOR 2 : MAIN VENDOR 1 : BHEL/CUSTOMER		NAME OF THE REPRESENTATIVE : SIGNATURE : DATE :							
			BHEL		BIDDER/VENDOR'S PARTICULARS						BIDDER/VENDOR'S COMPANY SEAL	

		QUALITY PLAN (FOR LT SWGR)		CUSTOMER		PROJECT		SPECIFICATION NUMBER				
				BIDDER/VENDOR		QUALITY PLAN NUMBER		PED-506-00-Q-002, REV. 03		SPECIFICATION TITLE		
				WORKS ADDRESS		ITEM		LV SWITCHGEAR		SECTION		
Sl. No.	COMPONENT/ OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	10	11	12	
	IN PROCESS											
1.0	FABRICATION	1. DIMENSION	MA	MEASUREMENT	100%	APPD. DRGS/DATASHEET	APPD. DRGS/DATASHEET	INSP.REPORT	2	-	-	
		2. ALIGNMENT	MA	MEASUREMENT & VISUAL	100%	-do-	-do-	-do-	2	-	-	
		3. FINISH/ SURFACE DEFECT	MA	VISUAL	100%	-do-	-do-	-do-	2	-	-	
2.0	PRE-TREATMENT & PAINTING (POWDER COATING)	1) PRE-TREATMENT OF STEEL (7 TANK PROCESS)	MA	PROCESS	MFR. PRACTICE	MANUFACTURER'S STD.	MANUFACTURER'S STD.	QC Records	2	-	-	
		2) PAINT SHADE	MA	VISUAL	1 SAMPLE/ LOT	BHEL SPEC./ APPD. DRGS/ DATASHEET	BHEL SPEC./ APPD. DRGS/ DATASHEET	QC Records	2	-	-	
		3) PAINT THICKNESS & ADHESION	MA	MEASUREMENT	FEW PLACES	MANUFACTURER'S STD.	MANUFACTURER'S STD.	QC Records	2	-	-	
3.0	PANEL ASSEMBLY	1) SHELL ASSEMBLY	MA	PROCESS	100%	INTERNAL DRGS. MEETING REQUIREMENTS OF BHEL APPROVED DRGS.	INTERNAL DRGS. MEETING REQUIREMENTS OF BHEL APPROVED DRGS.	QC Records	2	-	-	
		2) SIZE OF BUSBAR & BUSBAR FINISH	MA	PROCESS	100%	-do-	-do-	QC Records	2	-	-	
		3) COLOR CODING OF BUSBAR	MA	PROCESS	100%	-do-	-do-	QC Records	2	-	-	
		4) INSULATOR TYPE & MOUNTING	MA	PROCESS	100%	-do-	-do-	QC Records	2	-	-	
		5) BUSBAR SUPPORT DISTANCE & TIGHTNESS OF BOLTS FOR MAIN BUS- BARS & BUSBAR JOINTS	MA	PROCESS	100%	MFR. DRAWINGS	MFR. DRAWINGS	QC Records	2	-	-	
		6) MAIN, CONTROL & AUXILIARY BUSBAR CLEARANCES	MA	PROCESS	100%	INTERNAL DRGS. MEETING REQUIREMENTS OF BHEL APPROVED DRGS.	INTERNAL DRGS. MEETING REQUIREMENTS OF BHEL APPROVED DRGS.	QC Records	2	-	-	
4.0	MODULE ASSEMBLY	1) COMPONENT IDENTIFICATION	MA	PROCESS	100%	MFR. DRAWINGS	MFR. DRAWINGS	QC Records	2	-	-	
LEGENDS P : PERFORM W : WITNESS V : VERIFICATION MA : MAJOR CR : CRITICAL			3 : SUB-VENDOR 2 : MAIN VENDOR 1 : BHEL/CUSTOMER		NAME OF THE REPRESENTATIVE : SIGNATURE : DATE :							
			BHEL		BIDDER/VENDOR'S PARTICULARS				BIDDER/VENDOR'S COMPANY SEAL			

		QUALITY PLAN (FOR LT SWGR)		CUSTOMER		PROJECT		SPECIFICATION NUMBER			
				BIDDER/VENDOR		QUALITY PLAN NUMBER		PED-506-00-Q-002, REV. 03		SPECIFICATION TITLE	
				WORKS ADDRESS		ITEM		LV SWITCHGEAR		SECTION	

Sl. No.	COMPONENT/ OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
		2) COMPONENT LAYOUT, MOUNTING & DIMENSIONS	MA	PROCESS	100%	MFR. DRAWINGS	MFR. DRAWINGS	QC Records	2	-	-	
		3) INCOMING & OUTGOING POWER CONTACT ASSEMBLY & ALIGNMENT, CONTROL CONTACTS ASSEMBLY	MA	PROCESS	100%	MFR. DRAWINGS	MFR. DRAWINGS	QC Records	2	-	-	
		4) POWER CIRCUIT WIRE/ STRIP TERMINATION & CLEARANCES	MA	PROCESS	100%	MFR. DRAWINGS	MFR. DRAWINGS	QC Records	2	-	-	
5.0	MARKING/LABELLING	1. CORRECTNESS	MA	VISUAL	100%	-do-	-do-	INSPN REPORT	2	-	-	
		2. ADHESION/ FIXING	MA	VISUAL	100%	-do-	-do-	-do-	2	-	-	
6.0	PRE-FINAL INSPECTION	1. ALIGNMENT	MA	VISUAL	100%	BHEL SPEC. & RELEVANT. STD.	BHEL SPEC. & RELEVANT. STD.	TEST CERTIFICATE.	2	-	-	
		2. PERFORMANCE	CR	ELECTRICAL	100%	-do-	-do-	-do-	2	-	-	
		3. IR & HV	CR	ELECTRICAL	100%	-do-	-do-	-do-	2	-	-	
7.0	FINAL INSPECTION	1. PHYSICAL BLEMISHES	MA	VISUAL	100%	BHEL SPEC.	BHEL SPEC.	INSP. REPORT	2	1	-	
		2. ALIGNMENT	MA	VISUAL	100%	IS-8623	IS-8623	-do-	2	1	-	
		3. DIMENSIONS INCLUDING SHEET STEEL THICKNESS	MA	MEASUREMENT	100%	IS-3427	IS-3427	-do-	2	1	-	
		4. PAINT SHADE	MA	VISUAL	100%	BHEL SPEC.	BHEL SPEC.	-do-	2	1	-	
		5. PAINT THICKNESS	MA	MEASUREMENT	FEW PLACES	APPD. DRG/ APPD. DATASHEET/ RELEVANT IS	APPD. DRG/ APPD. DATASHEET/ RELEVANT IS	-do-	2	1	-	
		6. PAINT ADHESION	MA	MECH. TESTS	-do-	APPD. DRG.	APPD. DRG.	-do-	2	1	-	
		7. VERIFICATION OF B.O.M. INCLUDING CABLE GLANDS & LUGS	MA	VISUAL	100%	-do-	-do-	-do-	2	1	-	
		8. INTER CHANGEABILITY	MA	MECHANICAL	10%	BHEL SPEC./ APPD. DRG.	BHEL SPEC./ APPD. DRG.	-do-	2	1	-	
LEGENDS P : PERFORM W : WITNESS V : VERIFICATION MA : MAJOR CR : CRITICAL 3 : SUB-VENDOR 2 : MAIN VENDOR 1 : BHEL/CUSTOMER			NAME OF THE REPRESENTATIVE : SIGNATURE : DATE :									
BHEL			BIDDER/VENDOR'S PARTICULARS							BIDDER/VENDOR'S COMPANY SEAL		

		QUALITY PLAN (FOR LT SWGR)		CUSTOMER		PROJECT		SPECIFICATION NUMBER			
				BIDDER/VENDOR		QUALITY PLAN NUMBER		PED-506-00-Q-002, REV. 03		SPECIFICATION TITLE	
				WORKS ADDRESS		ITEM		LV SWITCHGEAR		SECTION	

Sl. No.	COMPONENT/ OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS		
									P	W	V			
1	2	3	4	5	6	7	8	9	10			11		
		9. BREAKER OPERATION AT SERVICE, TEST & ISOLATED POSITION	CR	ELECTRICAL	100%	BHEL SPECIFICATION	BHEL SPECIFICATION	-do-	2	1	-			
		10. EARTHBUS DIMENSIONS EARTHING OF DRAWOUT MODULES, DOOR ETC.	MA	MECHANICAL	100%	BHEL SPECIFICATION	BHEL SPECIFICATION	-do-	2	1*	-	* For BHEL/Customer, the extent of check shall be 10%.		
		11. ROUTINE TESTS	CR	ELECTRICAL	100%	BHEL SPEC./APPD. DRGS	BHEL SPEC./APPD. DRGS	-do-	2	1	-			
		12. IR TEST BEFORE & AFTER HV TEST	MA	ELECTRICAL	100%	IS 8623 (93)	IS 8623 (93)	-do-	2	1	-			
		13. FUNCTION PERFORMANCE	CR	ELECT. & MECH. TESTS	1	-do-	-do-	-do-	2	1	-			
		14. TYPE TESTS												
		a) TEMPERATURE RISE TEST	CR	ELECTRICAL	1/ITEM	-do-	-do-	-do-	2	-	1**	** REFER NOTE "A & B" BELOW.		
		b) DEGREE OF PROTECTION TEST	CR	MECHANICAL	1/ITEM	-do-	-do-	-do-	2	-	1**	** REFER NOTE "A & B" BELOW.		
		c) SHORT TIME CURRENT TEST	CR	ELECTRICAL	1/ITEM	-do-	-do-	-do-	2	-	1**	** REFER NOTE "A & B" BELOW.		
		d) TYPE-2 COORDINATION TEST	MA	ELECTRICAL	AT LEAST 5 SAMPLE RATINGS	BHEL SPEC./ APPD. DRGS	BHEL SPEC./ APPD. DRGS	-do-	2	-	1**	** REFER NOTE "A & B" BELOW.		
		15. INTERLOCKS, PROTECTION & METERING	CR	SECONDARY INJECTION	100%	-do-	-do-	-do-	2	1	-			
		16. EASE OF WITHDRAWAL & INSERTION	MA	MECHANICAL	100%	-do-	-do-	-do-	2	1	-			
		17. ACCESSIBILITY OF COMPONENT & SAFETY (SHROUDING)	MA	VISUAL	100%	BHEL SPEC./ APPD. DRGS	BHEL SPEC./ APPD. DRGS	-do-	2	1	-			
		18. WIRING NEATNESS & FIRMNESS	CR	PULLING	SAMPLE	-do-	-do-	-do-	2	1	-			
		19. BUS BAR TIGHTNESS	MA	MECHANICAL	SAMPLE	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	-do-	2	1	-			
		20. MAIN, CONTROL & AUXILIARY BUSBAR CLEARANCES	MA	PROCESS	100%	INTERNAL DRGS. MEETING REQUIREMENTS OF BHEL APPROVED DRGS.	INTERNAL DRGS. MEETING REQUIREMENTS OF BHEL APPROVED DRGS.	-do-	2	1	-			
	NOTES A TEST CERTIFICATES TO BE FURNISHED FOR VERIFICATION BY ENGINEERING. B CONDUCTION OF TESTS TO BE DONE IF REQUIRED BY BHEL TECHNICAL SPECIFICATION & TEST CERTIFICATES FOR THE SAME TO BE FURNISHED FOR VERIFICATION BY ENGINEERING. C ONLY APPROVED MAKE OF COMPONENTS ARE TO BE USED. D FUNCTIONAL/PERFORMANCE CHECKS TO BE CONDUCTED ON ENTIRE BOARD AND ALL POWER SUPPLIES SWITCHED ON. E PACKING SHALL BE SUCH THAT DURING TRANSPORTATION NO DAMAGE IS CAUSED TO THE SWITCHGEAR.													
	LEGENDS P : PERFORM W : WITNESS V : VERIFICATION MA : MAJOR CR : CRITICAL			3 : SUB-VENDOR 2 : MAIN VENDOR 1 : BHEL/CUSTOMER		NAME OF THE REPRESENTATIVE : SIGNATURE : DATE :			BIDDER/VENDOR'S PARTICULARS				BIDDER/VENDOR'S COMPANY SEAL	

FORM NO. PEM-6041-0												
		QUALITY PLAN	CUSTOMER			PROJECT TITLE			SPECIFICATION NUMBER			
			BIDDER/VENDOR			QUALITY PLAN			SPECIFICATION TITLE			
			WORK ADDRESS			NUMBER PED-506-00-Q-005, REV. 03						
			SYSTEM			ITEM : LPBS / LOCAL STARTERS/LCC/JB'S			SECTION VOLUME III			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	10	11	12	
1.0	RAW MATERIAL & BOUGHT OUT ITEMS											
1.1	SHEET STEEL/CHANNELS	1. DUCTILITY(BENDING TEST)	CR	MECHANICAL	SAMPLE	IS-1079(94)/IS-513(94)/IS-2062(2006)	IS-1079(94)/IS-513(94)/IS-2062(2006)	TEST CERTIFICATE	3/2	-	2	FOR SHEET STEEL
		2. SURFACE FINISH DEFECTS	MA	VISUAL	100%	IS-1079(94)/IS-513(94)/IS-2062(2006)	NO RUSTING/NO VISUAL DEFECTS	QC RECORDS	3/2	-	2	
		3. THICKNESS /DIMENSION	MA	MEASUREMENT	SAMPLE	IS-1079(94)/IS-513(94)/IS-2062(2006)	BHEL SPEC./APPD.DRG. IS-1730	-DO-	3/2	-	2	
1.2	WIRES	1. SURFACE DEFECTS	MA	VISUAL	100%	IS-1554/IS-694(90)/	IS-1554/IS-694(90)/	-DO-	3/2	-	-	ISI MARKED
		2. SIZE , COLOUR	MA	VISUAL	1/TYPE/LOT	IS-1554/IS-694(90)/	IS-1554/IS-694(90)/	-DO-	2	-	1	
1.3	ZINC INGOT FOR GALVANIS	CHEM. COMP.	MA	CHEM. TEST	EACH	IS-209	IS-209	TEST CERT	3/2	-	1,2	
1.4	ELECTRICAL COMPONENTS LIKE FUSE, SWITCHES, INDICATING LAMPS, PUSH BUTTON, TERMINALS, GASKETS CABLE GLANDS AND LUGS	1. MAKE, TYPE, RATING	MA	VISUAL	SAMPLE	BHEL SPEC./APPD. DRG. & BOM	BHEL SPEC./APPD. DRG. & BOM	QC RECORDS	3/2	-	-	
		2. OPERATION/ FUNCTIONAL CHECK	CR	ELECTRICAL TEST	SAMPLE	RELEVANT IS AND CATALOGUE	RELEVANT IS AND CATALOGUE	-DO-	3/2	2	2	
1.5	INDICATING INSTRUMENTS [IF APPLICABLE]	1. MAKE, TYPE, RATING	MA	VISUAL	SAMPLE	BHEL SPEC./APPD.DRG	BHEL SPEC./APPD.DRG.	QC RECORDS	2	-	-	
		2 ROUTINE TEST.	MA	ELECTRICAL	SAMPLE	IS1248(2003)/BHEL SPEC/APPD. DRG.	IS1248(2003)/BHEL SPEC/APPD. DRG.	TEST CERT	3/2	-	1, 2	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
SHEET 1 OF 4			DATE						BIDDER'S/VENDOR'S COMPANY SEAL			

FORM NO. PEM-6041-0											
		QUALITY PLAN	CUSTOMER			PROJECT TITLE			SPECIFICATION NUMBER		
			BIDDER/ VENDOR	WORK ADDRESS	SYSTEM	QUALITY PLAN NUMBER PED-506-00-Q-005, REV. 03			SPECIFICATION TITLE		
						ITEM : LPBS / LOCAL STARTERS/LCC/JB'S			SECTION VOLUME III		
						SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK
1	2	3	4	5	6	7	8	9	10	11	
2.0	IN-PROCESS CONTROL										
2.1	NIBBLING/PUNCHING	1. CUTOUT SIZES	MA	MEASUREMENT	100%	APPD. DRGS	APPD. DRGS	QC RECORDS	3/2	-	2
		2. DEBURRING	MI	VISUAL	100%	-DO-	-DO-	-DO-	3/2	-	-
2.2	FABRICATION	1. DIMENSIONS	MA	MEASUREMENT	100%	APPR. DRGS	APPR. DRGS	QC RECORDS	3/2	2	-
		2. ALIGNMENT	MA	MEASUREMENT	100%	MFR'S STD	MFR'S STD	-DO-	3/2	2	-
		3. WELDING QUALITY	MI	VISUAL	100%	-DO-	-DO-	-DO-	3/2	2	-
2.3	PRE-TREATMENT & PAINTING (7 OR 8 TANK PROCESS)	1. PRE-TREATMENT OF STEEL	MA	PROCESS CHECK	PERIODIC	MFR. SPEC./STD., IS-6005	MFR. SPEC./STD., IS-6005	QC RECORDS	3/2	-	-
		2. SURFACE FINISH & COVERAGE	MA	VISUAL	100%	MFR. SPEC./STD., IS-6005	MFR. SPEC./STD., IS-6005	QC RECORDS	3/2	-	-
		3. PAINT THICKNESS	MA	MEASUREMENT	100%	-DO-	-DO-	QC RECORDS	3/2	-	2
		4. SHADE	MA	VISUAL	100%	-DO-	-DO-	-DO-	3/2	-	2
		5. ADHESION	MA	SCRATCH TEST / CROSS OUT TAPE	SAMPLE	-DO-	-DO-	-DO-	3/2	-	2
BHEL			PARTICULARS			BIDDER/VENDOR			BIDDER'S/VENDOR'S COMPANY SEAL		
			NAME								
			SIGNATURE								
SHEET 2 OF 4			DATE								

		QUALITY PLAN		CUSTOMER			PROJECT TITLE			SPECIFICATION NUMBER			
				BIDDER/ VENDOR			QUALITY PLAN			SPECIFICATION TITLE			
				WORK ADDRESS			NUMBER PED-506-00-Q-005, REV. 03						
		SYSTEM			ITEM : LPBS / LOCAL STARTERS/LCC/JB'S			SECTION			VOLUME III		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS	
1	2	3	4	5	6	7	8	9	10	P	W	V	11
2.4	WIRING, GASKET, NAME PLATE, COMPONENT MOUNTING ETC.	1. WIRING LAYOUT	MA	VISUAL	100%	APPD. DRGS & SPEC.	APPD. DRGS & SPEC.	QC RECORDS	3/2	-	-	-	PVC CHANNELS TO BE USED
		2. WORKMANSHIP AND FINISH CORRECTNESS COMPLETENESS	MA	VISUAL	100%	-DO-	-DO-	-DO-	3/2	-	-	-	
3	FINAL INSPECTION												
3.1	PHYSICAL	1. WORKMANSHIP & FINISH, PAINT SHADE	MA	VISUAL	100%	BHEL SPEC. APPD. DRG IS:5/IS:6005	BHEL SPEC. APPD. DRG IS:5/IS:6007	INSPN REPORT	3/2	2,1	-	-	
		2. ADHESION	MA	SCRATCH TEST / CROSS OUT TAPE	SAMPLE	MFR. SPEC./STD, IS-6005	MFR. SPEC./STD., IS-6005	QC RECORDS	3/2	2,1	-	-	
		3. WIRING LAYOUT	MA	VISUAL	100%	BHEL SPEC. APPD. DRG	BHEL SPEC. APPD. DRG	INSPN REPORT	3/2	2,1	-	-	
		4. COMPONENT LAYOUT & FIXING, ACCESSIBILITY AND SAFETY	MA	VISUAL	100%	-DO-	-DO-	-DO-	3/2	2,1	-	-	
		5. COMPONENT IDENTIFICATION (MARKING/ NAME PLATES)	MA	VISUAL	100%	APPD. DRG.	APPD. DRG.	-DO-	3/2	2,1	-	-	
		6. PROPER WIRE TERMINATION	MA	PULLING	SAMPLE	-DO-	NO LOOSE CONNECTIONS. ALL TERMINATION TO BE LUGGED	-DO-	3/2	2,1	-	-	
		7. DOOR LOCK FUNCTIONING	MA	OPERATON	100%	APPD. DRG	NO MISMATCH	-DO-	3/2	2,1	-	-	
BHEL			PARTICULARS			BIDDER/VENDOR							
			NAME										
			SIGNATURE										
SHEET 3 OF 4			DATE						BIDDER'S/VENDOR'S COMPANY SEAL				

FORM NO. PEM-6041-0												
		QUALITY PLAN	CUSTOMER			PROJECT TITLE			SPECIFICATION NUMBER			
			BIDDER/VENDOR			QUALITY PLAN			SPECIFICATION TITLE			
			WORK ADDRESS			NUMBER PED-506-00-Q-005, REV. 03						
			SYSTEM			ITEM : LPBS / LOCAL STARTERS/LCC/JB'S			SECTION	VOLUME III		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	10	11		
		8. OVERALL DIMENSIONS	MA	MEASUREMENT	100%	APPD. DRG.	APPD. DRG.	INSPN. REPORT	3/2	2,1	-	IR-HV-IR TEST TO BE DONE SEE NOTE -1 BELOW
		9. CONTINUITY	CR	ELECTRICAL	100%	APPD. DRG., BHEL SPEC., & RELEVANT IS	APPD. DRG., BHEL SPEC., & RELEVANT IS	-DO-	3/2	2,1	-	
		10. IR-HV-IR	CR	ELECTRICAL	100%	-DO-	-DO-	-DO-	3/2	2,1	-	
		11. DEGREE OF PROTECTION (DOP)	CR	ELECTRICAL	1/ITEM	APPD. DRG./RELEVANT IS	APPD. DRG./RELEVANT IS	TEST CERT	3/2		2,1	
LEGENDS P : PERFORM W : WITNESS V : VERIFICATION MA : MAJOR CR : CRITICAL 3 : SUB-VENDOR 2 : MAIN VENDOR 1 : BHEL/CUSTOMER NOTE: 1. IF TC'S FOR DEGREE OF PROTECTION/EXPLOSION PROOFNESS IS AVAILABLE FROM AN INDEPENDENT LABORATORY AND ACCEPTED BY BHEL/CUSTOMER FOR IDENTICAL DESIGN (SIZE SHALL BE SMALLER THAN THAT INDICATED IN THE TC) THESE TESTS NEED NOT BE REPEATED.												
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
SHEET 4 OF 4			DATE						BIDDER'S/VENDOR'S COMPANY SEAL			

Below sub vendor list comprises of BHEL 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



C&I TECHNICAL SPECIFICATION
For
HVAC SYSTEM

4X111 MW VISHNUGAD HEP

**C&I TECHNICAL SPECIFICATION
FOR
HVAC SYSTEM**



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C&I Technical Specification

HVAC SYSTEM

SECTION-C

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Specific Technical Requirements (C&I): 1. Bidder shall supply complete Relay based HVAC system with separate Central Control & Annunciation panels for Air Conditioning system and Ventilation system as per specification. The bidder shall provide complete Instrumentation (temperature sensors, humidity sensors, local indicators (for pressure and temperature etc.) & remote position indication along with other accessories required) for control, monitoring and operation of entire HVAC System. Details specification of relay panel is mentioned further in this section-C. 2. The requirements given are to be read in conjunction with detailed Technical specification enclosed in the specification. Further in case of any discrepancy in the requirement within the same / different Section noted by the bidder in the specification, will be brought to the notice of BHEL in the form of pre bid clarification. In absence of any pre-bid clarification, the more stringent requirement as per interpretation of customer/BHEL shall prevail without any commercial implication. 3. Local control posts/local control panel for operation & status indication of drives for Air Washer Units shall be provided. Bidder to confirm supply of the required no. of control post/panel to control the operation of all Air Washer Units. The protection and Interlock for various drives shall be done through relays mounted in the Local Control Panel. Detail of Local Control Panel is mentioned in Section-D. 4. The field I/Os to be grouped together in Junction Boxes suitably and a common trunk cable shall be taken to the panel. All fields cabling for instruments/motor/pump/blower to JB is in bidder's scope of supply. All instruments shall be terminated on JB/LCP in field. Both the instrument and JB/LCP are in bidder scope. 5. 415 V AC/ 240 V AC supply is in bidder scope. Necessary power supply for panel, instruments etc. and any other supply like 24 V DC, 110 V AC etc. shall be derived by the bidder. The necessary hardware for the same shall be in Bidder's scope. Suitable Automatic changeover arrangement of the input feeders also to be provided by the bidder in the LCP. 6. The power supply for fire dampers shall be fed from the Local Control Panel of the Ventilation system. Provision for input fire signal from fire alarm system to be ensured in the Control panel for opening/ closing of the motor		

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operated fire dampers. Open/Close indication shall be available on Panel placed in Control room. 7. The quantity of instruments indicated in tender P&ID and Design Memorandum/Philosophy are minimum, for bidding purpose. However, bidder shall also include in his proposal all the instruments and devices, which are needed for the completeness of system/equipment, supplied by the bidder, even if the same is not specifically appearing in the P&ID and Design philosophy. If any additional instruments are required for safe & reliable operation of plant during detail engineering, bidder shall supply the same without any price implication. 8. Supplied system shall have provision for hardwired connectivity of critical signals with plant SCADA. Same shall be decided during detailed engineering. 9. Provision for earthing of the panel to be provided by vendor. 10. All manual valves at pump suction / discharge shall be provided with Open and Close Limit Switches. 11. Vendor to submit GA drawing of control panel 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. 12. All the instrumentation equipment's and accessories under this specification shall be furnished as per technical specification and ranges, makes/numbers as approved by the owner during detail engineering. 13. The necessary root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifold and all the other accessories required for mounting/erection of the local instruments shall be furnished, even if not specifically asked for, on as required basis. The instrument fittings shall be of forged SS. Instrument piping shall be designed for maximum design pressure & temperature of the process. The contacts of equipment mounted instruments, sensors, switches etc. for external connection including spare contacts shall be wired out to the LCP. 14. Following signal exchange shall take place between MCC & Local Control Panel for Unidirectional LT drives:		

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• Drive start command & stop commands. • Drive ON and OFF feedback. • MCC disturbance (when Thermal Overload relay operates or MCC isolated or MCC control power supply fails or Emergency Local Stop Push Button is pressed). • Current feedback (4-20 mA) of all drives greater than 30KW. 15. Following signal exchange shall take place between Local Control Panel & Actuator/MCC for Bi-directional drives (with integral starter): • Actuator open & close command. • MCC Disturbed • Actuator status feedback by means of limit switches (open/close). • Torque Switch contacts (open/close) • Valve position feedback (4-20 mA) for inching duty drives. 16. The make/model of various instruments/items/systems shall be as per Customer approved vendor list. No commercial and delivery implication in this regard shall be acceptable. In case of any conflict and repetition of clauses in the specification, the more stringent requirements among them are to be complied with. 17. For cable scope refer Electrical scope sheet between BHEL and vendor defined in electrical specification. 18. The specifications for instruments mentioned in the specification are minimum requirements. The detail specifications shall be finalized during detail engineering. 19. The bidders shall specifically mention any deviation they would like to take on the C&I specification. In absence of no deviation, it will be considered as compliance to the specification in totality. 20. Bidder to perform tests of C&I items/instruments/systems as per Quality plans/type test attached in the specification. However, if any test not specified in the quality plan but specified in specification Tests for I&C equipment included elsewhere in specification will have to perform by Bidder without any cost implication.		

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21. Instrument installation and accessories required for the same shall be in Bidder's scope and shall be submitted after award of contract. However any instrument/ analyzer installation not covered in the same shall be subject to customer and BHEL approval during detailed engineering. 22. Contractor shall furnish Instrument Schedule, I/O list, Drive list, Cable Schedule, Cable interconnection, JB grouping, Annunciation list, SOE list, List of Instruments/devices. Also reusable database format like MS Excel, MS Access etc. of these documents shall also be provided by Contractor in BHEL approved format. Soft copy of the formats shall be provided to the successful bidder. 23. Local control panel, if any, required for operation shall be in bidder scope. 24. All instrument scales and charts shall be calibrated and printed in metric units and shall have linear graduation. The ranges shall be selected to have the normal reading in 75% of full scale. All scales and charts shall be calibrated and printed in Metric Units as follows: • Temperature - Degree centigrade (deg. C) • Pressure - Kilograms per square centimeter (Kg/cm²). • Draught - Millimeter of water column (mm WC). • Vacuum - Millimeter of mercury gauge (mm Hg). or water column (mm WC) • Flow (Liquid) - Tonn/Hour • Density - Grams per CC 25. All the instruments and control devices provided on panels shall be of miniaturized design, mosaic compatible with front draw out facility and flexible plug-in connection at rear. The display/ scale and/ or label should be easily readable under normal operating conditions. 26. Instruments for sensing, transmission and measuring system shall be of electronic type with signal transmission in current mode of 4-20 mA DC. For interrogation of potential free contacts, 24V DC power supply shall be employed.		

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27. Tripping contact for unit as well as for equipment shall be separate from interlock and alarm contacts. Also the tripping contact for equipment and unit shall be separate. 28. Indicating type process switches deriving contact from pointer shall not be acceptable. Wherever blind switches are provided, separate gauges for local indication shall be provided to facilitate easy operation / maintenance. The contacts of switch devices (process switches, limit switches) etc. unless higher rating is required for specific application, shall be rated continuously for 5A at 240 V AC, 50 Hz (breaking inductive circuits) and 0.25 A at 220V DC. 29. Each switching element including the contacts from limit and torque switches of valve actuators shall be provided with two contacts. All spare contacts of the switch devices shall be wired to the nearest junction box/ terminal box. 30. All electronic input and output modules shall be short circuit proof. These shall also be tropicalized, and components shall be of industrial grade or better. All equipment/systems located in the field shall be suitable for continuous operation without loss of function, departure from specifications or damage, at the ambient temperature of 50 deg.C and relative humidity of 95%. All equipment / systems located in air conditioned areas shall also be designed and constructed to operate for short periods of plant operation when air-conditioning equipment malfunctions (without loss of function, departure from specifications requirements or damage) at the maximum ambient temperature of 50 deg.C and relative humidity of 95%. RH. 31. All metallic cases of relays, instruments and other panel mounted equipment including gland plates, shall be connected to the earth bus by independent copper wires of size not less than 2.5 sq. mm. The colour code of earthing wires shall be green. Earthing wire shall be connected on terminals with suitable clamp connectors and soldering shall not be permitted. The connections of the plug-in modules to earth bar have to be made before the plugs make contact. 32. Looping of earth connections which would result in loss of earth connection to other devices when the loop is broken, shall not be permitted. However,		

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looping of earth connections between equipments to provide alternative paths to earth bus can be provided. 33. Recommended tools & testing instruments, if any, required for O & M after commissioning shall be included in the offer and their technical particulars & quantities shall be indicated in Annexure-VII. Unit prices for these optional tools & tackles shall be furnished separately in the price schedule. It is mandatory for the supplier to supply these tools and testing instruments as finalised. 34. Redundancy of sensors shall be provided A) Triple redundancy for all analog and binary inputs required for protection of systems/drives. B) For all control functions dual redundancy of the sensors shall be provided by the bidder. 35. The control cables shall be of 650 V grade, heavy duty, multi-core, color coded or core numbered, annealed high conductivity stranded copper conductor, insulated with HR PVC insulation, Un-armoured, PVC sheathed, FRLS, conforming to IS 1554 (Part-I & II). The outer sheath is of specially formulated PVC compounds. All control cables (except current transformer secondary circuits) shall have at least 20 % spare cores. 36. Control cables shall be standardized as much as possible in order to supply only a few different type (e.g. 4, 5, 7, 10, 14, 19, 27) Control, annunciation, voltage and current transformers secondary wiring shall be 650/1100 V grade, multi-conductor cables, Single conductor cables shall be used for short runs. For the cables for pick-ups, for data transmission to CCS and elsewhere the flexible cables are necessary, the conductors shall be plain copper, stranded wire type with PVC core insulation. The cables for analog signals transmission to computers of Computerized Control System shall be 600 V grade screened twisted pair solid multi-conductor of 0.8 millimeter diameter. The cables for current and voltage transformers secondary wiring, temperature detectors, gauges, alarm circuits, data transmission to Computerized Control System etc. shall have braided screen of tinned Cu or steel wires.		

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37. Multi-core control cables shall be colour coded for identification of cores as per IS:1554-1976. 38. Following colour scheme shall be adopted for power cables: <table><tr><td>1 – Core</td><td>Red, Yellow, Blue or Black</td></tr><tr><td>2 – Core</td><td>Red and Black</td></tr><tr><td>3 – Core</td><td>Red, Yellow and Blue</td></tr><tr><td>4 – Core</td><td>Red, Yellow, Blue and Black</td></tr><tr><td>5 – Core</td><td>Red, Yellow, Blue, Black and Green or Light Green</td></tr></table> 39. Where the number of cores exceeds 5, two adjacent cores (counting core and direction core) in each layer are colored Blue and yellow and the remaining cores are Light grey. Control cables with core identified by numbers can also be provided. 40. <u>CONTROL & OPERATIONAL REQUIREMENTS FOR VENTILATION SYSTEM</u> a) The ON/OFF commands for ventilation systems of machine hall and transformer hall in remote mode of operation will be organized from the operating station, ventilation control and annunciation panel installed in computerized control room and in local mode from MCC or by push-buttons, located in ventilation chambers of different supply / exhaust air systems. b) Non-essential ventilating systems shall be operated only from MCC or push-button stations located at ventilating systems. c) The ventilation systems of Butterfly valve chamber shall be operated in local mode from MCC or by push-buttons, located in the ventilation room. d) One central ventilation control and annunciation panel shall be supplied for installation at Station Control Area (SCA) with control switches, alarm annunciators, ON/OFF position lamps, ventilation systems mimic diagram etc. e) Engraved Mechanical Mimic Diagram shall be provided with aluminum / steel sheet. Ventilation systems position lamps shall be provided on mimic diagram. f) The ventilation systems, which will serve and stand-by modes of operation, shall be provided with control board near ventilation system. Selector			1 – Core	Red, Yellow, Blue or Black	2 – Core	Red and Black	3 – Core	Red, Yellow and Blue	4 – Core	Red, Yellow, Blue and Black	5 – Core	Red, Yellow, Blue, Black and Green or Light Green
1 – Core	Red, Yellow, Blue or Black											
2 – Core	Red and Black											
3 – Core	Red, Yellow and Blue											
4 – Core	Red, Yellow, Blue and Black											
5 – Core	Red, Yellow, Blue, Black and Green or Light Green											

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switches (service/stand-by), control switches, relays shall be provided with these control boards. g) All other control functions, necessary blockings shall be organized into control modules of corresponding MCC. h) The control boxes shall be installed at the fire dampers. The front face of the control boxes shall mount selector switches "Local/Remote" and push buttons "Open/Close". i) In the remote mode, the fire dampers shall get closed in case of fire in respective locations automatically & fans supplying exhausting air from / to the premises shall stop. j) Provisions shall be made for entering "the fire dampers close" signal into the control boxes from the corresponding Fire Detection and Alarm Panels. k) All wiring required to meet the above requirements shall be in the scope of supplier l) Fresh Air Supply: The proposed ventilation of the power house complex shall cater to three (3) areas along with their approach/access/escape passage isolated from each other's namely, machine hall, cavern including annex bays floors, transformer hall and GIS Hall cavern, main access tunnel. Air changes for various rooms and different areas shall be as per relevant Indian or International standard. • When the indoor temperature is below 18 Deg C the temperature controlled system will operate return air dampers of M/C hall and Transformer hall ventilation supply air rooms to the fully open position and a portion of the used air will be sucked by the supply fans which will get mixed with the cool fresh supply air entering into the power house. • When the power house indoor temperature is above 18 Deg C, the temperature controlled system will operate return air dampers of M/C hall and Transformer hall to the fully closed position. The hot air will be discharged outside the power house along with exhaust air of toilets, batteries etc. through exhaust fans. 41. <u>CONTROL & OPERATIONAL REQUIREMENTS FOR AC SYSTEM</u> • Each Air Conditioning unit shall be controlled from a control box. The control box shall be of flawless metallic construction finished with white powder coated enamel paint. The controls shall incorporate: - i. Sequential start of compressor motors ii. Overload and under voltage tripping iii. ON/OFF indication of compressor and blower motors iv. Temperature control switch to adjust the thermostat.		

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• The control unit shall be fixed on the wall. Wiring between the control box, condensing and evaporator units shall be in the contractor's scope and it shall be done aesthetically. • In addition to fixed type control panel, a mobile remote control unit shall be provided for each air conditioning unit. 42. 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. 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 Vendor 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 Vendor without any price/time implication.		

9.4**DETAILED DESCRIPTION OF THE RELAY PANELS**

- 9.4.1 The panels to be provided shall have vertical front panel with equipment mounted thereon. In case of panels having width more than 800 mm, double leaf doors shall be provided. The doors shall have handles with built in lock and key facility.

Constructional Features

- 9.4.2.1 *The relay panels shall be fabricated from cold rolled steel sheet of not less than 3mm thickness for load bearing members of the panels such as base frame, side sheets, front sheet of door frames, side & bottom and 2mm for top & rear portions. The panels shall be suitably reinforced with sufficient number of steel members so as to provide level surfaces, resistance to vibration and rigidity during transportation & installation.
- 9.4.2.2 All the panels shall be of same height & depth and shall be capable of being assembled or dismantled with minimum disturbance to the adjacent panels. The bottom of the panels shall be suitable for erection on flush concrete floor and screwed to it by means of equally spaced grout bolts, projecting through the base channel members of the frame. The embedded base, foundation frames/channels and foundation bolts / fasteners etc. shall form part of the supply.
- 9.4.2.3 The panels shall be completely metal enclosed type and shall be dust, moisture & vermin-proof suitable to meet the requirements. The degree of protection of the relay panels shall not be less than IP-52 as per the relevant standard. The relay panels shall be suitable to meet the above stated requirements and other requirements as per DIN 40050.
- 9.4.2.4 All doors, removable covers and panels shall be provided with neoprene gaskets all around Ventilating louvers, if provided, shall have suitable screens and filters. The screens shall be made of either brass or GI wire mesh.
- 9.4.2.5 Design & selection of materials and workmanship of panels shall be such as to result in neat appearance, inside and outside with no welds, rivets or bolt-head visible from outside with all interior surfaces turned and visible smooth.

- 9.4.2.6 The cable entries shall be from the bottom of the panels. The gland plates of the panels (fitted without glands at the bottom of the panels) shall be connected to earthing of the panel/station through a flexible braided copper conductor rigidly. Necessary detailed drawings indicating details of the foundations with the necessary openings for cable entry etc. shall be supplied after award of contract but well in advance to enable the purchaser to prepare the floor plan. However, preliminary details in this regard and over-all size of equipment offered shall be furnished alongwith the tender. The purchaser will make provision for foundations with pockets and for foundation bolts. The contractor shall supply the channels for foundation bolts, pipes, nuts, lock nuts and washers, etc. The panels shall be fixed on the embedded foundation channels with intervening layers of anti-vibrations strips made of shock absorbing materials. Necessary number of cable glands suitable for armoured PVC/XLPE cables entering from the bottom shall be supplied by the contractor.
- 9.4.2.7 All unfinished surfaces of the steel panels and frame shall be painted with two priming coats of approved primer paint on the interior and exterior surfaces of steel, which shall be followed by applying an undercoat i.e. suitable base and binder for the finishing coat. The finishing coat shade shall be as under :-
- Exterior surface-stoved enamel. The colour of panels shall be finalized by the purchaser during the detailed engineering stage. The panels shall have semi-glossy finish.
 - Interior surface-stoved enamel semi-glossy white.
 - Base frame-stoved enamel black.
- The panel shall be given a plastic covering, if necessary, for protection of the panels during transit. Sufficient quantity of finishing paint shall be supplied to enable the purchaser to restore at site that finishing paint which has been damaged during transit.
- 9.4.2.8 Relay panels of modular construction would also be acceptable.
- 9.4.3 **Mounting of Equipment**
- All equipment, particularly all plug-in modules, electronic cards and elements shall be mounted such that removal and replacement can be accomplished individually without interruption of service to adjacent devices and are readily accessible without the use of special tools. Terminal marking on the equipment shall be clearly visible.
- 9.4.3.1 The contractor shall provide necessary cut-outs and do mounting & wiring of the equipment, to be supplied by other manufacturers for mounting in his panel in accordance with the corresponding manufacturers drawings. The Contractor shall co-ordinate with other suppliers in this regard Cut-outs, provided for future mounting of equipment shall be properly blanked off with blanking plates.
- 9.4.3.2 The centre lines of relays shall be not less than 450 mm from the bottom of the panel.
- 9.4.3.3 No equipment shall be mounted on the doors. Except as indicated at 9.4.9.6.

- 9.4.3.4 The height of panels shall be matched with the other panels to be supplied by the supplier of generating unit & CCS. The necessary coordination in this regard shall be responsibility of the EPC Contractor.
- 9.4.3.5 All equipment connections and cabling shall be designed and arranged to minimise the risk of damage which may be caused by fire. The bidder shall indicate in his offer special requirements, if any, for the type of fire protection arrangement proposed to be provided in the control room, machine hall, GIS bay and cable spreading areas.
- 9.4.4 **Panel internal wiring and other equipments & accessories**
- 9.4.4.1 The panels shall be supplied complete with inter-connecting wiring between all the electrical devices mounted & wired inside the panels and between the devices & terminal blocks for the devices to be connected to equipment outside the panels. When the panels are arranged to be located adjacent to each other, all inter-panel wiring & connections between the panels shall be furnished and the wiring shall be carried out internally. The adjacent inter-panel wiring shall be clearly indicated in the drawings furnished by the contractor.
- 9.4.4.2 All wiring shall be carried out with 1100 V grade, single core, and stranded copper conductor wires with FRLS insulation. The wiring shall be flame, vermin & rodent proof and shall have Oxygen Index of not less than 29 & Temperature Index of not less than 250 degree C.. The number & minimum size of the stranded copper conductors used for internal wiring shall be as follows :
- All circuits except the circuits for current transformers and voltage transformers: one 2.5 mm² per lead.
 - All current transformer circuits: One 6 mm² per lead.
 - Voltage transformer circuits: One 6 mm² per lead.
- 9.4.4.3 All internal wiring shall be securely supported, neatly arranged, readily accessible and connected to equipment terminals & terminal blocks. Wiring gutters, troughs shall be used for this purpose.
- 9.4.4.4 The bus wiring for auxiliary AC and DC supplies, voltage transformer circuits, annunciation circuits and other common services shall preferably be provided near the top of the panels running throughout the entire length of the panels. A.C. circuits, D.C. circuits & circuits operating at different voltages shall be grouped separately and the wiring for each of these groups shall be segregated. The D.C. feeders provided with miniature circuit breakers and voltage relays to initiate an alarm in case of tripping of the breaker. The bidder shall furnish a detailed wiring diagram of D.C. distribution scheme proposed by him for control & protection circuit for the approval of the purchaser.
- 9.4.4.5 Wire terminations shall be made with solderless crimping type and tinned copper lugs, which firmly grip the conductor. Insulated sleeves shall be provided at all the wire terminations. Engraved core identification plastic ferrules marked to correspond with panel wiring diagram shall be fitted at the other ends of each wire. The ferrules shall fit tightly on the wire and shall not fall off when the wire is disconnected from terminal blocks.

- 9.4.4.6 All the wires directly connected to trip circuit breakers shall be distinguished by the addition of red coloured unlettered ferrules. The numbers 6 and 9 shall not be included for ferrule purposes.
- 9.4.4.7 Longitudinal troughs extending throughout the full length of the panel held against the ceiling shall be provided for inter-panel wiring. Interconnections for the adjacent panels shall be brought on to a separate set of terminal blocks located near the slots of holes meant for taking the inter-connecting wires. The arrangements provided shall permit easy interconnections to adjacent panels at site and wires for this purpose shall be provided by contractor looped & punched properly inside the panel.
- 9.4.4.8 Contractor shall be solely responsible for the completeness and correctness of the internal wiring and for proper functioning of the connected equipment.
- 9.4.4.9 All the wirings between Generator Protection Panel and Unit Control Board (UCB) shall be provided and terminated by the supplier. All the wirings between Feeder Protection Panel/Busbar Protection Panel/XLPE Cable Protection Panel and Control and Metering Panel for Switchyard (located in GIS Hall and arranged from other supplier) shall also be provided and terminated by the supplier.
- 9.4.5 **Terminal Blocks**
- 9.4.5.1 All internal wiring for the external equipment shall terminate on terminal blocks, preferably vertically mounted on each panel. Terminal blocks shall be of 1100 V grade and have 10 amps. continuous rating, made of suitable moulded plastic material/ polyamide, metal parts made up of copper, complete with insulated barriers, stud type terminals, washers, nuts & lock nuts. Terminal block design shall include a white fibre marking strip with clear plastic & slip-on/clip-on terminal covers. The markings on the terminal strips shall correspond to wire number and terminal numbers on the wiring diagrams.
- 9.4.5.2 Terminal blocks for secondary leads of current transformer & voltage transformer shall be provided with test links and isolating facilities. The secondary leads of CTs shall be provided with short -circuiting and earthing facilities.
- 9.4.5.3 At least 20% spare terminals shall be provided on each panel and these spare terminals shall be uniformly distributed on all terminal blocks.
- 9.4.5.4 Unless otherwise specified, each side of the terminal blocks shall be suitable for connecting 16 mm² Aluminium cables to be arranged by the purchaser for AC/DC Power supply circuits to panels.
- 9.4.5.5 There shall be a minimum clearance of 250 mm between the first row of terminal blocks and the associated cable gland plate & / or panel side wall. The minimum clearance between rows of terminal blocks shall be of 150 mm.
- 9.4.5.6 Arrangement of terminal block assemblies and the wiring channels within the enclosure shall be such that a row of terminal blocks is run parallel and in close proximity with each side of the wiring duct to provide for convenient

attachment of internal panel wiring. The side of the terminal block opposite the wiring duct shall be reserved for the purchaser's external cable connections. All adjacent terminal blocks shall also share this field wiring corridor. All wiring shall be provided with adequate support inside the panels to hold them firmly and to enable free & flexible termination without causing strain on the terminals.

- 9.4.5.7 All necessary accessories for cable termination such as gland plates, crimp type lined copper lugs, supporting clamps & brackets, wiring troughs & gutters etc. for purchaser's cables shall be included in scope of supply of the contractor. The number, type, voltage rating & size of such cables shall be decided during detailed design stage.

9.4.6 **Test Blocks**

Switchboard type, back connected, semi-flush mounting type test blocks with suitably rated contacts shall be provided for routine checks/ testing. The current terminals shall be provided with links or other devices for shorting the terminals of current transformer leads prior to interrupting the normal circuits, without causing open circuit in the C.T. secondary. Test block covers shall be removable from the front of the panel and shall be provided with suitable lead sealing arrangement to prevent unauthorised access to the test studs.

9.4.7 **Name plates and markings**

- 9.4.7.1 All equipment mounted on front and rear side as well as inside the panels shall be provided with individual name plates with equipment designation engraved as per applicable standards. The large and bold name plates shall also be provided for circuit/feeder designation on the top of each panel on front as well as rear side,

- 9.4.7.2 All front mounted equipments inside the panel shall also be provided with individual name plates engraved at the rear with tag numbers corresponding to one shown in the panel internal wiring to facilitate easy tracing of the wiring. The name plates shall be mounted directly by the side of the respective equipment and shall not be hidden by the equipment wiring.

- 9.4.7.3 Name plates shall be made of non-rusting metal or plastic or other better material. Name plates shall be black with white engraved lettering. The name plates inscription and size of the name plates and letters shall be submitted to the purchaser for his approval.

- 9.4.7.4 All relays and other devices shall be clearly marked with manufacturer's name, type, serial number and data (for electrical parameters/particulars).

9.4.8 **Miscellaneous Accessories and Supporting Steel**

9.4.8.1 **Interior Lighting**

Each panel shall be provided with a fluorescent lighting fixture rated for 240 volts, single-phase, 50 Hz supply for the interior illumination of the panel during maintenance. The fitting shall be provided with MCB and switching of the fitting shall be controlled by the respective panel door switch.

9.4.8.2 **Convenience Outlets**

One no. 240V AC socket with switch suitable to accept 5 Amps/15 amps. round pin Indian plug shall be provided in the interior of each panel with ON-OFF switch for connection of hand lamps etc.

9.4.8.3 Space Heaters

Tubular space heaters suitable for single phase 240 volts AC supply shall be provided at the bottom of the panels to prevent condensation of the moisture. The space heaters shall be controlled through thermostats to maintain the desired temperature. The watt loss shall be low enough to keep the surface temperature well below the permissible limits.

9.4.8.4 Supporting Steel

All necessary embedded levelling steel, sills, anchor bolts, channels & other parts for supporting & fastening the panels and vibration dampers shall be supplied by the contractor. The embedded parts with detailed instructions shall be supplied in time to meet the schedule for insertion in the building structure. All trays and their supporting structure shall also be supplied.

9.4.9 Earthing**9.4.9.1**

All panels shall be equipped with an earth bus securely fixed. The location of earth bus shall ensure no radiation interference for earth systems under various switching conditions of isolators and breakers. The material and the size of the bus bar shall be at least 25 x 6 mm copper unless specified otherwise. When several panels are mounted adjoining to each other, the earth bus shall be made continuous and necessary connectors & clamps for this purpose shall be included in the scope of supply of contractor. Provision shall be made for extending the earth bus bars to future adjoining panels on either side.

9.4.9.2

Provision shall be made for each earth bus of the end panels for connecting purchaser's earthing grid in the vicinity of the equipment at two separate points. Necessary terminal clamps and connectors for this purpose shall be included in the scope of supply of Contractor. The earth wires or screens should be clearly bonded and earthed to the gland plate. The earthing scheme shall be approved by the purchaser.

9.4.9.3

All metallic cases of relays, instruments and other panel mounted equipment including gland plates, shall be connected to the earth bus by independent copper wires of size not less than 2.5 sq. mm. The colour code of earthing wires shall be green. Earthing wire shall be connected on terminals with suitable clamp connectors and soldering shall not be permitted. The connections of the plug-in modules to earth bar have to be made before the plugs make contact.

9.4.9.4

Looping of earth connections which would result in loss of earth connection to other devices when the loop is broken, shall not be permitted. However, looping of earth connections between equipments to provide alternative paths to earth bus can be provided.

9.4.9.5

CT and VT secondary, neutral or common lead shall be earthed at one place only at the terminal blocks where they enter the panel. Such earthing shall be made through links so that earthing may be removed from one group without disturbing continuity of earthing system for other groups.

9.4.9.6 FAULT INDICATING LAMP

Suitable DC operated red coloured lamp indication facility shall be provided on each set of Protection Panel. The lamp shall be mounted either on top of the front door or just above the door in such a way that it shall be visible from long distance. The lamp shall be operated during any kind of the faults

inside the panel. A suitable reset push button after clearance of the fault and lamp test push button shall be provided.

9.4.9.7 **DC Supply Changeover feature**

All panels shall be equipped with automatic changeover to alternate DC supply from the 2 available DC supply sources i.e. DC1 & DC2. This arrangement shall be facilitated in such a way that in case of failure or loss of DC1(orDC2) supply, the panel shall be supplied from DC2(orDC1) supply with automatic changeover. Suitable rated diodes shall be used to avoid mixing of DC supplies or reverse current flowing. A suitable delay timer may also be used to satisfy the parallel operation criteria of any 2 DC supplies.

9.5 **PROTECTIONS**

General Protection Function

The alarm/status of each individual protection function & trip operation shall be communicated to SCADA. The numerical system shall have built in features/hardware interface to provide such inputs to SCADA for analog/digital values.

A trip coil supervision function shall for each lockout trip relay & each of the circuit breaker trip coils. It shall incorporate both the pre-close & post-close supervision of trip coils & associated trip circuits. An audible alarm shall be given in the event of operation of trip coil supervision function. It shall have a time delay on drop-off of not less than 200ms. Trip coil supervision function as a built in feature of the Generator & GT protection units is acceptable, provided it meets all other requirements specified here, including loss of DC supply



C&I Technical Specification

HVAC SYSTEM

SECTION-D



INSTRUMENTS SPECIFICATION

Specification for Pr. Gauge, D.P. Gauge, Temp. Gauge and Level Gauge

Sl. No.	Features	Essential / Minimum Requirements		
		Pr. Gauge / D.P. Gauge	Temp. Gauge	Level Gauge
1	Sensing Element and Material	Bourdon for high pressure, Diaphragm / Bellow for low pr. of 316 SS	Inert gas actuated SS Bulb and Capillary.	Tempered toughened Borosilicate gauge glass steel armoured reflex or transparent type.
2	Body material	Die-cast aluminium	Die-cast aluminium	Forged carbon steel / 304 SS
3	Dial size	150 mm	150 mm	Tubular covering entire range.
4	End connection	½ inch NPT (M)	¾ inch NPT (M)	Process connection as per ASME PTC and drain / vent 15 NB.
5	Accuracy	±1% of span	±1% of span	±2%
6	Scale	Linear, 270 Deg. Arc graduated in metric units.	Linear, 270 Deg. Arc graduated in Deg. C	Linear vertical
7	Range selection	Cover 125% of max. of scale	Cover 125% of max. of scale	Cover 125% of max. of scale
8	Over range test	Test pr. For the assembly shall be 1.5 to the max. design pr. at 38 Deg. C.		
9	Housing	Weather and dust proof as per IP-55	Weather and dust proof as per IP-55	CS/304 SS leak proof
10	Zero / Span adjustment	Provided	Provided	--
11	Identification	Engraved with service legend or engraved phenolic laminated tag plate	Engraved with service legend or laminated phenolic name plate	Engraved with service legend or laminated phenolic name plate
12	Accessories	Blow out disc, siphon, snubber, pulsation dampener, chemical seal (if required by process) gauge isolation valve	SS Thermowell	Gasket for all KEL-F shield for transparent type vent and drain valves of Steel / SS as per CS / Alloy process requirement.
13	Material of Bourdon movement	316 SS / 304 SS	316 SS / 304 SS	

1.6 Process Actuated Switches

Sl. No.	Features	Essential / Minimum Requirements Switches devices (Pr., Temp., Flow, Level Switches)			
		Pr. Switch / D.P.	1 <u>TEMP. SWITCH</u>	2 <u>LEVEL SWITCH</u>	3 <u>LIMIT SWITCH</u>
1	Sensing Element	Piston actuated for high pressure and diaphragm or bellows for low pr. / vacuum	Vapour pressure sensing, liquid filled bellow type with bulb and capillary (10 m minimum)	1.Capacitance types for oil and dirty medium, water, condensate application. Capacitance / conductivity / ultrasonic type for acid / alkali application Radio-frequency / ultrasonic type for ash hopper, ash slurry application Float type for application decided during detailed eng.	Micro switch
2	Material	316 SS	Bulb: 316 SS Capillary: 304 SS	316 SS	Silver plated high conductivity non-corrosive
3	Repeatability	±0.5% for full range	±0.5% for full	±0.5% for full range	±0.5%
4	End connection	½ Inch NPT (F)	½ Inch NPT (F)	1" NB Socket Weld	
5	Over range proof pressure	150% of max. design press.	---	150% of max. design press.	---
6	No. of contacts	2 NO + 2 NC, SPDT snap action dry contact			
7	Rating of contacts	60V DC, 6VA (or more if required by DCS).			
8	Enclosure	Weather and dust proof as per IP-55			
9	Set point / dead	Provided over full range			
10	Accessories	Syphon, snubber, chemical seal, pulsation dampener as required by process	Thermowell of 316 SS and packing glands	All mounting accessories	

11	Mounting	Suitable for enclosure / rack mounting or direct mounting	Direct factory mounting on valves, equipment with provision for adjusting at site.
12	Elect. Connection	Plug in socket	
13	General	Where the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seal shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application.	

1.7 Thermocouple

Sr. No.	Features	Essential/Minimum Requirements
1	Type of Thermocouple. :	16 AWG wire of Chromel-Alumel (Type K) or 24 AWG wire Pt-Rhodium-PT (Type R) depending on operating temperature Range (ungrounded type).
2	No. of element :	Duplex
3	Housing/ Head :	IP-55/ Diecast Aluminium. Plug in connectors are to be provided for external signal cable connection.
4	Sheathing of Thermocouple:	Swaged type magnesium oxide insulation.
5	Calibration and accuracy :	As per IEC-751/ANSI-C-96.1(special class) for T/C.
6	Characteristic :	Linear with respect to temp, within $\pm 1/2$ percent of top range value.
7	Accessories :	Thermowell (as specified in sl. no.1.9) and shall be spring loaded for positive contacts with the well.
8	Standard :	ANSI C 96.1 for Thermocouple and ASME PTC-19.3 for Thermo-well.

1.8 Resistance Temperature Detector (RTD)

Sr. No.	Features	Essential/Minimum Requirements
1	Type of RTD. :	Four wire, Pt-100 (100 Ohms resistance at zero degree Centigrade).
2	No. of element:	Duplex
3	Housing/Head:	IP-55/Die cast Aluminium. Plug in connectors are to be provided for external signal cable connection.
4	Sheathing of RTD:	Metal sheathed, ceramic packed
5	Calibration and accuracy:	As per DIN-43760 Class-A for RTD
6	Characteristic:	Linear with respect to temp, within $\pm 1/2$ percent of top range value.
7	Accessories:	Thermo well (as specified in sl. no.1.9) and shall be spring loaded for positive contacts With the well.
8	Standard:	DIN-43760 for RTD and ASME PTC-19.3 for Thermo-well.

1.9 Thermo well

Thermo well (for all process temp. elements) shall be one piece solid bored type of 316 SS of step-less tapered design. (As per ASME PTC 19.3 1974). For Mill classifier outlet long life solid sintered tungsten carbide material of high abrasion resistance shall be provided. For Air & Flue Gas 316 SS protecting tube with welded cap.

1.10 Temperature Transmitter

Following types of 2-wire temperature transmitter (directly powered from 4-20 mA input cards of PLC / DDCMIS) shall be provided. The temperature transmitter shall be fully compatible with thermocouples and RTDs being provided by the contractor. Temperature compensation of the thermocouples shall be performed in the temperature transmitter itself.

(a) Single Input Head mounted Temperature Transmitter

These shall be suitable for mounting in the head of temperature element itself. The protection class of head of thermo well along with its plug-in connector shall be min. IP 65.

(b) Single Input DIN-rail mounted Temperature Transmitter

These shall be suitable for mounting on DIN-rails in JB's. The specifications of the JB's shall be as specified elsewhere in the spec. CABLE with additional DIN-rails and IP 65 Protection Class. This temperature transmitter shall be the ones, which are especially designed for DIN-rail mounting with IP 20 protection class. These shall have terminals for input/output provided on front side when mounted on DIN-rail Head mounted temperature transmitter with clamps to make it suitable for DIN-rail mounting shall not be acceptable under this category.

(c) Dual-input Temperature Transmitter with Indicator

These shall be suitable for mounting on pipes/support. These shall be provided for temperature measurement which are used for tripping/protection of auxiliaries e.g. for bearing temperature on which trip is envisaged. Indicator shall be provided with these transmitters. These transmitters shall have bump less change over facility to second sensor in case first sensor fails. This change over is to be alarmed. Protection class shall be IP 65 minimum.

Common requirements for each of the above type of temperature transmitters:

- (i) Output : 2-wire (power supply from input card of Control System) with 4-20 mA output with Superimposed HART protocol signal.
- (ii) Input : Same transmitter shall be capable to handle Pt-100 RTD, Thermocouples-K&R types (input type to be selectable at site through HART terminal).
- (iii) Isolation : min. 500 V AC
- (iv) EMC : as per EN 61326 compatibility
- (v) Operating ambient : 0 to 85 deg C (without indicator) temperature 0 to 70 deg. C (with indicator)
- (vi) Power supply : Compatible with input module of Control System
- (vii) Accessories : Mounting arrangements including clamps etc.

(viii) Composite Accuracy:

(a) For head mounted and DIN-rail mounted

Accuracy (Refer types note 2)

RTD = $\leq 0.4\%$ of 0-250 deg C. span

T/C-K type = $\leq 0.4\%$ of 0-600 deg C. span

T/C-R type = $\leq 0.4\%$ of 0-1000 deg C. Span

CJC accuracy (for thermocouples) shall be ≤ 1 deg.

(b) For dual input type:

RTD = $\leq 0.25\%$ of 0-250 deg C. Span

T/C-K type = $\leq 0.2\%$ of 0-600 deg.C span

CJC accuracy (for thermocouples) shall be ≤ 1 deg. C.

Notes:

1. In case of failure (open or burn-out) of RTD/thermocouple, temp. transmitter shall provide low temperature output.
2. Composite Accuracy is to be calculated as summation of all applicable accuracies of temp. transmitter, for converting sensor input to output in 4-20 mA (e.g. basic accuracy, digital accuracy, D/A accuracy. etc.) and temperature effect on these accuracies at ambient temperature of 50 deg. C. based on the figure / formula given in the standard product catalogue for span as specified above for various types of Temperature Elements specified. All such accuracy/temperature effect figures in catalogue shall be first converted to deg. C, and then percentage of these converted accuracy in specified span shall be calculated to compare with the specified composite accuracy figures.

1.11 SPECIFICATION FOR ELECTRONIC TRANSMITTER FOR PRESSURE, D.P., FLOW AND LEVEL ELECTRONIC TRANSMITTERS:

Sr. No.	Features	Essential/Minimum Requirements
1.	Type of Transmitter	Microprocessor based 2 wire type, Hart protocol compatible.
2.	Accuracy	$\pm 0.1\%$ of calibrated span (minimum)
3.	Output signal range	4-20 mA DC (Analog) along with superimposed digital signal based on HART protocol
4.	Turn down ratio	10:1 for vacuum/very low pressure applications. 30:1 for other applications.

- | | | |
|-----|-------------------------|--|
| 5. | Stability | <p>$\pm 0.1\%$ of calibrated span for six months for Ranges up to and including 70 Kg/cm².</p> <p>$\pm 0.25\%$ of calibrated span for six months for Ranges more than 70 Kg/cm² (g).</p> |
| 6. | Zero and span drift | <p>+/- 0.015% per deg.C at max span.</p> <p>+/-0.11% per deg.C at min. span.</p> |
| 7. | Load impedance | 500 ohm (min.) |
| 8. | Housing | Weather proof as per IP-55 with durable corrosion resistant Coating. |
| 9. | Over Pressure | 150% of max. Operating pressure |
| 10. | Connection (Electrical) | Plug and socket type |
| 11. | Process connection | 1/2 inch NPT (F) |
| 12. | Span and Zero | Continuous, tamper proof, Remote as well as adjustability Manual from instrument with zero suppression and elevation facility. |
| 13. | Accessories | <p>-Diaphragm seal, pulsation dampeners, siphon etc. as required by service and operating condition.</p> <p>-2 valve manifold for absolute pressure transmitters (3-valve manifold for gauge/ vacuum pressure transmitters) and 5 valve manifold for DP/level/flow transmitters.</p> <p>-For hazardous area, explosions proof enclosure as described in NEC article 500.</p> |
| 14. | Diagnostics | Self Indicating feature |
| 15. | Power supply | 24V DC $\pm 10\%$. |
| 16. | Adjustment/calibration/ | Centralized PC based system. |

Notes :

In case it becomes necessary to use a DP transmitter for pressure measurement then a 3-valve manifold should be used in place of 2-valve manifold.

LVDT type is not acceptable.

Where the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire

volume above the diaphragm shall be completely filled with an inert liquid suitable for the application.

1.12 Ultrasonic Type Level Transmitter

Sl. No Features

1. Type of Transmitter

2. Output signal

3. Sensor Accuracy

4. Sensor Repeatability

5. Power supply

6. Temperature compensation

7. Configuration

8. Housing

9. Calibration

10. Zero and Span adjustment

11. Sensor Material

12. False signal tolerance

13. Range

14. Display

15. Diagnostics

16. Load Impedance

17. Electrical Connection

18. Accessories

Essential/Minimum requirements

Non contact Microprocessor based 2 wire type, HART protocol compatible Ultrasonic transmitter.

Galvanic ally isolated 4-20mA DC (Analog) along with superimposed digital signal (based on HART protocol). +/- 0.5% of calibrated span.

3 mm or better.

24 V DC +/- 10%

To be provided within transducer.

Sensor unit and Electronic units are to be separate. It shall be possible to mount the Electronic unit at a remote accessible location from the transducer. All cables and weather proof fittings to interconnect transducer to electronic unit shall be provided.

Weather proof as per IP-55 with durable corrosion resistant epoxy coating.

Through HART Communicator.

Continuous, tamper proof, remote as well as manual adjustability from instrument. It shall be possible to calibrate the instrument without any level in the tank/sump etc

Corrosion resistant material to suit individual application requirement.

Transmitter shall be capable of ignoring false echoes from internal tank/sumps obstructions such as pipes, heating coils or agitator blades. Also transmitter shall have adjustable damping circuitry

Range of transmitter shall be capable of covering the complete level span of tank taking care of blocking distance, frequency attenuation due to surface, obstructions, vapors etc

Minimum 4 character display with integral keypad, access protected by user code.

Loss of echo alarm etc

500 ohms minimum

Plug and socket

- All weather canopy for protection from direct sunlight and direct rain.

- All mounting hardware and accessories required for erection and commissioning mounting fittings material shall be SS 316.

- For hazardous areas, explosion proof enclosure as described in NEC article 500.

engineering.
 Power supply : 240V AC, 50 Hz to be arranged by the supplier.
 Output : 4-20 mA DC capable of driving a load impedance of 500 ohms
 minimum.

1.15 ROTAMETERS

SR. NO.	FEATURES	ESSENTIAL / MINIMUM REQUIREMENTS
1.	TYPE	VARIABLE AREA METAL TUBE
2.	FLUID MEDIA	WATER/OIL
3.	TUBE BODY	SS316
4.	MATERIAL OF FLOAT	316 SS
5.	INDICATOR	LINEAR SCALE
6.	ACCESSORIES	FLANGE, ORIFICE IN CASE OF BYPASS ROTAMETER (FOR LINE SIZE ABOVE 100 MM)
7.	HOUSING PROTECTION CLASS	IP-55
8.	ACCURACY	+ 2% OF MEASURED VALUE.

1.16 FIELD MOUNTED LOCAL JUNCTION BOXES

(i)	No. of ways	12/24/36/48/64/72/96/128 with 20% spare terminals.
(ii)	Material and Thickness	4mm thick Fiberglass Reinforced Polyester.
(iii)	Type	Screwed at all four corners for door. Door handle shall be self Locking with common key. Door gasket shall be of synthetic rubber.
(iv)	Mounting clamps and accessories	Suitable for mounting on walls, columns, structures etc. The brackets, bolts, nuts, screws, glands and lugs required for erection shall be of brass, included in Bidders scope of supply.
(v)	Type of terminal blocks	Rail mounted maxitermi or cage-clamp type suitable for conductor size up to 2.5 mm ² . A M6 earthing stud shall be provided.
(vi)	Protection Class	IP: 55 minimum for indoor & IP-66 minimum for outdoor
(vii)	Colour	to be decided during detailed engineering & Subject to Employer's approval.



LOCAL PANEL SPECIFICATION, DATASHEET AND QUALITY PLAN

	SPECIFICATION FOR LOCAL PANELS	SPECIFICATION NO.: PE-SS -999- 145 -054A	
		VOLUME	II B
		SECTION	D
		REV. NO. 00	DATE : 06-09-2016
		SHEET	1 OF 6

1.0 SCOPE

This specification covers the Design, Manufacture, Inspection and Testing at the manufacturer's works, proper packing for transportation and delivery to site, **supervision, erection, and commissioning at site** of Local Panels required for control and monitoring of HVAC system for 4x111 MW VISHUGAD HEP.

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.

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3.1.7 The class of protection shall be in accordance with IP-52 unless otherwise specified in the data sheet – A (No. PES-145-54A-DS1-0).

3.1.8 All steel surfaces shall be cleaned by sand / pellet blasting, treated for pickling, degreasing and phosphating etc. by seven tank method. The panel shall have a high quality finish and appearance. The panel shall be painted with two coats of primer followed by two coats of epoxy / synthetic enamel based final paint of color shade and finish as given in data sheet-A (No. PES-145A-DS1-0). Minimum thickness of the paint shall be 85 microns for external paint and 70 microns for internal paint.

3.1.9 The cable glands of the required size and type as given in data sheet-A (No. PES-145A-DS1-0) shall be supplied alongwith the Panel.

3.1.10 All operable and indicating devices shall be mounted on the front of the panel while aux. Relays / timers MCBs etc. required for realization of control logics shall be mounted on a mounting plate inside the panel. Auxiliary relays and timers etc. shall be grouped according to the control function. No operable or indicating devices shall be mounted below 750 mm and above 1800 mm (w.r.t. finished ground level). The devices shall be located in such a way so as to ensure easy access for operation / maintenance.

3.1.11 Single / dual control power supply feeders of voltage class as specified in data sheet-A (No. PES-145A-DS1-0) shall be provided by the purchaser. In case redundant power supply feeders are provided then auto changeover unit shall be mounted on the panel are in the panel supplier's scope. Where DC control power supply is specified an additional 240V, 50 Hz AC supply feeder for powering of space heater and lighting shall be provided by the purchaser. Suitable arrangement shall be provided inside the panel to receive and terminate the power supply feeder(s). For this purpose MCBs of suitable current rating shall be provided by the vendor. A supervisory relay along with a pilot lamp to indicate control supply 'ON' shall be provided on the panel. Any other power supply required for the operation of the devices mounted in the panel shall be arranged by the vendor.

3.1.12 The internal wiring shall be carried out with 1100 volt grade PVC insulated copper multi strand wire / flexible of 1.5mm² size. AC & DC wires shall be kept separate from each other. Separate coloured wires to be used for AC and DC circuits. All wires shall be properly numbered and identified with ferrules as per the Control scheme / wiring diagram. Wires shall be routed and run through PVC troughs.

3.1.13 Terminal blocks shall be clip on type, 1100 volts grade. Separate terminal blocks shall be used for AC & DC circuits. The terminals shall be suitable for terminating 0.5 mm² to 2.5mm² external cables. **The TB points in terminal block shall be cage clamp type / screw type.** The terminal for ammeters shall be provided with removable links for shorting CTs. Each terminal strip shall be provided with identification strip. The terminal shall not be mounted below 250 mm **height from finished floor. The panel shall have ten (20) percent spare terminal.**

3.1.14 The interior of each panel shall be suitably illuminated through fluorescent **lamps / tube lights with shrouded cover of minimum 15W** operable on 240V 50 Hz AC power supply through panel door switch. A 15 Amp. 3-pin Power receptacle shall be provided.

3.1.15 Suitable space heaters operable on 240 Volts 50 Hz AC power system shall be provided at the panel bottom. These shall be designed to maintain the panel temperature five (5) deg. C above the ambient temperature during maintenance shutdown. Suitable isolating and control devices comprising of MCB, thermostat etc. shall be provided for the space heater.

3.1.16 The panel shall be provided with a copper earth bus of 25 x 6 mm size running throughout the width of the panel. It shall be terminated internally with 10 mm bolts at extreme ends for connection to; main station earth. The panel mounted equipments / devices shall be connected to earth bus through green coloured PVC insulated stranded copper conductor of 2.5 mm² size.

3.1.17 Local Panel shall be provided with main name plate of 150 mm x 40 mm size having inscription of 20 mm height. The individual devices on the panels shall be as provided with separate name plate with inscription of 3 mm height. The instrument / devices shall be provided with stick on label plates inside the panel. The material of the main and individual labels shall be three (3) ply 3 mm thick Traffolyte

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

3.1.18 Vendor shall furnish electric load and heat load list (in case panel is to be placed in ac environment) of each panel.

3.2 Hazardous Area Panel Requirement (if applicable)

3.2.1 The Local Panel located in hazardous area shall be pressurized as per NFPA-496 requirements to render it non-hazardous. Alarms shall be provided for local and remote annunciation when pressurisation falls below 2.5 mm of water column. Protection shall be of type Z of NFPA-496. It shall not be possible to switch ON the power of purged section unless it is purged as per the recommendation of NFPA-496. Vendor must provide a protective device on the panel to protect the panel from over pressurisation.

3.2.2 Vendor shall supply pressurisation kit consisting of valves, restriction orifices, dual filter regulation, pressure gauges, pressure switches, rotameter etc. Pressurisation kit shall be surface mounting on a metal board and located outside the local panel. Pressurisation kit shall further consist of solenoid valve flow switch, timer blow off safety device etc., so as to make purging fully automatic. However final start shall be manual. Panel protection against over pressure to be provided as per NFPA-496.

3.2.3 Pressurised local control panel pressurization kit assembly design shall provide minimum leakage flow through the Local Control Panel. Panel venting shall be as per NFPA-496.

3.2.4 All components in the local panel like indicating instruments, push buttons switches, lamps etc., which are required to be energized without panel pressurization or before completion of purge cycle shall be explosion proof as per NEMA-7 & suitable for area classification.

3.2.5 All push buttons etc. requiring frequent operation during machine running shall have good positive sealing. Weatherproof housing or cover to be provided wherever necessary. Vendor shall provide pressurisation bypass switch outside explosion proof enclosure of pressurized panel with lamp indication. This shall be used only during maintenance. All hinges, screws, other non-painted metallic parts shall be of stainless steel material.

3.2.6 Provision to switch off manually all types of power shall be provided in the panel. In addition, it shall also be possible to switch off power circuits / components which are powered from motor control centre or control room manually in case of pressurization failure. All such cables from MCC and main control room shall be terminated in explosion proof boxes (NEMA-7).

3.3 Control & Monitoring devices

3.3.1 Instruments like Indicators, recorders, single loop controllers etc. as applicable and specified elsewhere for the plant / equipment shall be supplied and mounted on the panel.

3.3.2 Alarm Annunciator System
It shall be solid state discrete facia type having a sequence of ISA-S18.1A or as specified, opaque facia windows of 70 mm x 50 mm size, having two (2) lamps per window, and hooter of 10W, and provision for repeat group alarm at remote. The annunciator shall be provided with ten (10) percent spare windows or minimum two (2) windows along with electronics.

3.3.3 Relays
The relays shall be electromagnetic type suitable for specified control supply. Its contact configuration and rating shall be suitable for the specified control function. However minimum contact rating shall be 5 Amp AC & 2 Amp DC as applicable. There shall be ten (10) percent spare contacts.

3.3.4 Timers
The timers shall be electronic type suitable for specified control supply. Its contact configuration and rating shall be suitable for the specified control function. However, minimum contact rating shall be 5 Amp AC & 2 Amp DC as applicable.

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

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

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

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

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

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

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

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

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

4.0 TESTING AND INSPECTION

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

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



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

4.3.1 Routine Tests

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

4.3.2 Type Tests

1. Enclosure Class Test

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5.0 SPARES AND CONSUMABLES

5.1 Commissioning Spares and consumables

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

5.2. Mandatory Spares

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

5.3. Recommended Spares

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

6.0 DRAWINGS AND DOCUMENTS

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

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

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

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

7.0 MARKING AND PACKING

7.1 Panel with all instruments / devices mounted on it shall be suitably packed & protected for the entire period of despatch, storage and erection against impact, abrasion, corrosion, incidental damage due 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 4x111 MW VISHUGARH HEP		SPECIFICATION NO.: PE-SS-413-145-054A	
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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	FRONT	☒ 3.0 mm	
		OTHER	☒ 3.0 mm	
		DOOR	☒ 3 mm	
		HEIGHT	☐ 2365 mm for stand-alone panels. ☐ Other	
		OTHER	☒ Load bearing sheet front shall have 3mm thickness ☒ 2mm thickness for top and rear portions	
TECHNICAL	INPUT POWER SUPPLY * (ANY OTHER POWER REQUIREMENT TO BE DERIVED FROM THIS SUPPLY ONLY)		☐ 240V 50 Hz AC ☐ 220V DC ☒ 415V 3 PHASE 3W ☒ 415V 3 PHASE 4W	
	NO. OF FEEDERS		☒ 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	
	ALARM ANNUNCIATOR WINDOW (EXCLUDING SPARES)		☒ REQUIRED TO BE DECIDED DURING DETAILED ENGINEERING	
	PAINT TYPE		☒ EPOXY ENAMEL ☐ EPOXY POWDER COATED	
	MIMIC (TYPE OF MIMIC- MATERIAL, THICKNESS TO BE SPECIFIED DURING DETAILED ENGG.)		☒ REQUIRED ☐ NOT REQUIRED	
	PANEL COLOUR (EXTERNAL)		☐ LIGHT GREY (Shade 631 IS-5) ☐ OPALINE GREEN (Shade 275) . TO BE DECIDED DURING DETAILED ENGINEERING	
	FINISH (EXTERNAL)		☐ MATT ☐ GLOSSY ☒ SEMI GLOSSY	
	PANEL COLOUR (INTERNAL)		☒ WHITE ☐ CREAM ☐ OFF WHITE	
	FINISH (INTERNAL)		☐ MATT ☐ GLOSSY ☒ SEMI GLOSSY	
	CLASS OF PROTECTION		☒ IP52 (FOR INDOOR SERVICE) ☐ IP-55 (FOR OUTDOOR SERVICE)	
	CONTROL HARDWARE		☒ RELAY BASED	
	FOUNDATION ARRANGEMENT		☒ FOUNDATION BOLTS ☐ ANCHOR FASTENERS	
	WEIGHT OF PANEL (Kg.)		(Vendor to specify)	
	PANEL TYPE		☐ PRESSURISED ☒ UNPRESSURISED As per Requirement	
	CABLE GLAND		☒ DOUBLE COMPRESSION	



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									P	W	V	
1.0	INCOMING Sheet Steel (CRCA & HR)	1. Chemical Composition	MA	Chemical analysis	Sample	IS:1079 IS:513	IS:1079 IS:513	Test Certificate	3	---	2	
		2. Bend Test	CR	Mech. test	Sample	IS:1079 IS:513	IS:1079 IS:513	Log Book	2	---	---	
		3. Surface finish	MA	Visual	100%	Factory Standard / Sample	Factory Standard / Sample	Log Book	2	---	---	
		4. Waviness	MA	Visual	100%	Factory Standard	No Waviness	Log Book	2	---	---	
		5. Thickness	MA	Measurement	100%	BHEL Spec.	BHEL Spec.	Log Book	2	---	---	
		6. Mill marking	MA	Visual	100%	Factory Standard	Factory Standard	Log Book	2	---	1	
2.0	Flats / Angles / Channels	1. Dimensions	MA	Measurement	Sample	IS:2062	IS:2062	Log Book	2	---	---	
		2. Surface Defects	MA	Visual	100%	Factory Standard / Sample	Factory Standard / Sample	Log Book	2	---	---	
		3. Straightness	MA	Measurement	100%	Factory Std.	Factory Std.	Log Book	2	---	---	
		4. Mill marking	MA	Visual	100%	IS:2062	IS:2062	Log Book	2	---	1	
3.0	Cables / Wires	1. Visual / Surface defects	MA	Visual	100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	2	---	---	
		2. IR and HV	MA	Electrical	100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	2	---	---	

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

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

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3 - Sub-vendor

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		3. Conductor a) Resistance b) Size c) Sheet colour	MA MA MA	Electrical Measurement Visual	100% 100% 100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	2	---	---	
		4. Type / Routine Test Certificates	MA	Verification	100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	3	---	2	
4.0	Electrical Components like Annunciator Transformers Lamps Switches PBs Contactors Relays Timers Space Heaters Thermostat Indicating meters etc.	1. Verification at make and Type 2. Verification of Test Certificates 3. Operation / Functional check 4. I.R. 5. H.V. 6. Calibration 7. Pick up / Drop off Voltage	CR CR CR MA MA MA MA	Visual Scrutiny of Type / Routine T.Cs. Electrical Electrical Electrical Electrical	Sample 100% Sample+ 100% 100% 100% 100% 100%	BHEL Spec. and BOM Relevant IS Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue	BHEL Spec. and BOM Relevant IS Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue	Log Book Log Book Log Book Log Book Log Book Log Book Log Book	2 2 2 2 2 2 2	--- --- --- --- --- --- ---	--- --- --- --- --- 1 ---	+ for relay & contactors only @ for all components except relays & contactors.
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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	---	---	
6.0	IN PROCESS 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	---	---	
8.0	ASSEMBLY 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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									P	W	V	
9.0	Pre-treatment and Painting	1. Pretreatment Process	MA	Visual	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		2. Process parameters like bath temp. concentration etc.	MA	Measurement	Periodic	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		3. Dipping / Removal Time	MA	Measurement	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		4. Surface quality after every dip	MA	Visual	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		5. Primer after phosphating	MA	Visual, Thickness	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		6. Putty Application & Rubbing after primer	MA	Visual	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		7. Paint first coat	MA	Visual, Thickness	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		8. Putty Application and Rubbing after first coat of paint	MA	Visual	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		9. Paint second coat	MA	Visual, Thickness, Scratch test Colour adhesion	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	

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									P	W	V	
10.	Panel Wiring	1. Wiring Layout	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	
		2. Wiring Termination (Crimped Lugs)	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	
		3. Ferrule numbers	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	
		4. Colour of wiring	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	1	
		5. Size of Conductor	MA	Measurement	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	1	
11.	Component Mounting	1. Correct components	MA	Visual	100%	Approved drgs., Specs. & BOM	Approved drgs., Specs. & BOM	Log Book	2	---	---	
		2. Fixing	MA	Visual	100%	Approved drgs., Specs. & BOM	Approved drgs., Specs. & BOM	Log Book	2	---	---	
12.	FINAL Final Inspection	1. Workmanship	MA	Visual	100%	Factory Standard	Factory Standard	Inspection Report	2	1	1	At Random by BHEL, based on 100 % internal test reports by Mfr.
		2. Component layout (neatness, accessibility & safety) Mounting / Proper fixing of all components	MA	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	
		3. Components identification Marking / Name plates	MA	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	

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Sl. No.	Component / operation	Characteristics Checked	* Cate gory	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^{\$}			Remarks	
									P	W	V		
		5. Dimensions	MA	Measurement	100%	BHEL approved drg. / Spec., BOM	BHEL approved drg. / Spec., BOM	Inspection Report	2	1	1	At Random by BHEL, based on 100 % internal test reports by Mfr.	
		6. Door functioning	MA	Functional	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1		
		7. Paint Shade	CR	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1		
		8. Paint Thickness	CR	Measurement	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1		
		9. Workmanship of Gaskets	MA	Visual	100%	Factory Standard	Factory Standard	Inspection Report	2	1	1		
		10. Wiring Layout	MA	Visual	100%	BHEL approved drg.	BHEL approved drg.	Inspection Report	2	1	1		
		11. Wire Termination	MA	Pulling manually	Sample	-----	Firm termination	Inspection Report	2	1	1		
		12. Continuity	MA	Electrical	100%	-----	Continuity OK	Inspection Report	2	1	1		

LEGEND: * CR - Critical characteristics
 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 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 IS-13947 Part-1, IS-2148.	BHEL approved spec., drg relevant IS-13947 Part-1, IS-2148.	Type Test Certificate	3	---	1	
14	ROUTINE TEST	IR before & after HV Test	CR	Electrical	100%	BHEL approved spec., drg., BOM & relevant IS.	BHEL approved spec., drg., BOM & relevant IS.	Test Report	2	1	1	
15	FUNCTIONAL TEST	1. Control Logic Operation	CR	Electrical	100%	BHEL approved spec. / drg.	BHEL approved spec. / drg.	Inspection Report	2	1	1	
		2. Instrument Calibration	CR	Electrical	10%	BHEL approved spec. / drg.	BHEL approved spec. / drg.	Inspection Report	2	1	1	
		3. Temperature rise	CR	Electrical	100%	BHEL approved spec/drg. & relevant IS.	BHEL approved spec/drg & relevant IS.	Inspection Report	2	1	1	

LEGEND: * CR - Critical characteristics
 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



INSTRUMENTS QUALITY PLAN



STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR FLOW SWITCH

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	100%	APPROVED SPEC./ DATA SHEETS	P	W	V	
	TYPE						
	RANGE						
	MODEL / TAG No.						
	END CONNECTION						
	DIMENSIONS						
	SIZE						
2	ACCURACY & REPEATABILITY (WET CALIBRATION)	100%		P	W	V	
3	HV / IR	100%		P	W	V	
4	CONTACT RATING / No. OF CONTACTS	RANDOM		P	W	V	
5	MATERIAL TC FOR BODY, WET PARTS, SENSING ELEMENT	ONE / LOT		P	W	V	
6	ACCESSORIES AS APPLICABLE	100%		P	W	V	
7	DEGREE OF PROTECTION	ONE / LOT		P	W	V	
8	OVER PRESSURE TEST	100%		P	W	V	

Legend :

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL,
P = Perform, W = Witness, V = Verification

Note :

- Quantum of check shall be as below :
100 % - By Manufacturer
- Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
- Manufacturer to carry out routine test for 100%
- Contractor to provide compliance certificate for tests/checks verified 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 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	

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Note :

- Quantum of check shall be as below :
100 % - By Manufacturer
- Manufacturer to carry out ROUTINE TEST on 100 %.
- Contractor to provide compliance certificate for tests/checks verified 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 FLOAT OPERATED LEVEL 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	
	MODEL NO/TAG NO						
	TYPE						
	END CONNECTION						
2	ON/OFF DIFFL	SEE NOTE-5	---	P	W	V	
3	REPEATABILITY			P	W	V	
4	IR TEST			P	W	V	
5	HV TEST			P	V	V	
6	PR. TEST ON CHAMBER			P	V	V	
7	MATL. TC FOR CHAMBER & FLOAT	FOR LOT	---	V	V	V	
8	CONTACT CONFIG. & RATING FOR MICROSWITCH	FOR LOT	---	V	V	V	
9	TC FOR DEGREE OF PROTECTION	TYPE TEST	---	V	V	V	
10	MANUFACTURER TO ENSURE WELDING PROCEDURE, WELDERS & NDT AS PER ASME FOR PR >40 KG/CM2	SEE NOTE-1 BELOW	---	P	V	V	
11	CHECK FOR TEMP. SUITABILITY FOR MICROSWITCH AND LEAD WIRE		---	V	V	V	
12	ACCESSORIES AS APPLICABLE		APPROVED SPEC./ DATA SHEETS	V	V	V	

Legend :

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Note :

- Quantum of check shall be as below :
100 % - By Manufacturer
- Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
- Manufacturer to carry out ROUTINE TEST on 100 %.
- When material correlation is not available, MFR's compliance to be provided
- IBR certificates shall be provided wherever required.
- Contractor to provide compliance certificate for tests/checks verified 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 ANALYTICAL INSTRUMENTS

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	
	VISUAL						
	MAKE, MODEL No.						
	POWER SUPPLY						
	TYPE						
2	DIMENSIONS CHECK			P	V	V	
3	FUNCTIONAL CHECK			P	V	V	
4	LEAKAGE TEST			P	V	V	
5	HV / IR TEST			P	V	V	
6	LINEARITY			P	V	V	
7	RESPONSE TIME			P	V	V	
8	ENCLOSURE CLASS			P	V	V	
9	ACCESSORIES, AS APPLICABLE			P	V	V	
10	ACCURACY / CALIBRATION			P	V	V	
11	ALARM CONTACT TEST			P	V	V	
12	ANALOG OUTPUT CHECK			P	V	V	
13	BURN-IN TEST OF ELECTRONIC PARTS	1/LOT		P	V	V	
14	IN-BUILT INDICATOR, ZERO, SPAN, RANGE SCALE SELECTION ETC	SEE NOTE-1 BELOW		P	V	V	

Legend :

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P = Perform, W = Witness, V = Verification

Note :

- Quantum of check shall be as below :
100 % - By Manufacturer
- Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
- Contractor to provide compliance certificate for tests/checks verified 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 :

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Note :

- Quantum of check shall be as below :
100 % - By Manufacturer
- Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
- Manufacturer to carry out ROUTINE TEST on 100 %.
- Contractor to provide compliance certificate for tests/checks verified 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 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 :

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Note :

- Quantum of check shall be as below :
100 % - By Manufacturer
- Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
- When material corelation are not available manufacturer's compliance to be provided.
- 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 TEMPERATURE ELEMENT

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 No./TAG No.						
	PROCESS CONNECTION						
2	STABILITY			P	W	V	
3	INSULATION RESISTANCE			P	W	V	
4	ENCLOSURE CLASS			P	W	V	
5	RESPONSE TIME			P	W	V	
7	ACCURACY			P	W	V	
8	HYDROSTATIC TEST			P	W	V	
9	ELECTRICAL CHARACTERISTIC OF SENSOR (CONTINUITY OF T/C WIRES & INSULATION RESISTANCE OF RTD LEADS w.r.t. BODY			P	W	V	
10	TEMP CURVES / CHARTS			P	V	V	
11	AMBIENT TEMP. EFFECT CHECK			P	W	V	
12	HV TEST			P	W	V	

Legend :

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Note :

- Quantum of check shall be as below :
100 % - By Manufacturer
- Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
- Contractor to provide compliance certificate for tests/checks verified by contractor and submit the same alongwith test certificates to be verified by BHEL.
- IBR certificate to be provided, if applicable



STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR TEMPERATURE 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	
	DIAL SIZE						
	MODEL NO./TAG NO./TYPE						
	RANGE/SCALE						
	END CONNECTION						
2	CALIBRATION	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	ACCURACY						
	REPEATABILITY						
	HYSTERESIS						
3	OVER TEMP. TEST			P	W	V	
4	AMBIENT TEMP. COMPENSATION CHECK	1 OF TYPE		P	V	V	
5	REVIEW OF TC FOR MATERIALS OF	FOR LOT	APPROVED SPEC./ DATA SHEETS	V	V	V	
	SENSOR						
	MOVEMENT						
	PROCESS CONNECTION						
	THERMOWELL						
	HOUSING						
6	REVIEW OF TC FOR DEGREE OF PROTECTION	TYPE TEST		V	V	V	
7	THERMOWELL	SEE NOTE-1 BELOW	AS PER APPD DWG		V	V	
	MATERIAL TC & DIMN. CHECK						
	HYD.TEST						
	OVER RANGE TEST						

Legend :

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Note :

- Quantum of check shall be as below :
100 % - By Manufacturer
- Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
- Manufacturer to carry out ROUTINE TEST on 100 %.
- IBR certificate to be provided if called for in specn.
- Contractor to provide compliance certificate for tests/checks verified 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 :

- Quantum of check shall be as below :
100 % - By Manufacturer
- Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
- Manufacturer to carry out ROUTINE TEST on 100 %.
- When material correlation is not available, MFR's compliance to be provided
- Contractor to provide compliance certificate for tests/checks verified 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	ONE / LOT		P	W	V	
3	ACCURACY			P	W	V	
4	MATERIAL TC FOR			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 :

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P = Perform, W = Witness, V = Verification

Note :

- Quantum of check shall be as below :
100 % - By Manufacturer
- Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
- Manufacturer to carry out ROUTINE TEST on 100 %.
- Contractor to provide compliance certificate for tests/checks verified by contractor and submit the same alongwith test certificates to be verified by BHEL.

MEASURING INSTRUMENTS (PRIMARY AND SECONDARY) pg1of2						
ITEMS	TESTS	Dimensions (R)	Make, Model, Type, Rating (R)	Process / Electrical connection (R)	Calibration (R)	Test as per standard(R)
1. PR Gauge (IS-3624)		Y	Y	Y	Y	Y
2. Temp. Gauge (BS-5235)		Y	Y	Y	Y	Y
3. Pr./D.P.Switch (BS-6134)		Y	Y	Y	Y	Y
4.Electronic Transmitter (IEC-770)		Y	Y	Y	Y	Y
5. Temp. Switch		Y	Y	Y	Y	Y
6. Recorder (IS-9319/ANSI C-39.4)		Y	Y	Y	Y	Y
7. Vertical indicators		Y	Y	Y	Y	Y
8. Digital Indicators		Y	Y	Y	Y	Y
9. Integrators		Y	Y	Y	Y	Y
10. Electrical Metering Instrument (IS-1248)		Y	Y	Y	Y	Y
11. Transducer (IEC-688)		Y	Y	Y	Y	Y
12. Thermocouples (ANSI-MC-96.1)		Y	Y	Y	Y	Y
13. RTD (IEC-751)		Y	Y	Y	Y	Y
R-Routine Test A- Acceptance Test Y – Test applicable						
Note: 1) Detailed procedure of Burn-in and Elevated Temperature test shall be as per Quality Assurance Programme in General Technical Conditions 2) This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the Practices and Procedure adopted alongwith relevant supporting documents.						

MEASURING INSTRUMENTS (PRIMARY AND SECONDARY

Pg2of2

TESTS ITEMS											
	Dimensions (R)	Make, Model, Type, Rating (R)	Process / Electrical connection (R)	Calibration (R)	Requirement as per standard (R)	WPS approval (A)	Non-destructive testing (R)	Insulation Resistance (R)	IBR Certification as applicable (R)	Hydro test (R)	Material test certificate (A)
14. Thermowell									Y	Y	Y
15. Cold junction compensation box	Y	Y	Y	Y				Y			
16. Orifice plate (BS-1042)	Y	Y	Y	Y *	Y	Y **	Y **		Y	Y* *	Y
17. Flow nozzle (BS-1042)	Y	Y	Y	Y *	Y	Y	Y		Y	Y	Y
18. Level transmitter/ switch	Y	Y	Y	Y				Y	Y	Y	Y
*Calibration to be carried out on one flow element of each type and size if calibration carried out as type test same shall not be repeated.											
** If applicable											
R-Routine Test A- Acceptance Test Y – Test applicable											
Note: 1) Detailed procedure of Burn-in and Elevated Temperature test shall be as per Quality Assurance Programme in General Technical Conditions 2) This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the Practices and Procedure adopted alongwith relevant supporting documents.											

ELECTRICAL ACTUATOR WITH INTEGRAL STARTER

ITEM/ COMPONENT/ SUB SYSTEM ASSEMBLY/ TESTING	Test/Attributes												
	Characteristics	RPM ®	No Load Current ®	IR & HV Test®	Mounting Dimension®	All routine Test as per Standard & Specification®	Correct Phase Sequence®	Operation & Setting of limit Switch/Torque Switch®	Stall Torque/Current (A)	Hand Wheel operation/ Auto de clutch function (A)	Function of Aux. like Potentiometer, space heater, position indicator ®	EPT output ®	Grease leakage ®
	ELECTRICAL ACTUATOR WITH INTEGRAL STARTER (IS-9334)												
	Motor	Y	Y	Y	Y	Y							
	Final Testing	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Note: 1) Detailed procedure of Burn-in and Elevated Temperature test shall be as per Quality Assurance Programme in General Technical Requirements 2) This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the practices and procedure adopted along with relevant supporting documents. ® - Routine Test (A) - Acceptance Test Y - Test applicable													

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 :-

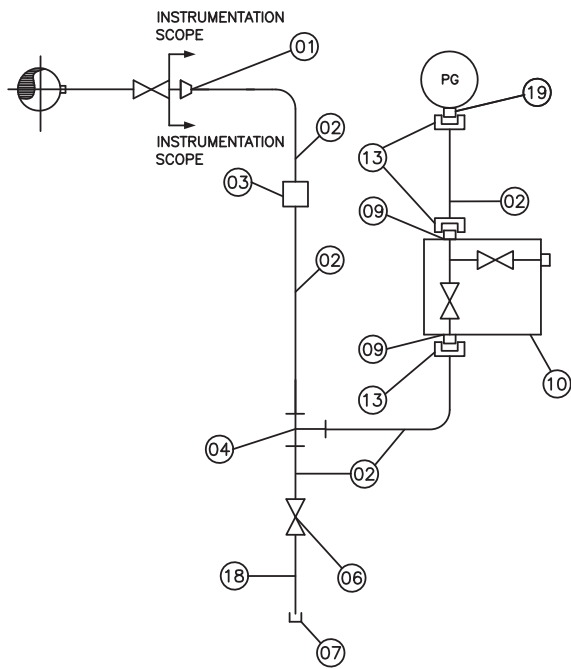
A/R – AS REQUIRED

NPTF – NATIONAL PIPE THREAD FEMALE

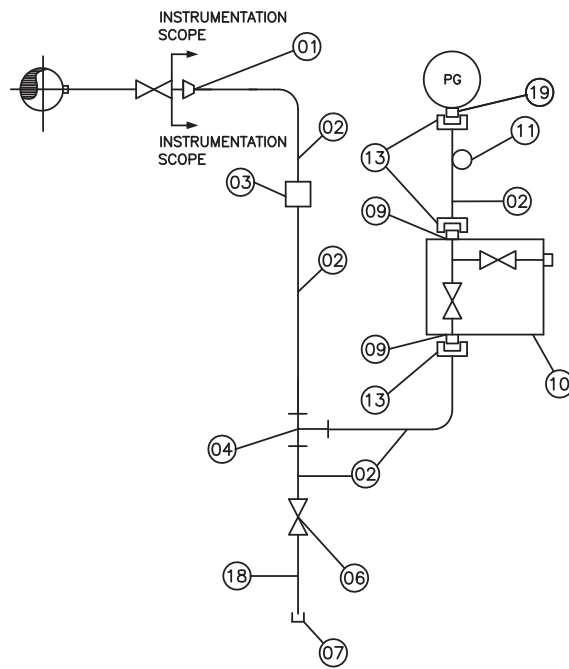
NPTM – NATIONAL PIPE THREAD MALE

SW – SOCKET WELD

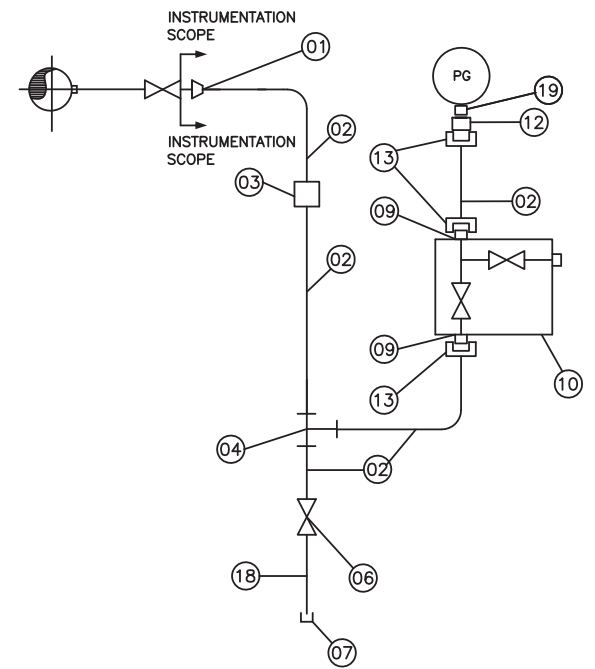
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	NOTES			
DRG. NO.	PE-DG-999-145-XXXX			
REV. NO.	00	DATE	05.11.13	
SHT	2	OF	9	



WATER SERVICE

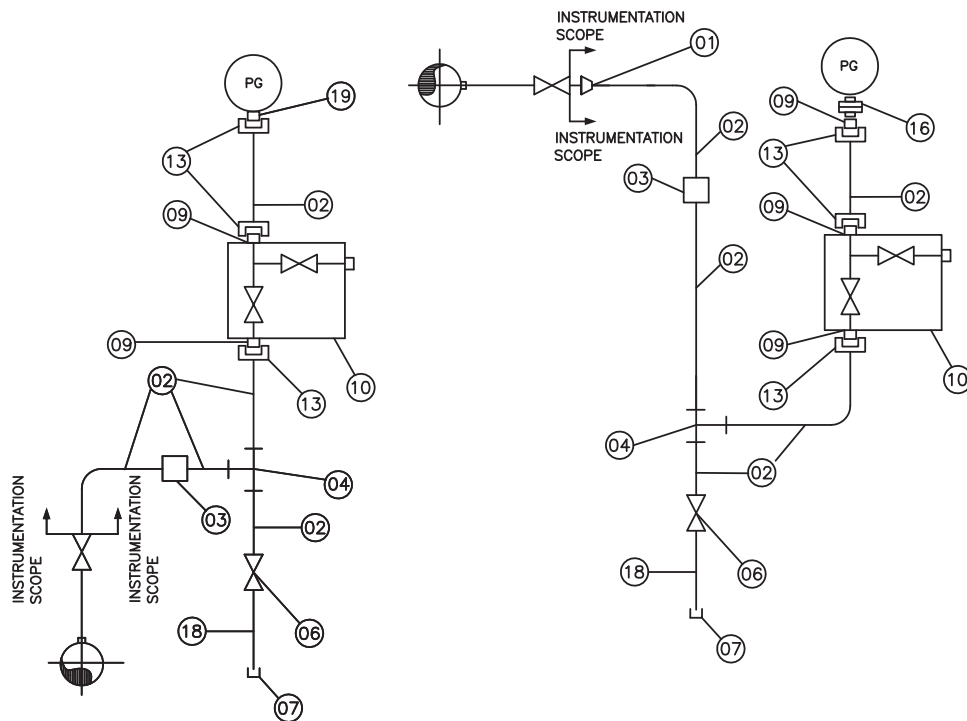


STEAM SERVICE



PULSATING SERVICE

	TITLE :-			DRG. NO.		PE-DG-999-145-XXXX	
	INSTRUMENT INSTALLATION DIAGRAM			REV. NO.		00	DATE 05.11.13
	PRESSURE GAUGES			SHT		3	OF 9



AIR SERVICE

WITH CHEMICAL SEAL
(FOR VISCOUS NON-CORROSIVE FLUID ONLY)

ITEM NO	ITEM/DESCRIPTION	MATERIAL	SIZE	QTY				
				WATER	STEAM	PULSA TING	AIR	CHEM ICAL
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

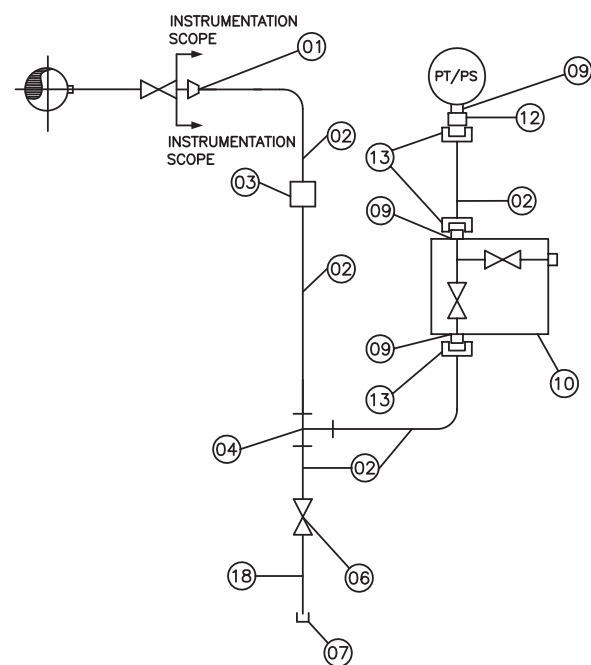
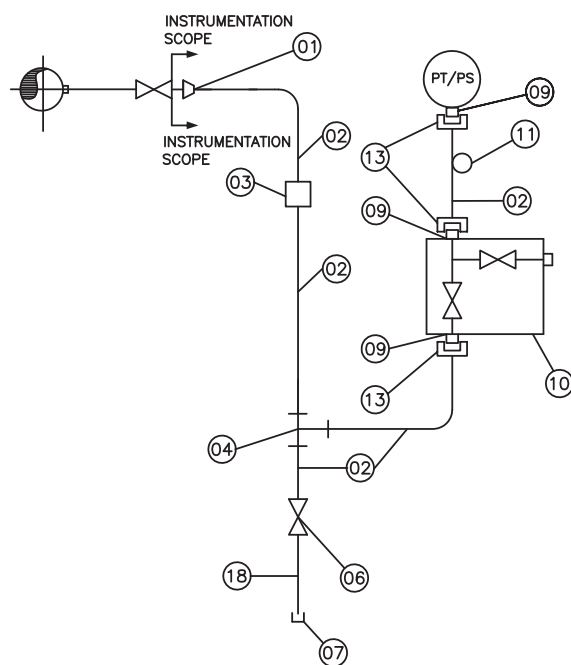
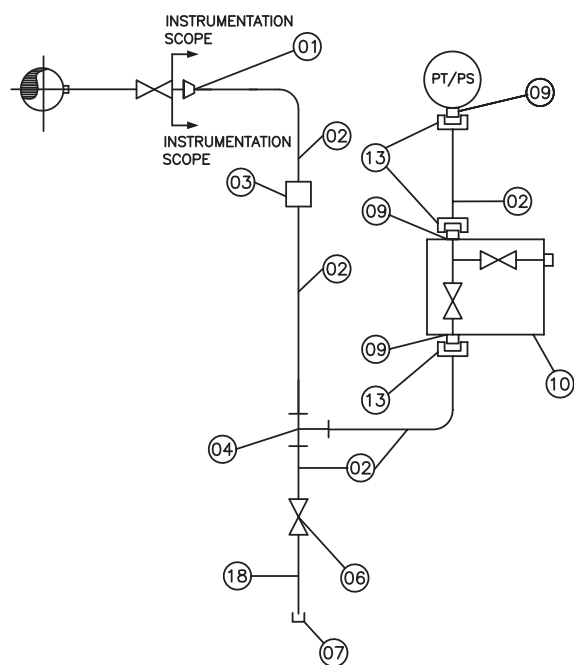


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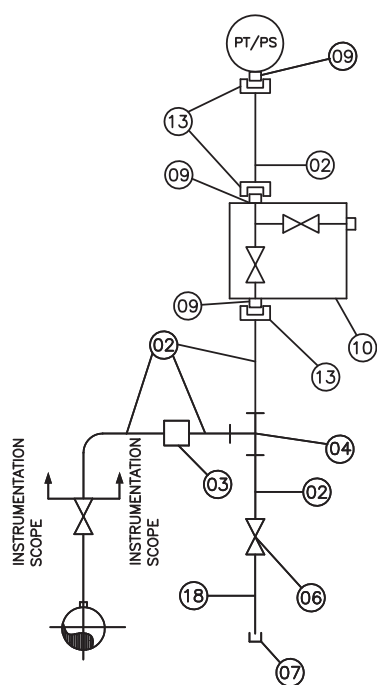
INSTRUMENT INSTALLATION DIAGRAM

PRESSURE GAUGES

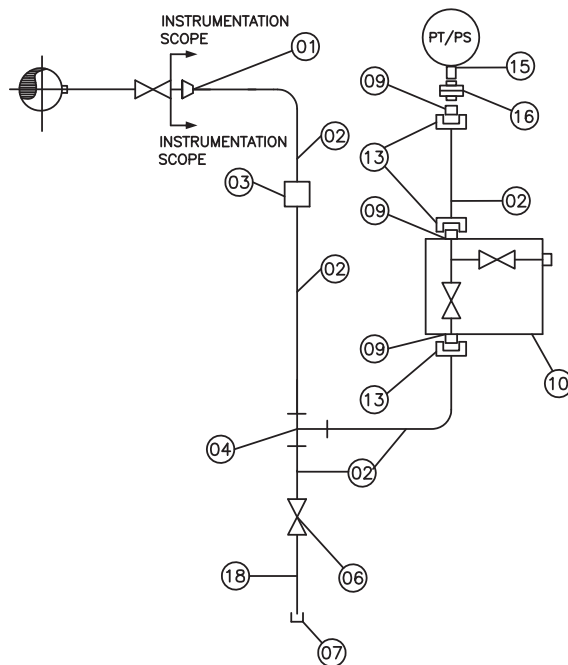
DRG. NO.	PE-DG-999-145-IXXX			
REV. NO.	00	DATE	05.11.13	
SHT	4	OF	9	



	TITLE :-		DRG. NO.		PE-DG-999-145-IXXX	
	INSTRUMENT INSTALLATION DIAGRAM PRESSURE SWITCHES/TRANSMITTERS		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	PULSA TING	AIR	CHEM ICAL
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



TITLE :-

INSTRUMENT INSTALLATION DIAGRAM

PRESSURE SWITCHES/TRANSMITTERS

DRG.
NO.

PE-DG-999-145-IXXX

REV.
NO.

00

DATE

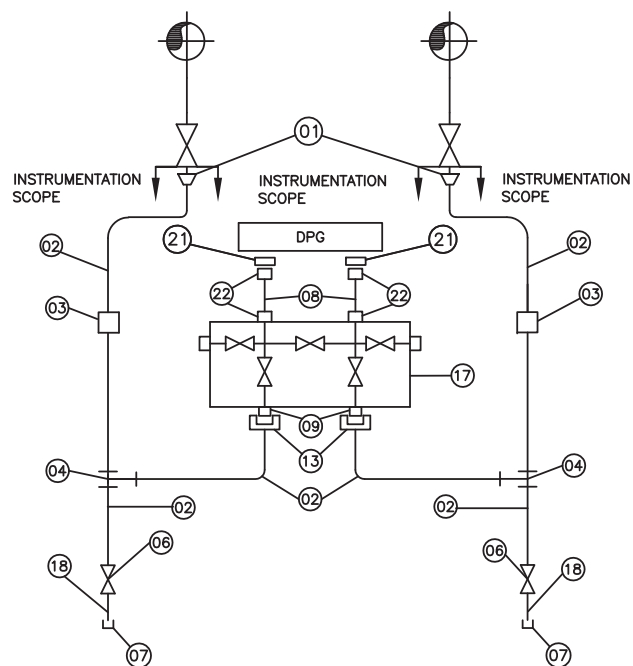
05.11.13

SHT

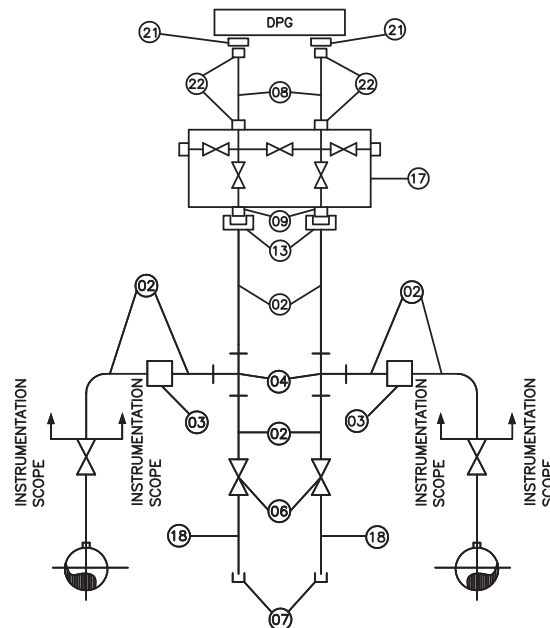
6

OF

9



WATER SERVICE



AIR SERVICE

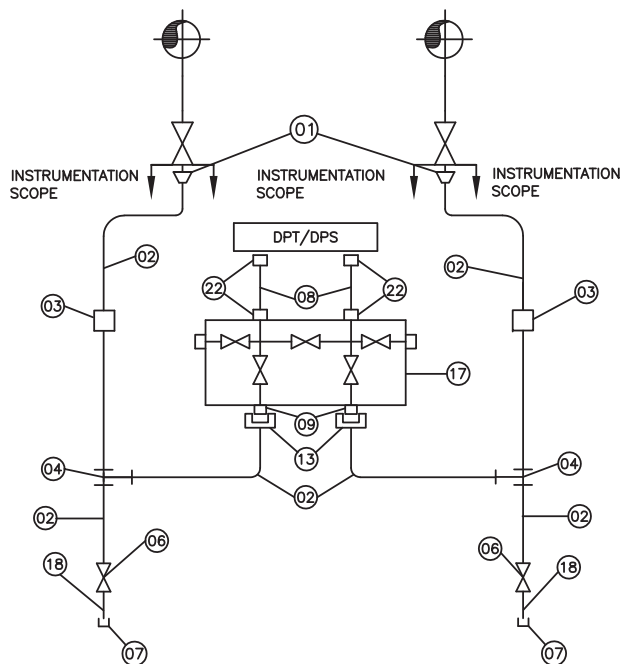
ITEM NO	ITEM/DESCRIPTION	MATERIAL	SIZE	QTY	
				WATER	AIR
01	REDUCER (IF APPLICABLE)	SS316	1" X 1/2"SW	02	00
02	SEAMLESS PIPE	SAME AS MAIN PIPE	1/2"	A/R	A/R
03	FORGED COUPLING	SAME AS MAIN PIPE	1/2" SW	A/R	A/R
04	FORGED TEE	SAME AS MAIN PIPE	1/2" SW	02	02
06	FORGED GLOBE VALVE	SAME AS MAIN PIPE	1/2" 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



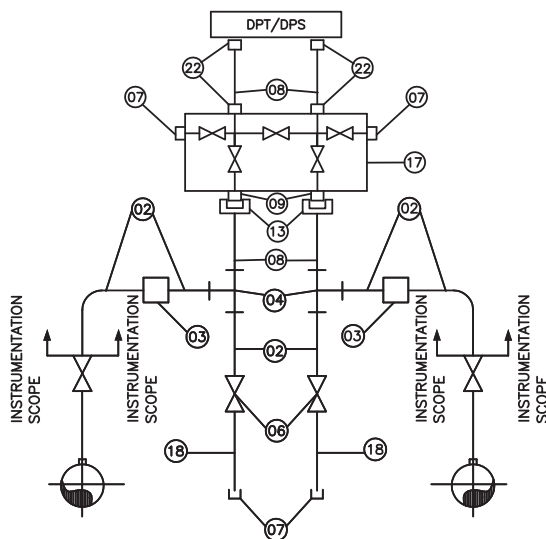
TITLE :-

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

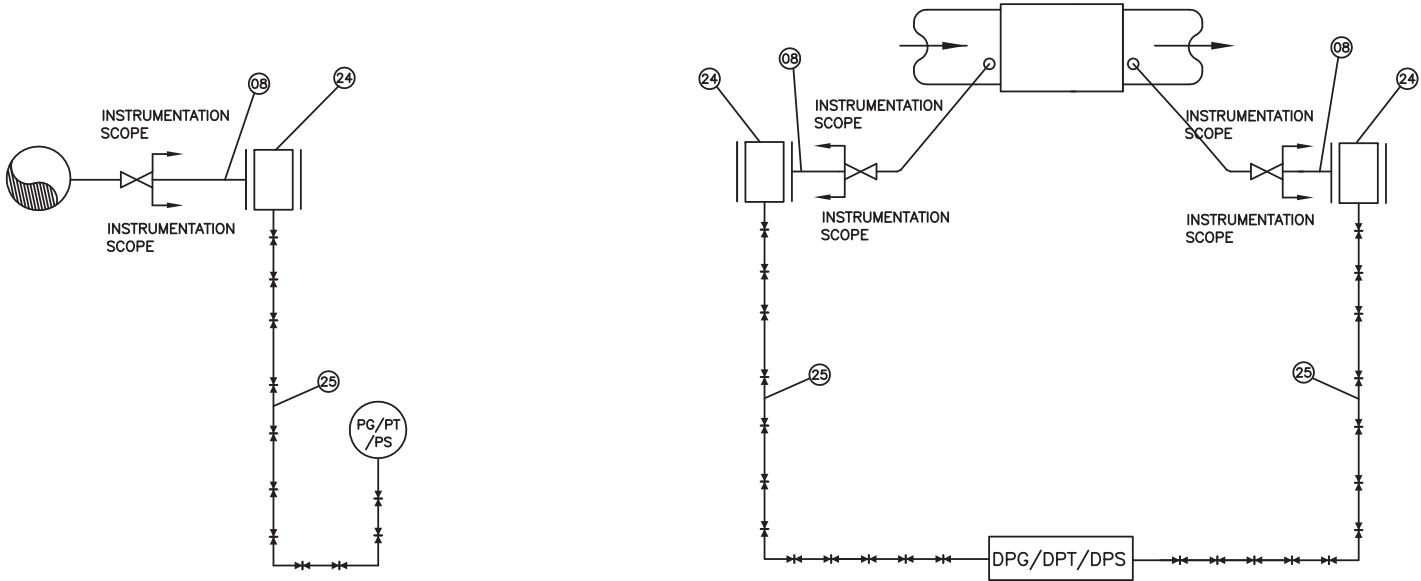


TITLE :-

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

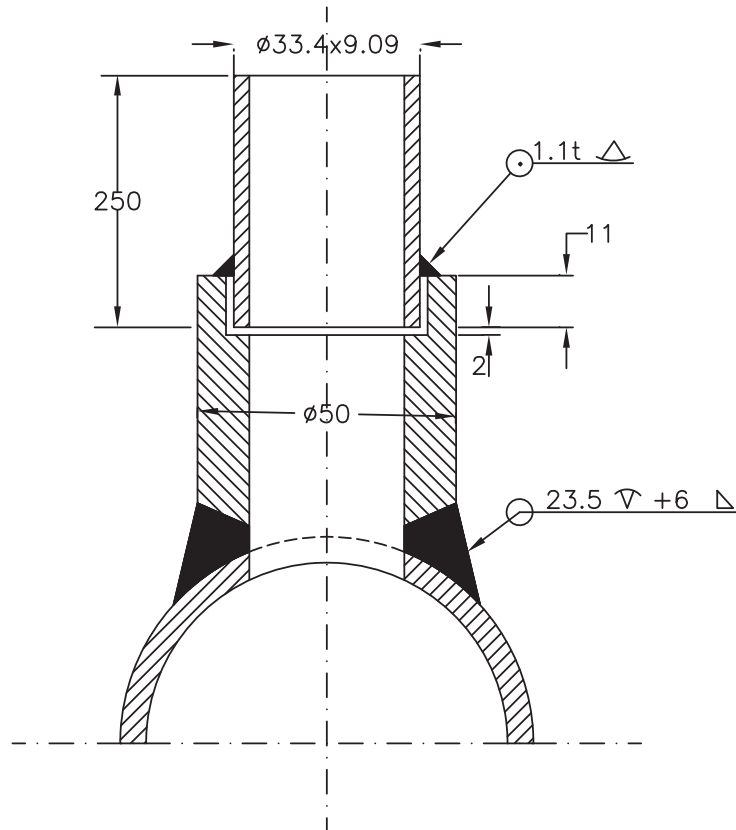


TITLE :-
INSTRUMENT INSTALLATION DIAGRAM
WITH CAPILLARY TUBES

DRG. NO.	PE-DG-999-145-XXXX		
REV. NO.	00	DATE	05.11.13
SHT	9	OF	9

STANDARD STUB DETAILS (PRESSURE/TEMPERATURE)

JOB No. 999					TITLE									
STATUS First Issue					STANDATD STUB DETAILS (PRESSURE/TEMPERATURE)									
DISTRIBUTION					MODULE 2									
TO					 BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA					DEPT	NAME	SIGN	DATE	
No.OFF										CODE	DESN	RV/MG		29.02.12
										CHD	MK		29.02.12	
										APPD	SHB		29.02.12	
REV	DATE	ALTD	CHD	APPD	REV	DATE	ALTD	CHD	APPD	STANDARD DOCUMENT				
										DEPT.	SCALE 1:800	DRAWING No.		
										SIGN		PE-SS-999-145-I101A		
										DATE		SHEET 1	OF 10	REV 00



NOTE :

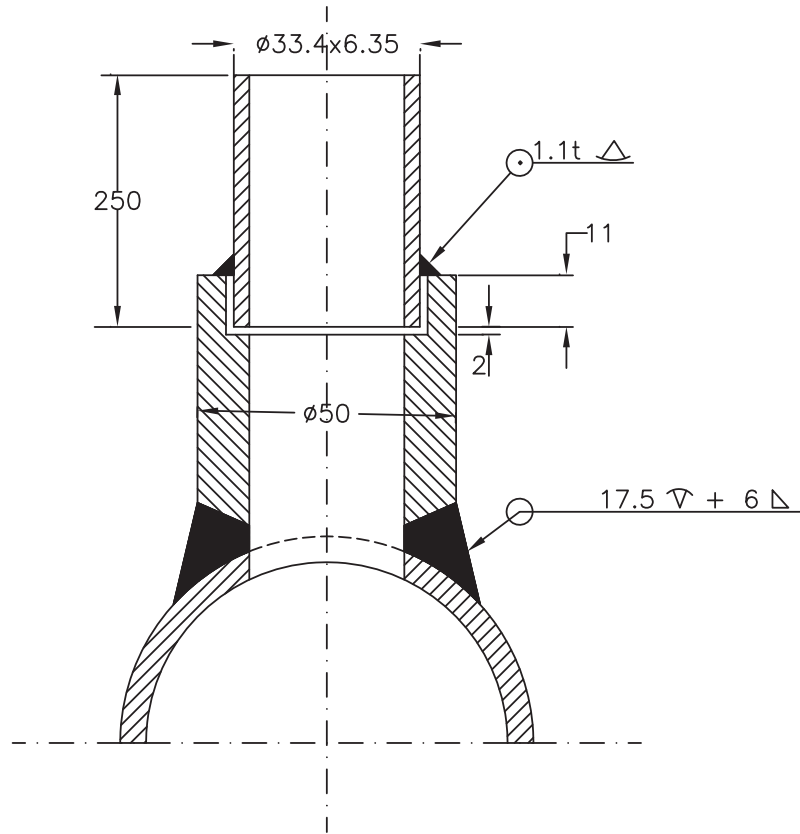
1. MATERIAL OF THE BOSS AND NIPPLE SHALL BE THE SAME AS THE PIPE INTO WHICH IT IS WELDED AND CONFORM TO ANSI B16.11.
2. THE LENGTH OF NIPPLE SHOULD BE 250 MM.
3. STUB LENGTH SHALL BE 64mm UPTO 200Nb PIPE, 45mm ABOVE 200Nb PIPE SIZE.
4. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE INDICATED
5. EDGE HOLE MUST BE CLEAN AND SQUARE OR ROUNDED SLIGHTLY (1/64" RADIUS) FREE FROM BURRS, WIRE EDGES OR OTHER IRREGULARITIES



TITLE : INSTRUMENT STUB DETAILS FOR PRESSURE MEASUREMENT

DRG. NO.
PE-SS-999-145-I101A
REV. 00

(SYSTEM PRESS > 40Kg/Cm2 AND CLASS 9000 #) SH. 02 OF 10 SHS.



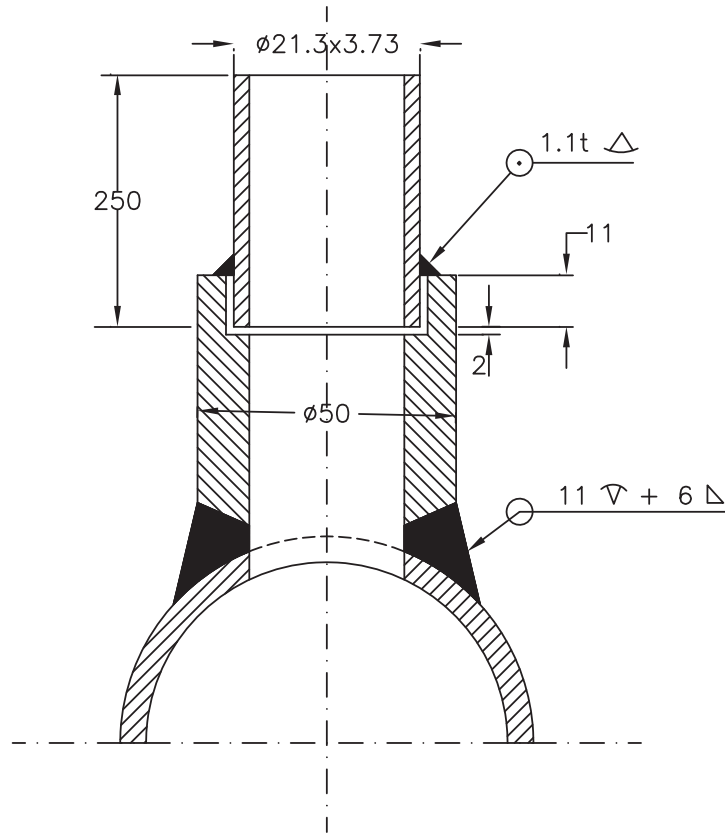
NOTE :

1. MATERIAL OF THE BOSS AND NIPPLE SHALL BE THE SAME AS THE PIPE INTO WHICH IT IS WELDED AND CONFORM TO ANSI B16.11.
2. THE LENGTH OF NIPPLE SHALL BE 250 MM.
3. STUB LENGTH SHALL BE 64mm UPTO 200Nb PIPE, 45mm ABOVE 200Nb PIPE SIZE.
4. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE INDICATED
5. EDGE HOLE MUST BE CLEAN AND SQUARE OR ROUNDED SLIGHTLY ($1/64''$ RADIUS) FREE FROM BURRS, WIRE EDGES OR OTHER IRREGULARITIES



TITLE :
**INSTRUMENT STUB DETAILS
 FOR PRESSURE MEASUREMENT**
 (SYSTEM PRESS > 40Kg/Cm2, CLASS 6000#)

DRG. NO.
PE-SS-999-145-I101A
 REV. 00
 SH. 03 OF 10 SHS.



NOTE :

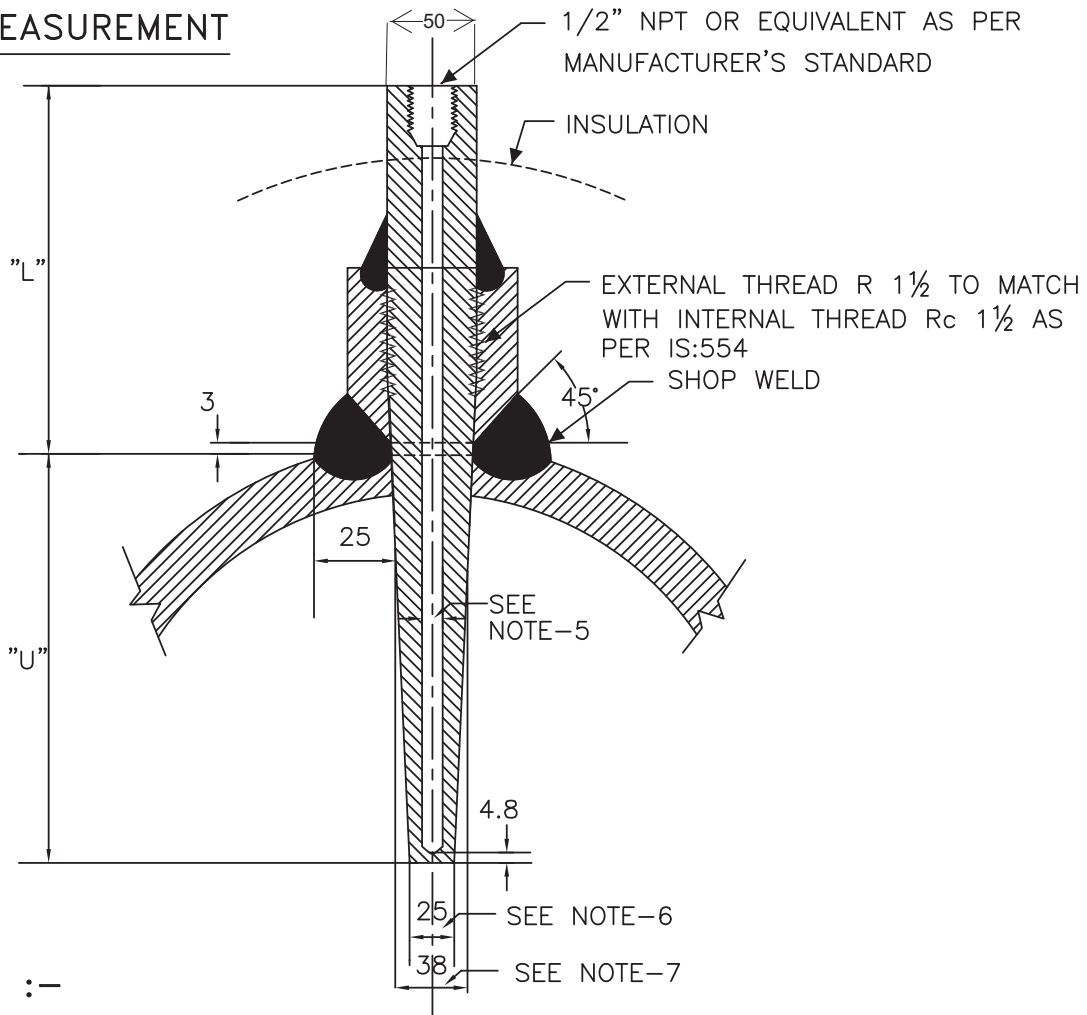
1. MATERIAL OF THE BOSS AND NIPPLE SHALL BE THE SAME AS THE PIPE INTO WHICH IT IS WELDED AND CONFORM TO ANSI B16.11.
2. THE LENGTH OF NIPPLE SHALL BE 250 MM.
3. STUB LENGTH SHALL BE 64mm UPTO 200Nb PIPE, 45mm ABOVE 200Nb PIPE SIZE.
4. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE INDICATED
5. EDGE HOLE MUST BE CLEAN AND SQUARE OR ROUNDED SLIGHTLY ($1/64''$ RADIUS) FREE FROM BURRS, WIRE EDGES OR OTHER IRREGULARITIES
6. FOR PU COATED PIPE REFER SHT NO-9.



TITLE :
INSTRUMENT STUB DETAILS
FOR PRESSURE MEASUREMENT
 (SYSTEM PRESS UPTO 40Kg/Cm², CLASS 3000#)

DRG. NO.
PE-SS-999-145-I101A
 REV. 00
 SH. 04 OF 10 SHS.

TEMP. MEASUREMENT



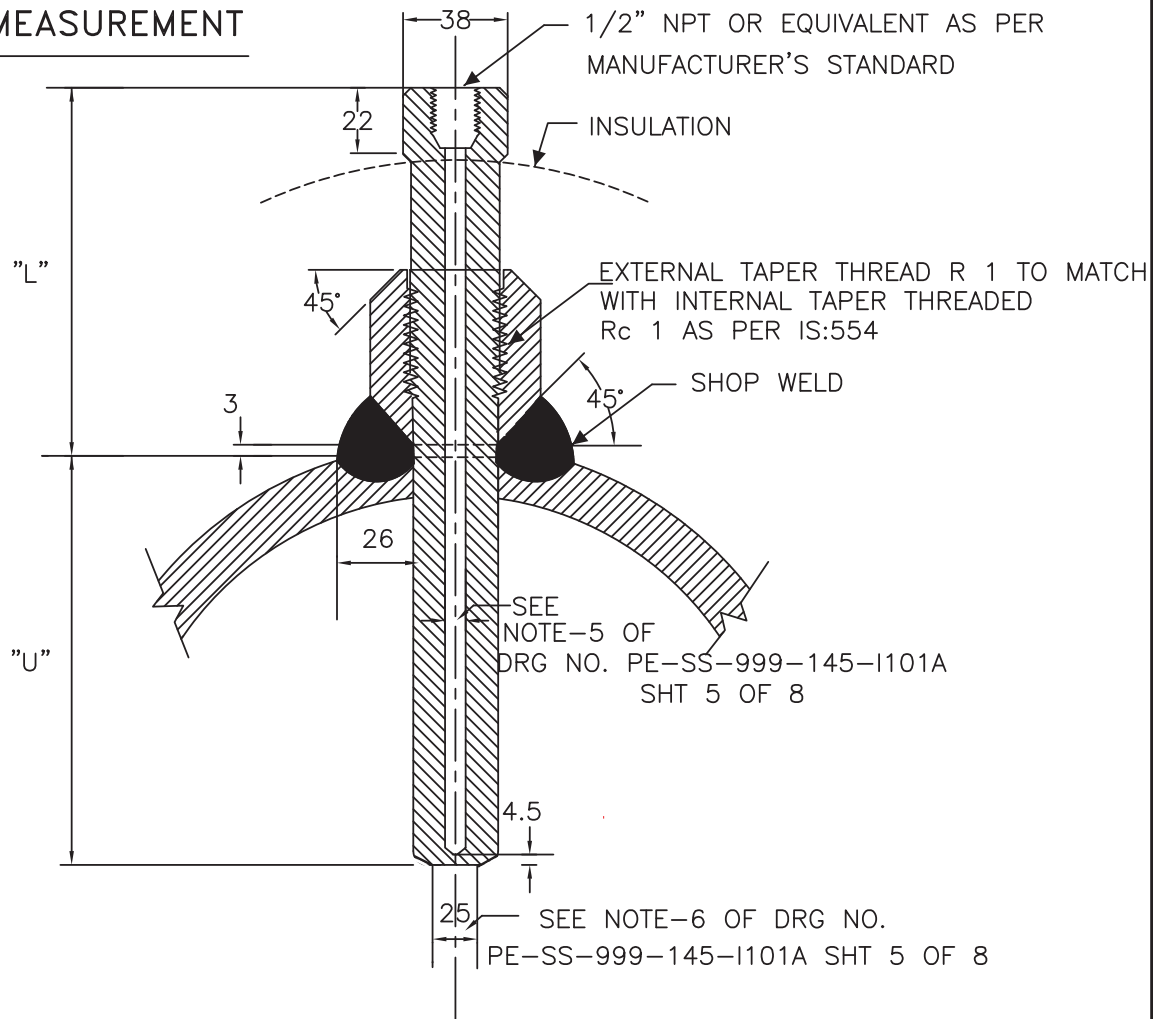
NOTES :-

1. THIS TYPE OF TEMPERATURE BOSS SHALL BE USED FOR THE PROCESS PRESS EQUAL/ ABOVE 40 KG/CM²(g).
2. THE MATERIAL OF THE BOSS SHALL BE SIMILAR TO PIPING MATERIAL.
3. MATERIAL OF THE THERMOWELL SHALL BE OF 316SS.
4. THERMOWELL SHALL BE DRILLED BAR STOCK TYPE.
5. INTERNAL BORE OF THE THERMOWELL SHOULD BE SELECTED BASED ON THE NORMAL SIZE OF THE SENSING ELEMENT AS PER ASME PTC-19.3.
6. THE BOTTOM DIAMETER OF THE THERMOWELL TYPICALLY SHOWN HERE SHALL BE SUBJECT TO VARIATION BASED ON THE INTERNAL BORE OF THERMOWELL AND THICKNESS OF THERMOWELL MATERIAL TO WITHSTAND THE PROCESS PRESS AND TEMP AS PER ASME PTC-19.3.
7. THERMOWELL SHALL BE SUITABLE TO MATCH THE STUB DIMENSIONS AS PER Rc 1½.
8. THE 'U' & 'L' DIMENSIONS SHALL BE SELECTED BASED ON PARTICULAR APPLICATION.
9. ORIENTATION OF STUB ON VERTICAL/ HORIZONTAL PIPES SHALL BE 90° TO THE CENTRE LINE OF THE PIPES, FOR PIPE SIZE LARGER THAN 4". HEIGHT OF STUB SHALL BE 64mm FOR PIPE OD < 200Nb AND 45mm FOR PIPE OD ≥ 200Nb.
10. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE INDICATED



TITLE :	DRG. NO.
INSTRUMENT STUB DETAILS (TEMP)	PE-SS-999-145-I101A
(APPLICABLE FOR PIPE SIZE ABOVE 4")	REV. 00
[PROCESS PRESS EQUAL/> 40 Kg/Cm2 (g)]	SH. 05 OF 10 SHS.

TEMP. MEASUREMENT



NOTES :-

1. THIS TYPE OF TEMPERATURE BOSS IS APPLICABLE FOR THE PROCESS PRESS/ TEMP. BELOW 40 KG/CM²(g)/400°C.
2. FOR PRESS. TIGHT JOINTS THE BOSS SHOULD HAVE INTERNAL TAPERED PIPE THREAD Rc 1 AS PER IS:554. THE LENGTH OF THREAD ENGAGEMENT SHOULD BE AS PER ABOVE STANDARD.
3. SEE NOTES-2 TO 9 IN SHT. 5 OF 8 OF THIS DRG.
4. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE INDICATED
5. FOR PU COATED PIPING REFER SHEET NO-10 FOR TEMP STUB DETAILS.

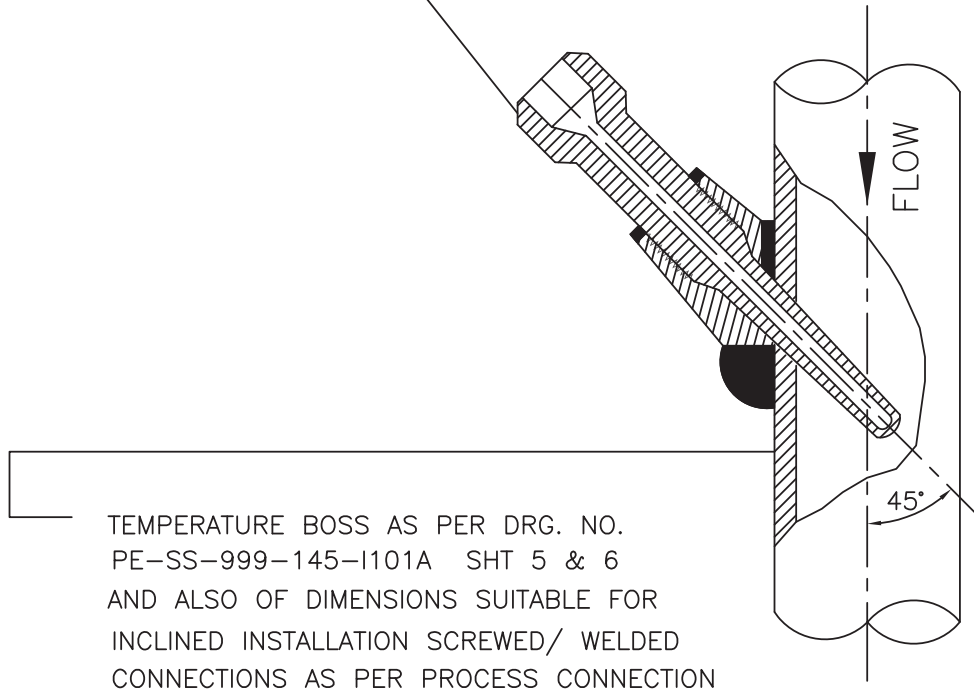


TITLE :
INST. STUB DETAILS (TEMP)
 (APPLICABLE FOR PIPE SIZE ABOVE 4")

DRG. NO.
PE-SS-999-145-I101A
 REV. 00

[PROCESS PRESS < 40 Kg/Cm² (g), TEMP < 400 °C] SH. 06 OF 10 SHS.

THERMOWELL SUITABLE FOR THE BOSS
AS PER DRG. NO.
PE-SS-999-145-I101A SHT 5 & 6



TEMPERATURE BOSS AS PER DRG. NO.
PE-SS-999-145-I101A SHT 5 & 6
AND ALSO OF DIMENSIONS SUITABLE FOR
INCLINED INSTALLATION SCREWED/ WELDED
CONNECTIONS AS PER PROCESS CONNECTION

NOTES :-

1. INCLINED INSTALLATION OF THERMOWELL SHALL BE APPLICABLE FOR 4" AND SMALLER LINE SIZE BUT LIMITED TO MIN. 3" LINE SIZE.
2. FOR 2" AND SMALLER LINE SIZE NECESSARY EXPANDER OF MIN. 3" SIZE OF MAIN PIPING SPECIFICATION SHALL BE USED.
3. THIS TYPE OF INSTALLATION IS APPLICABLE FOR HORIZONTAL AND VERTICAL PIPE SECTION.
4. FOR STEAM SERVICES EXPANDER SECTION TO BE USED ONLY IN VERTICAL RUN.
5. THE EXPANDER SECTION SHALL BE OF ADEQUATE LENGTH (AT LEAST 3-4 TIMES DIA OF THE MAIN PROCESS PIPE AT BOTH SIDES OF THE INSTALLED THERMOWELL).



TITLE :

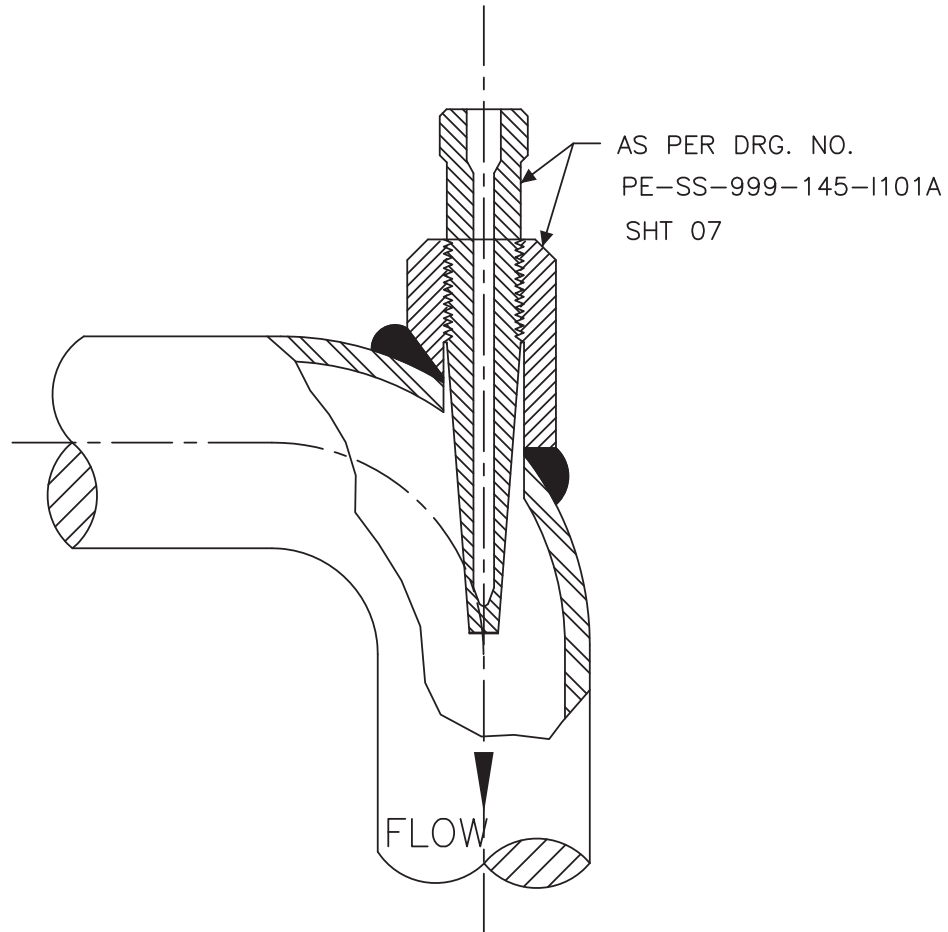
THERMOWELL INSTALLATION

DRG. NO.

PE-SS-999-145-I101A

REV. 00

SH. 07 OF 10 SHS.



NOTES :-

1. FLOW INSTALLATION OF THERMOWELL SHALL BE APPLICABLE FOR 4" AND SMALLER LINE SIZE BUT LIMITED TO MINIMUM 3" LINE SIZE.
2. FOR 2" AND SMALLER LINE SIZE NECESSARY EXPANDER OF ELBOW FORM (AS SHOWN) OF MINIMUM 3" SIZE SHALL BE USED.
3. ELBOW EXPANDER SECTION IN HORIZONTAL PLANE TO BE USED FOR LIQUID SERVICE. FOR STEAM SERVICES EXPANDER SECTION TO BE USED IN VERTICAL PLANE.



TITLE :

THERMOWELL INSTALLATION

DRG. NO.

PE-SS-999-145-I101A

REV. 00

SH. 08 OF 10 SHS.



TECHNICAL SPECIFICATION
FOR
HVAC SYSTEM

4X111 MW VISHNUGAD HEP

LIST OF DELIVERABLES

LIST OF DELIVERABLES OF PEM - C&I DEPARTMENT FOR MAUX PACKAGES									
PACKAGE: HVAC SYSTEM FOR 4x111 MW VISHUGAD HEP									
DOCUMENT NUMBER				PE-GL-413-145-I100		SHEET		1 of 1	
SI.No.	DRAWING NO.	DRAWING/DOCUMENT TITLE	CATEGORY	CUSTOMER	FROM	USER	REMARKS		
INSTRUMENTATION									
1	PE-V9-413-553-I901	INSTRUMENT DATA SHEETS	A	-	VENDOR	C&I			
2	PE-V9-413-553-I902	INSTRUMENT SCHEDULE	I	-	VENDOR	C&I			
3	PE-V9-413-553-I903	INSTRUMENT INSTALLATION/ HOOK UP	A	-	VENDOR	C&I			
4	PE-V9-413-553-I904	FIELD JB TERMINATIONS /GROUPING	I	-	VENDOR	C&I			
5	PE-V9-413-553-I905	QUALITY PLANS (Tx and Analyser)	A	-	VENDOR	C&I			
RELAY BASED LCP									
1	PE-V9-413-553-I905	LOCAL CONTROL PANEL DATA SHEET	A	-	VENDOR	C&I			
2	PE-V9-413-553-I906	PANEL EXTERNAL & INTERNAL GA DRAWING	A	-	VENDOR	C&I			
3	PE-V9-413-553-I907	LIST OF HARDWIRED SIGNAL EXCHANGE WITH PLANT SCADA	A	-	VENDOR	C&I			
4	PE-V9-413-553-I908	LOCAL CONTROL PANEL QUALITY PLAN	A	-	VENDOR	C&I			
5	PE-V9-413-553-I909	MANDATORY SPARES BILL OF MATERIAL	A	-	VENDOR	C&I			
6	PE-V9-413-553-I910	CABLE SCHEDULE IN BHEL EXCEL FORMAT	I	-	VENDOR	C&I			
7	PE-V9-413-553-I911	CABLE INTERCONNECTION DETAILS	I	-	VENDOR	C&I			
	Notes:	413 - Project No							
		553 - SI No of MAX Package							
		\$\$ - Approval by BHEL if Vendor BBU Item Approval by Customer if Customer BBU Item							



HVAC SYSTEM

4X111 MW VISHNUGAD HEP

CABLE SCHEDULE FORMAT

Cable Schedule format

[illegible]



HVAC SYSTEM

4X111 MW VISHNUGAD HEP

SUB-VENDOR LISTS

SUB-VENDOR LIST (As on 04.01.2020)

SLNO	Package Name	Vendor Name	Vendor Address
1	DIFFERENTIAL PRESSURE SWITCH	SOR INC.	LARRY DEGARMO/Avdhesh Chandra, 14685 W. 105TH STREET LENEXA-KANSAS-USA Phone- 09810905139, Pincode : 66215 Email : Ldegarmo@sorinc.com, avdhesh@sherman-india.com,
2	INSTRUMENT FITTINGS	PANAM ENGINEERS	Mr. Santosh Shukla 203, Jaisingh Business,Parsiwada, Sahar road,Andheri(East), Mumbai,-Maharashtra,-India, Phone- 9892179529, Pincode : 400099, Email : santosh@panamengineers.com,
3	INSTRUMENT FITTINGS	Perfect Instrumentation Control (India) Pvt. Ltd.	MD Hussain Shaikh/Shahanawaz Khan Gala No. 168, Loheki Chwal,216/ 218, Maulana Azad Rd. Nagpada Junction Mumbai-Maharashtra-INDIA Phone- 91-9324383121 Pincode : 400008 Email : shahanawaz.khan@perfectinstrumentation.com
4	INSTRUMENT FITTINGS	PRECISION ENGINEERING INDUSTRIES	K. SITARAM/ K. SRINIVAS 7,SIDHAPURA INDUSTRIAL ESTATE S.V. ROAD,GOREGAON(W) MUMBAI-MAHARASHTRA-INDIA Phone- 022 42631700 Pincode : 400 062 Email : peiks@vsnl.com
5	INSTRUMENT FITTINGS	VIKAS INDUSTRIAL PRODUCTS	S.R.SINGH/NAVEEN SINGH B - 2, SECTOR - 6, NOIDA-UTTAR PRADESH-INDIA Phone- +91-9810122070 Pincode : 201301 Email : naveensingh@vsnl.com
6	INSTRUMENT FITTINGS	HP VALVES & FITTINGS INDIA PVT. LTD.	S. Harichandran/P.S. Pandi B-11, Mugappair Industrial Estate, CHENNAI-Tamilnadu-INDIA Phone- 044 26252537 Pincode : 600037 Email : sales@hpvalvesindia.com
7	INSTRUMENT FITTINGS	Fluid Controls Pvt. Ltd.	Sophie Y. Mochhala/Mayur Rajput J.V.PATEL, I.T.I CMPD, B.MADHUKAR MARG, ELPHINSTONE ROADSTN.(WR), MUMBAI-MAHARASHTRA-INDIA Phone- (022) 43338000 Pincode : 400013 Email : sales@fluidcontrols.com
8	INSTRUMENT FITTINGS	FLUIDFIT ENGINEERS PVT. LTD.	Mr. Abbas Bhola Potia Building No. 2, Office No. 3,292, Bellasis Road,Mumbai Central (East) Mumbai-Maharashtra-India Phone- 9920044113 Pincode : 400008 Email : ab@fluidfitengg.com
9	INSTRUMENT FITTINGS	Comfit & Valve Pvt. Ltd.	Mr. Jeetu Jain/Mr. Vinay Sosa Survey No. 23/1, Part 2, Ahmedabad-Mehsana Highway Laxmipura, Nandasan-Gujarat-INDIA Phone- 02764-267036/37 Pincode : 382705 Email : marketing@com-fit.com
10	INSTRUMENT FITTINGS	AURA INCORPORATED	NIRAJ SHARAN/SUJIT KUMAR W-167A, GREATER KAILASH-II NEW DELHI-DELHI-INDIA Phone- 9810182430 Pincode : 110048 Email : niraj@aurainc.com
11	INSTRUMENT FITTINGS	Arya Crafts & Engineering Pvt. Ltd.	Mr.Sanjay Brahman/Mr.Shyam Vazirani 102, Vora Industrial Estate No.4 Navghar, Vasai Road (E) Dist.Thane, Mumbai-Maharashtra-INDIA Phone- +91-250-2392246 Pincode : 401210 Email : arya@aryaengg.com
12	INSTRUMENTS PIPE FITTINGS	AURA INCORPORATED	NIRAJ SHARAN/SUJIT KUMAR W-167A, GREATER KAILASH-II NEW DELHI-DELHI-INDIA Phone- 9810182430 Pincode : 110048 Email : niraj@aurainc.com
13	INSTRUMENTS PIPE FITTINGS	Fluid Controls Pvt. Ltd.	Sophie Y. Mochhala/Mayur Rajput J.V.PATEL, I.T.I CMPD, B.MADHUKAR MARG, ELPHINSTONE ROADSTN.(WR), MUMBAI-MAHARASHTRA-INDIA Phone- (022) 43338000 Pincode : 400013 Email : sales@fluidcontrols.com
14	INSTRUMENTS PIPE FITTINGS	PRECISION ENGINEERING INDUSTRIES	K. SITARAM/ K. SRINIVAS 7,SIDHAPURA INDUSTRIAL ESTATE S.V. ROAD,GOREGAON(W) MUMBAI-MAHARASHTRA-INDIA Phone- 022 42631700 Pincode : 400 062 Email : peiks@vsnl.com
15	INSTRUMENTS PIPE FITTINGS	VIKAS INDUSTRIAL PRODUCTS	S.R.SINGH/NAVEEN SINGH B - 2, SECTOR - 6, NOIDA-UTTAR PRADESH-INDIA Phone- +91-9810122070 Pincode : 201301 Email : naveensingh@vsnl.com
16	INSTRUMENTS TUBE FITTINGS	PRECISION ENGINEERING INDUSTRIES	K. SITARAM/ K. SRINIVAS 7,SIDHAPURA INDUSTRIAL ESTATE S.V. ROAD,GOREGAON(W) MUMBAI-MAHARASHTRA-INDIA Phone- 022 42631700 Pincode : 400 062 Email : peiks@vsnl.com
17	INSTRUMENTS TUBE FITTINGS	VIKAS INDUSTRIAL PRODUCTS	S.R.SINGH/NAVEEN SINGH B - 2, SECTOR - 6, NOIDA-UTTAR PRADESH-INDIA Phone- +91-9810122070 Pincode : 201301 Email : naveensingh@vsnl.com
18	INSTRUMENTS TUBE FITTINGS	Fluid Controls Pvt. Ltd.	Sophie Y. Mochhala/Mayur Rajput J.V.PATEL, I.T.I CMPD, B.MADHUKAR MARG, ELPHINSTONE ROADSTN.(WR), MUMBAI-MAHARASHTRA-INDIA Phone- (022) 43338000 Pincode : 400013 Email : sales@fluidcontrols.com
19	INSTRUMENTS TUBE FITTINGS	AURA INCORPORATED	NIRAJ SHARAN/SUJIT KUMAR W-167A, GREATER KAILASH-II NEW DELHI-DELHI-INDIA Phone- 9810182430 Pincode : 110048 Email : niraj@aurainc.com
20	JUNCTION BOX	AJMERIA INDUSTRIAL & ENGINEERING WORKS	JIGNESH MAHENDRA AJMERIA DENA BANK BLDG.,SHREE NAGESH INDL. ESTATE,STATION ROAD, MUMBAI-MAHARASHTRA-INDIA Phone- 022 67973578 Pincode : 400 088 Email : ajmera@ajmera.net, jmajmera@yahoo.com
21	JUNCTION BOX	FLEXPRO ELECTRICALS PVT. LTD.	Mr. Dineshbhai Zaveri C-1/ 27&37, GIDC, Kabilpore, Navsari-Gujarat-India Phone- 02637-265140,265003 Pincode : 396424 Email : flexpro@flexproltd.com
22	JUNCTION BOX	Shrenik & Company,	Mr. Mitesh Shah/Mr. Pulin Shah 39 A/3 ,Panchratna Industrial Estate, Sarkhej-Bavla Road Ahmedabad-Gujarat-India Phone- 9825024921 Pincode : 382213 Email : sales@pustron.com, pulin@sumip.com
23	JUNCTION BOX	SUCHITRA INDUSTRIES	NO-2,OPP-27 AECS LAYOUT 2ND STG REJAMAHALVILAS EXTN 2ND STG BANGALORE -- Phone- Pincode : Email : suchitra.industriesblr@gmail.com
24	JUNCTION BOX	K.S.INSTRUMENTS PVT.LTD.	S Raghavan No. 72, 3rd Main, 1st Stage Industrial Suburb, Yeshwanthpur Bangalore-Karnataka-India Phone- 9880385770 Pincode : 560022 Email : sales1@ksinstruments.net

25	LEVEL GAUGE	SIGMA INSTRUMENTS CO.	Gopal Kannan/R Gopinath 201, ANANDRAJ INDUSTRIAL ESTATE, OFF.LBS MARG, SONAPUR LANE, BHANDUP (W) MUMBAI-MAHARASHTRA-INDIA Phone- +919821038162 Pincode : 400078 Email : sales@sigmainstruments.co.in
26	LEVEL GAUGE	TOSHNIWAL BROTHERS PVT.LTD.	WORKS:TOSHNIWAL IND.PVT.LTD, INDUSTRIAL ESTATE MAKHUPURA, AJMER-RAJASTHAN-INDIA Phone- 441171 Pincode : 305002 Email : toshniwalprocess@gmail.com
27	LEVEL GAUGE	BLISS ANAND PVT. LTD.	Mr. Vikas Anand/ Mr.RGRajan 92B & 93 B , IMT MANESAR Gurgaon-Haryana-India Phone- 0124-4366000 TO 9 Pincode : 122001 Email : sales@blissanand.com
28	LEVEL SWITCH-CAPACITANCE TYPE	Pune Techtrol Pvt. Ltd.	N.P.Khatan/Sudhakar Badiger S-18, MIDC Bhosari, Pune-Maharashtra-INDIA Phone- 9850560042 Pincode : 411 026 Email : ho@punetechtrol.com
29	LEVEL SWITCH-CAPACITANCE TYPE	LEVCON INSTRUMENTS PVT. LTD.	Mr Shayak Gupta/Badal Jana Rajkamal', 7th floor, 13, Camac Street KOLKATA-WEST BENGAL-INDIA Phone- 0 33 2283 2766 Pincode : 700017 Email : b_jana@levcongroup.com
30	LEVEL SWITCH-CAPACITANCE TYPE	SIGMA INSTRUMENTS CO.	Gopal Kannan/R Gopinath 201, ANANDRAJ INDUSTRIAL ESTATE, OFF.LBS MARG, SONAPUR LANE, BHANDUP (W) MUMBAI-MAHARASHTRA-INDIA Phone- +919821038162 Pincode : 400078 Email : sales@sigmainstruments.co.in
31	LEVEL SWITCH-CAPACITANCE TYPE	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	Office no. 53, Shree Manoshi Complex, Plot No. 5 & 6, Sec-3, Ghansoli (East), Navi Mumbai, -Maharashtra, -INDIA Phone- 9892230623, Pincode : 400 701, Email : sdbpl@vsnl.com
32	LEVEL SWITCH-CAPACITANCE TYPE	Flow Star Engineering Pvt. Ltd.,	MR. KHALID AKHTAR/MR. TAPAN KUMAR JANA Plot No-7 F/2, Northern India Industrial 20/3, Mathura Road FARIDABAD-HARYANA-INDIA Phone- 9818176380 Pincode : 121005 Email : khalid@flowstar.co.in
33	LEVEL SWITCH-CAPACITANCE TYPE	V. AUTOMAT & INSTRUMENTS (P) LTD.	Mr. R. K. BASSI/Mr. PRAVEEN KUMAR F-61, OKHLA INDL.AREA, PH-1 NEW DELHI-DELHI-INDIA Phone- 9810005826 Pincode : 110 020 Email : sales@vautomat.com
34	LEVEL SWITCH-CAPACITANCE TYPE	Baumer Technologies India Pvt. Ltd.	Mr. Shyam Warilani/Mr. V Suresh Babu 36, DAMJI SHAMJI INDUSTRIAL COMPLEX, OFF.-MAHAKALI CAVES ROAD, ANDHERI(E) MUMBAI-Maharashtra-INDIA Phone- +91 99589 25151 Pincode : 400093 Email : sales.in@baumer.com
35	LEVEL SWITCH-CONDUCTIVITY TYPE	V. AUTOMAT & INSTRUMENTS (P) LTD.	Mr. R. K. BASSI/Mr. PRAVEEN KUMAR F-61, OKHLA INDL.AREA, PH-1 NEW DELHI-DELHI-INDIA Phone- 9810005826 Pincode : 110 020 Email : sales@vautomat.com
36	LEVEL SWITCH-CONDUCTIVITY TYPE	BLISS ANAND PVT. LTD.	Mr. Vikas Anand/ Mr.RGRajan 92B & 93 B , IMT MANESAR Gurgaon-Haryana-India Phone- 0124-4366000 TO 9 Pincode : 122001 Email : sales@blissanand.com
37	LEVEL SWITCH-CONDUCTIVITY TYPE	HI-TECH SYSTEMS & SERVICES LTD.	Mr. Vikash Agrawal/Mr. Tarun Debnath 119, PARK STREET , KOLKATA-West Bengal-India Phone- 033-22290045 Pincode : 700016 Email : sandeep@hitech.in
38	LEVEL SWITCH-CONDUCTIVITY TYPE	SIGMA INSTRUMENTS CO.	Gopal Kannan/R Gopinath 201, ANANDRAJ INDUSTRIAL ESTATE, OFF.LBS MARG, SONAPUR LANE, BHANDUP (W) MUMBAI-MAHARASHTRA-INDIA Phone- +919821038162 Pincode : 400078 Email : sales@sigmainstruments.co.in
39	LEVEL SWITCH-CONDUCTIVITY TYPE	SOR INC.	LARRY DEGARMO/Avdhesh Chandra, 14685 W. 105TH STREET LENEXA-KANSAS-USA Phone- 09810905139, Pincode : 66215 Email : Ldegarmo@sorinc.com, avdhesh@sherman-india.com,
40	LEVEL SWITCH-CONDUCTIVITY TYPE	Sapcon Instrument Pvt Ltd.	131, PALSHIKAR COLONY Contact Person- Mr. Ashwin (9826080207) INDORE-MP-INDIA Phone- +91-731-4085751, Pincode : 452004 Email : sales@sapconinstruments.com
41	LEVEL SWITCH-CONDUCTIVITY TYPE	LEVCON INSTRUMENTS PVT. LTD.	Mr Shayak Gupta/Badal Jana Rajkamal', 7th floor, 13, Camac Street KOLKATA-WEST BENGAL-INDIA Phone- 0 33 2283 2766 Pincode : 700017 Email : b_jana@levcongroup.com
42	LEVEL SWITCH-CONDUCTIVITY TYPE	RAMAN INSTRUMENTS PVT.LTD.	Mr. N R Shenoy/Mr G B Vijh 8, First Floor.Plot : 160A Bait-Ush-Sharaf, 29th Road,Bandra(W) MUMBAI-Maharashtra-India Phone- 09892331381 Pincode : 400050 Email : ramanbpl@vsnl.com
43	LEVEL SWITCH-FLOAT TYPE	Pune Techtrol Pvt. Ltd.	N.P.Khatan/Sudhakar Badiger S-18, MIDC Bhosari, Pune-Maharashtra-INDIA Phone- 9850560042 Pincode : 411 026 Email : ho@punetechtrol.com
44	LEVEL SWITCH-FLOAT TYPE	LEVCON INSTRUMENTS PVT. LTD.	Mr Shayak Gupta/Badal Jana Rajkamal', 7th floor, 13, Camac Street KOLKATA-WEST BENGAL-INDIA Phone- 0 33 2283 2766 Pincode : 700017 Email : b_jana@levcongroup.com
45	LEVEL SWITCH-FLOAT TYPE	SOR INC.	LARRY DEGARMO/Avdhesh Chandra, 14685 W. 105TH STREET LENEXA-KANSAS-USA Phone- 09810905139, Pincode : 66215 Email : Ldegarmo@sorinc.com, avdhesh@sherman-india.com,
46	LEVEL SWITCH-FLOAT TYPE	SIGMA INSTRUMENTS CO.	Gopal Kannan/R Gopinath 201, ANANDRAJ INDUSTRIAL ESTATE, OFF.LBS MARG, SONAPUR LANE, BHANDUP (W) MUMBAI-MAHARASHTRA-INDIA Phone- +919821038162 Pincode : 400078 Email : sales@sigmainstruments.co.in
47	LEVEL SWITCH-FLOAT TYPE	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	Office no. 53, Shree Manoshi Complex, Plot No. 5 & 6, Sec-3, Ghansoli (East), Navi Mumbai, -Maharashtra, -INDIA Phone- 9892230623, Pincode : 400 701, Email : sdbpl@vsnl.com
48	LEVEL SWITCH-FLOAT TYPE	SBEM PVT. LTD.	MR.N.K. BEDARKAR/MR. VISHWANATH KARANDIK 39, ELECTRONIC CO.OP. ESTATE, PUNE SATARA ROAD PUNE,-MAHARASHTRA-INDIA Phone- 912041030100 Pincode : 411009 Email : newdelhi@sbem.co.in

49	LEVEL SWITCH-FLOAT TYPE	GENERAL INSTRUMENTS CONSORTIUM	Mr. Amarendra Kulkarni 194/195, Gopi Tank Road, Off. Pandurang Naik Marg, Mahim Mumbai-Maharashtra-India Phone- 9323195251 Pincode : 400016 Email : amarendra@general-gauges.com
50	LEVEL SWITCH-FLOAT TYPE	D.K. INSTRUMENTS PVT.LTD.	N.SIKDAR/ SUMIT SIKDAR 76/2,SELIMPUR RD DHAKURIA Kolkata-West Bengal-India Phone- 033-2415-1310. Pincode : 700031 Email : dkinst@vsnl.net
51	LEVEL SWITCH-FLOAT TYPE	V. AUTOMAT & INSTRUMENTS (P) LTD.	Mr. R. K. BASSI/Mr. PRAVEEN KUMAR F-61, OKHLA INDL.AREA, PH-1 NEW DELHI-DELHI-INDIA Phone- 9810005826 Pincode : 110 020 Email : sales@vautomat.com
52	LEVEL SWITCH-FLOAT TYPE	Baumer Technologies India Pvt. Ltd.	Mr. Shyam Warilani/Mr. V Suresh Babu 36, DAMJI SHAMJI INDUSTRIAL COMPLEX, OFF.-MAHAKALI CAVES ROAD, ANDHERI(E) MUMBAI-Maharashtra-INDIA Phone- +91 99589 25151 Pincode : 400093 Email : sales.in@baumer.com
53	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	Baumer Technologies India Pvt. Ltd.	Mr. Shyam Warilani/Mr. V Suresh Babu 36, DAMJI SHAMJI INDUSTRIAL COMPLEX, OFF.-MAHAKALI CAVES ROAD, ANDHERI(E) MUMBAI-Maharashtra-INDIA Phone- +91 99589 25151 Pincode : 400093 Email : sales.in@baumer.com
54	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	BOSE PANDA INSTRUMENTS PVT.LTD.	Mr. Partha Bose 44, Saheed Hemanta Kumar Bose, Sarani, Kolkata-West Bengal-India Phone- +91 33 2548 7220 Pincode : 700074 Email : parthabosebpi@gmail.com; bosepanda@vsnl.net
55	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	PRECISION MASS PRODUCTS PVT. LTD.	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol-Gujarat,- INDIA Phone- 9999464663 Pincode : 382729 Email : sales@precisionmass.com
56	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	A.N. INSTRUMENTS PVT. LTD.	MARKETING DIVISION, 5th FLOOR, 59-B, CHOWRINGHEE ROAD, KOLKATA-WEST BENGAL-INDIA Phone- 24757784,22472509 Pincode : 700020 Email : anidel@bol.net.in
57	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	FORBES MARSHALL (HYD) LTD.	MR SAILESH PATALAY/MR. M K SRINIVASAN PLOT NO.A-19/2, & T-4/2, IDA, NACHARAM, HYDERABAD-TELANGANA-INDIA Phone- 9849913704 Pincode : 500 076 Email : mksrinivasan@forbesmarshall.com
58	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	GAUGE BOURDON INDIA PVT. LTD.	194/195, Gopi Tank Road, Off Pandurang Naik Marg, Mahim Mumbai,-Maharashtra,- India, Phone- 011-41607463, Pincode : 400016, Email : gicdelhi@general-gauges.com,
59	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	H.GURU INDUSTRIES	Mr. G. D. Hazra/Mr. P. K. Mitra 10 B, HO-CHI-MINH SARANI, KOLKATA-WEST BENGAL-INDIA Phone- 033 2282 2463 / 1637 Pincode : 700071 Email : mguru@vsnl.net
60	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	H.GURU INSTRUMENTS (SOUTH INDIA) P. LTD	32,INDUSTRIAL SUBURB YESWANTHAPUR BANGALORE-KARNATAKA-www.hgurusouth.com Phone- 080-23370300, Pincode : 560022 Email : info@hgurusouth.com
61	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	Office no. 53, Shree Manoshi Complex, Plot No. 5 & 6, Sec-3, Ghansoli (East), Navi Mumbai,-Maharashtra,-INDIA Phone- 9892230623, Pincode : 400 701, Email : sdbpl@vsnl.com
62	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	Nesstech Instruments Private Limited	26/2, G Type, Global Industrial Park Near Nahuli Railway Crossing, Valvada Vapi-Gujarat-India Phone- 9920576002 Pincode : 396105 Email : sales@nesstech.co.in
63	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	Kaustubha Udyog,	S.No. 36/1/1, Sinhgad Road, Vadgaon Khurd, Near Lokmat Press, Pune,- Maharashtra,-India, Phone- 020-24393577, Pincode : Email : pressure@vsnl.com,
64	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	SWITZER PROCESS INSTRUMENTS PVT. LTD.	Mr. V S Jayaprakash, 128, SIDCO North Phase, Ambattur Estates CHENNAI-TAMIL NADU-INDIA Phone- 044-26252017/2018 Pincode : 600050 Email : sales@switzerprocess.co.in
65	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	SOR INC.	LARRY DEGARMO/Avdesh Chandra, 14685 W. 105TH STREET LENEXA-KANSAS-USA Phone- 09810905139, Pincode : 66215 Email : Ldegarmo@sorinc.com, avdesh@sherman-india.com,
66	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	INDFOS INDUSTRIES LIMITED	B-20-21, INDUSTRIAL AREA, MEERUT ROAD, GHAZIABAD-UP-INDIA Phone- 0120-2712016 Pincode : Email : mktg@indfos.com
67	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	GENERAL INSTRUMENTS CONSORTIUM	Mr. Amarendra Kulkarni 194/195, Gopi Tank Road, Off. Pandurang Naik Marg, Mahim Mumbai-Maharashtra-India Phone- 9323195251 Pincode : 400016 Email : amarendra@general-gauges.com
68	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	PRECISION MASS PRODUCTS PVT. LTD.	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol-Gujarat,- INDIA Phone- 9999464663 Pincode : 382729 Email : sales@precisionmass.com
69	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	DRESSER INDUSTRIES INC.	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol-Gujarat-India Phone- 02764-233682 Pincode : 382729 Email : Nishit.patel@ashcroftindia.com
70	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	INDFOS (INDIA) LIMITED	MR.L.C.VENKATRANGAN/MR.B.KANNAN New No.17, II Floor, Adwave Towers, Dr.Sevalia Shivaji Salai, T.Nagar Chennai-TamilNadu-INDIA Phone- +91 44 24353407 Pincode : 600017 Email : delhi@indfos.com
71	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	Barksdale GmbH, Germany	Michael Weileder Dorn Assenheimer, Strasse 27 Reichelsheim--Germany Phone- +91-9999107840 Pincode : D-61203 Email : msingh@barksdale.de
72	ROTAMETER	INSTRUMENTATION ENGINEERS PVT LTD	SH.N.V.RAM GOPAL/MS. N.NIHARIKA PLOTS 1,2,3, PHASE-III, IDA, JEEDIMETLA HYDERABAD-TELANGANA-INDIA Phone- 9848407365 Pincode : 500055 Email : ieddelhi@iefflowmeters.com

73	ROTAMETER	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	Office no. 53, Shree Manoshi Complex, Plot No. 5 & 6, Sec-3, Ghansoli (East), Navi Mumbai,-Maharashtra,-INDIA Phone- 9892230623, Pincode : 400 701, Email : sdbpl@vsnl.com
74	ROTAMETER	TANSA EQUIPMENTS PVT. LTD.	Mr. Vardhan Tamhankar, Unit No35/36/41,Om Anand Industrial Est. Mohanjee Sundarjee Road,Raghunath Nagar, Thane-Maharashtra-India Phone- 022-25832323 Pincode : 400604 Email : tansaindia@gmail.com
75	ROTAMETER	Flow Star Engineering Pvt. Ltd.,	MR. KHALID AKHTAR/MR. TAPAN KUMAR JANA Plot No-7 F/2, Northern India Industrial 20/3, Mathura Road FARIDABAD-HARYANA-INDIA Phone- 9818176380 Pincode : 121005 Email : khalid@flowstar.co.in
76	ROTAMETER	EUREKA INDUSTRIAL EQUIPMENTS PVT.LTD.	Mr V. K. Pandit/Mr Ashish Shaha 17-20, Royal chambers, Paud Road Pune-Maharashtra-India Phone- 9370469466 Pincode : 411038 Email : sales@eurekaflow.com
77	SIGHT FLOW INDICATORS	BLISS ANAND PVT. LTD.	Mr. Vikas Anand/ Mr.RGRajan 92B & 93 B , IMT MANESAR Gurgaon-Haryana-India Phone- 0124-4366000 TO 9 Pincode : 122001 Email : sales@blissanand.com
78	SIGHT FLOW INDICATORS	B.K.EQUIPMENTS PVT.LTD.	T. BALAKRISHNAN/S.VENKATESH 217 , ARCOT ROAD PORUR , CHENNAI-TAMIL NADU-INDIA Phone- 9444057761 Pincode : 600116 Email : bkequip@gmail.com
79	SIGHT FLOW INDICATORS	INSTRUMENTATION ENGINEERS PVT LTD	SH.N.V.RAM GOPAL/MS. N.NIHARIKA PLOTS 1,2,3, PHASE-III, IDA, JEEDIMETLA HYDERABAD-TELANGANA-INDIA Phone- 9848407365 Pincode : 500055 Email : iedelhi@ieflowmeters.com
80	SIGHT FLOW INDICATORS	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	Office no. 53, Shree Manoshi Complex, Plot No. 5 & 6, Sec-3, Ghansoli (East), Navi Mumbai,-Maharashtra,-INDIA Phone- 9892230623, Pincode : 400 701, Email : sdbpl@vsnl.com
81	SIGHT FLOW INDICATORS	SIGMA INSTRUMENTS CO.	Gopal Kannan/R Gopinath 201, ANANDRAJ INDUSTRIAL ESTATE, OFF.LBS MARG, SONAPUR LANE, BHANDUP (W) MUMBAI-MAHARASHTRA-INDIA Phone- +919821038162 Pincode : 400078 Email : sales@sigmainstruments.co.in
82	SIGHT FLOW INDICATORS	V. AUTOMAT & INTRUMENTS (P) LTD.	Mr. R. K. BASSI/Mr. PRAVEEN KUMAR F-61, OKHLA INDL.AREA, PH-1 NEW DELHI-DELHI-INDIA Phone- 9810005826 Pincode : 110 020 Email : sales@vautomat.com
83	TEMP. ELEMENT	DETRIVE INSTRUMENTATION & ELECTRONICS LTD.	320, TV INDUSTIAL ESTATE, OFF.DR.A.BESANT ROAD, BEHIND GLAXO, WORLI, MUMBAI-MAHARASHTRA-INDIA Phone- 24934125,24938403 Pincode : 400025 Email : trivtech@vsnl.com
84	TEMP. ELEMENT	GAUGE BOURDON INDIA PVT. LTD.	194/195, Gopi Tank Road, Off Pandurang Naik Marg, Mahim Mumbai,-Maharashtra,-India, Phone- 011-41607463, Pincode : 400016, Email : gicdelhi@general-gauges.com,
85	TEMP. ELEMENT	GOA INSTRUMENTS INDUSTRIES PVT.LTD.,	D2/5, Mapusa Industrial Estate, Mapusa, Goa,-MAHARASHTRA-INDIA Phone- 09326054551, Pincode : 403507, Email : sumukh@goainstruments.com,
86	TEMP. ELEMENT	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	Office no. 53, Shree Manoshi Complex, Plot No. 5 & 6, Sec-3, Ghansoli (East), Navi Mumbai,-Maharashtra,-INDIA Phone- 9892230623, Pincode : 400 701, Email : sdbpl@vsnl.com
87	TEMP. ELEMENT	Tempsens Instrument (I) Pvt Ltd	MR. V.P.RATHI/MR. HEMANT RATHI B-188A ROAD NO.5 , M.I.A UDAIPUR-RAJASTHAN-INDIA Phone- 09352420069 Pincode : 313003 Email : info@tempsens.com
88	TEMP. ELEMENT	Thermal Instrument India Pvt. Ltd.	Mr. Raghavendra M. Kulkarni 194/195, Gopi Tank Road Behind Citylight Cinema,Mahim Mumbai-Maharashtra-India Phone- 09322664709 Pincode : 400016 Email : ramk@qiconindia.com
89	TEMP. ELEMENT	TOSHNIWAL INDUSTRIES PVT. LTD.,	Industrial Estate, Makhupura, Ajmer,-Rajasthan,-India, Phone- 9352009000, Pincode : 305002, Email : info@tipl.com,
90	TEMP. ELEMENT	Nesstech Instruments Private Limited	26/2, G Type, Global Industrial Park Near Nahuli Railway Crossing, Valvada Vapi-Gujarat-India Phone- 9920576002 Pincode : 396105 Email : sales@nesstech.co.in
91	TEMP. ELEMENT	PYRO ELECTRIC INSTRUMENTS GOA PVT.LTD.	M. D. BICHU/R. M. BICHU G.B, HILL CROWN APARTMENTS, COLLEGE ROAD, MAPUSA-GOA-INDIA Phone- 9326114601 Pincode : 403507 Email : priyanka.marketing@pyro-electric.in
92	TEMP. ELEMENT	Baumer Technologies India Pvt. Ltd.	Mr. Shyam Warilani/Mr. V Suresh Babu 36, DAMJI SHAMJI INDUSTRIAL COMPLEX, OFF.-MAHAKALI CAVES ROAD, ANDHERI(E) MUMBAI-Maharashtra-INDIA Phone- +91 99589 25151 Pincode : 400093 Email : sales.in@baumer.com
93	TEMPERATURE GAUGE	Baumer Technologies India Pvt. Ltd.	Mr. Shyam Warilani/Mr. V Suresh Babu 36, DAMJI SHAMJI INDUSTRIAL COMPLEX, OFF.-MAHAKALI CAVES ROAD, ANDHERI(E) MUMBAI-Maharashtra-INDIA Phone- +91 99589 25151 Pincode : 400093 Email : sales.in@baumer.com
94	TEMPERATURE GAUGE	GOA INSTRUMENTS INDUSTRIES PVT.LTD.,	D2/5, Mapusa Industrial Estate, Mapusa, Goa,-MAHARASHTRA-INDIA Phone- 09326054551, Pincode : 403507, Email : sumukh@goainstruments.com,
95	TEMPERATURE GAUGE	FORBES MARSHALL (HYD) LTD.	MR SAILESH PATALAY/MR. M K SRINIVASAN PLOT NO.A-19/2, & T-4/2, IDA, NACHARAM, HYDERABAD-TELANGANA-INDIA Phone- 9849913704 Pincode : 500 076 Email : mksrinivasan@forbesmarshall.com
96	TEMPERATURE GAUGE	H.GURU INDUSTRIES	Mr. G. D. Hazra/Mr. P. K. Mitra 10 B, HO-CHI-MINH SARANI, KOLKATA-WEST BENGAL-INDIA Phone- 033 2282 2463 / 1637 Pincode : 700071 Email : mquru@vsnl.net
97	TEMPERATURE GAUGE	GOA THERMOSTATIC INSTRUMENTS PVT.LTD.	FLAT -B , GF, HILL CROWN APTS., COLLEGE ROAD, MAPUSA-GOA-INDIA Phone- Pincode : 403525 Email : gtilworks@pyro-electric.in

98	TEMPERATURE GAUGE	GAUGE BOURDON INDIA PVT. LTD.	194/195, Gopi Tank Road, Off Pandurang Naik Marg, Mahim Mumbai,-Maharashtra,- India, Phone- 011-41607463, Pincode : 400016, Email : gicdelhi@general-gauges.com,
99	TEMPERATURE GAUGE	H.GURU INSTRUMENTS (SOUTH INDIA) P. LTD	32,INDUSTRIAL SUBURB YESWANTHAPUR BANGALORE-KARNATAKA- www.hgurusouth.com Phone- 080-23370300, Pincode : 560022 Email : info@hgurusouth.com
100	TEMPERATURE GAUGE	A.N. INSTRUMENTS PVT. LTD.	MARKETING DIVISION, 5th FLOOR, 59-B, CHOWRINGHEE ROAD, KOLKATA-WEST BENGAL-INDIA Phone- 24757784,22472509 Pincode : 700020 Email : anidel@bol.net.in
101	TEMPERATURE GAUGE	PRECISION MASS PRODUCTS PVT. LTD.	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol-Gujarat,- INDIA Phone- 9999464663 Pincode : 382729 Email : sales@precisionmass.com
102	TEMPERATURE SWITCH	DRESSER INDUSTRIES INC.	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol-Gujarat-India Phone- 02764-233682 Pincode : 382729 Email : Nishit.patel@ashcroftindia.com
103	TEMPERATURE SWITCH	INDFOS (INDIA) LIMITED	MR.L.C.VENKATRANGAN/MR.B.KANNAN New No.17, II Floor, Adwave Towers, Dr.Sevalia Shivaji Salai, T.Nagar Chennai-TamilNadu-INDIA Phone- +91 44 24353407 Pincode : 600017 Email : delhi@indfos.com
104	TEMPERATURE SWITCH	TOSHNIWAL BROTHERS PVT.LTD.	WORKS:TOSHNIWAL IND.PVT.LTD, INDUSTRIAL ESTATE MAKHUPURA, AJMER- RAJASTHAN-INDIA Phone- 441171 Pincode : 305002 Email : toshniwalprocess@gmail.com
105	TEMPERATURE SWITCH	SWITZER PROCESS INSTRUMENTS PVT. LTD.	Mr. V S Jayaprakash, 128, SIDCO North Phase, Ambattur Estates CHENNAI-TAMIL NADU-INDIA Phone- 044-26252017/2018 Pincode : 600050 Email : sales@switzerprocess.co.in
106	TEMPERATURE SWITCH	SOR INC.	LARRY DEGARMO/Avdhesh Chandra, 14685 W. 105TH STREET LENEXA-KANSAS- USA Phone- 09810905139, Pincode : 66215 Email : Ldegarmo@sorinc.com, avdhesh@sherman-india.com,
107	TRANSMITTERS	SMART INSTRUMENTS LTD, BRAZIL	Agents: Digital Electronic Ltd. 74/11 'C' Cross Road MIDC Andheri (East) MUMBAI- MAHARASHTRA-INDIA Phone- 28208477 Pincode : 400093 Email : corp@delbby.rpgms.ems.vsnl.net.in
108	TRANSMITTERS	SBEM PVT. LTD.	MR.N.K. BEDARKAR/MR. VISHWANATH KARANDIK 39, ELECTRONIC CO.OP. ESTATE, PUNE SATARA ROAD PUNE,-MAHARASHTRA-INDIA Phone- 912041030100 Pincode : 411009 Email : newdelhi@sbem.co.in
109	TRANSMITTERS	Honeywell Automation India Limited	Mr. Ritwij Kulkarni 917, INTERNATIONAL TRADE TOWER, NEHRU PLACE, NEW DELHI-DELHI-INDIA Phone- 9890200584 Pincode : 110019 Email : rajesh.chaudhary@honeywell.com
110	TRANSMITTERS	TOSHNIWAL INDUSTRIES PVT. LTD.,	Industrial Estate, Makhupura, Ajmer,-Rajasthan,-India, Phone- 9352009000, Pincode : 305002, Email : info@tipl.com,
111	TRANSMITTERS	V. AUTOMAT & INTRUMENTS (P) LTD.	Mr. R. K. BASSI/Mr. PRAVEEN KUMAR F-61, OKHLA INDL.AREA, PH-1 NEW DELHI-DELHI-INDIA Phone- 9810005826 Pincode : 110 020 Email : sales@vautomat.com
112	TRANSMITTERS	Pune Techtrol Pvt. Ltd.	N.P.Khatan/Sudhakar Badiger S-18, MIDC Bhosari, Pune-Maharashtra-INDIA Phone- 9850560042 Pincode : 411 026 Email : ho@punetechtrol.com
113	TRANSMITTERS	PANAM ENGINEERS	Mr. Santosh Shukla 203, Jaisingh Business,Parsiwada, Sahar road,Andheri(East), Mumbai,-Maharashtra,-India, Phone- 9892179529, Pincode : 400099, Email : santosh@panamengineers.com,
114	TRANSMITTERS	NIVO CONTROLS PVT. LTD.	Mr. Praveen Toshniwal 104-115, Electronic Complex, Indore-M.P.-India Phone- 0731-4081305 Pincode : 452010 Email : sales@nivocontrols.com
115	TRANSMITTERS	SIEMENS LIMITED	Dr. Armin Bruck/Sandeep Mathur 130, Pandurang Budhkar Marg Worli Mumbai- Maharashtra-INDIA Phone- 0124 383 7377 Pincode : 400018 Email : ankit.varshney@siemens.com
116	TRANSMITTERS	EMERSON PROCESS MANAGEMENT (INDIA) PVT.LTD.	Mr. Amit Paithankar/Vikram Raj Singh 206-210,BALARAMA BUILDING 2ND FLR. BANDRA EAST MUMBAI-MAHARASHTRA-INDIA Phone- 9619121500 Pincode : 400051 Email : vikramraj.singh@emerson.com
117	TRANSMITTERS	Moore Industries International Inc.	Leonard.W. Moore/ Matt Moren 16650 Schoenborn St. North Hills-CALIFORNIA-USA Phone- +1 818 830 5548 Pincode : 91343 Email : mmoren@miinet.com
118	TRANSMITTERS	ABB INDIA LIMITED	MR. RAJIV GOVIL 14, MATHURA ROAD, FARIDABAD-HARYANA-INDIA Phone- 09971085678 Pincode : 121003 Email : vipin.swami@in.abb.com
119	TRANSMITTERS	Endress + Hauser (India) Pvt. Ltd.,	Mr. Prakash Vaghela 215-216, DLF Tower 'A', Jasola District Centre, New Delhi,-New Delhi,-India, Phone- 9717593001, Pincode : 110025, Email : prakash.vaghela@in.endress.com,
120	TRANSMITTERS	YOKOGAWA INDIA LIMITED,	PLOT NO.96, ELECTRONICS CITY COMPLEX, HOSUR ROAD, BANGALORE,- KARNATAKA,-INDIA, Phone- 080-41586000, Pincode : Email : uday.shankar@in.yokogawa.com,

Note:

1) Sub-Vendor List is subject to end user approval.

2) New Sub-Vendor if proposed by Vendor during contract stage shall subject to end user approval.



Mandatory Spares

4X111 MW VISHNUGAD HEP

MANDATORY SPARES

8.35 SPARES:-

Mandatory Spares:- Mandatory spares considered being sufficient for successful operation and maintenance of equipment for a period of 5 years, are listed below:

1.	Data storage drives of each type/model used	01 No
2.	Time synchronizing network cable with connectors	01 No.
3.	Power supply modules/unit and I/O	04 sets of each type
4.	Network interface cards of type/ model used	04 sets of each type
5.	Other Plug in cards type/model used	04 sets of each type
6.	Operator Workstation complete with all accessories	1 No.
7.	Modem of type for every 10 or less installed.	01 sets of each type
8.	Repeater of type/model used	02 sets of each type
9.	Optical fiber coupling unit	10 % of installed
10.	Connectors, patch chords head etc. of type/model used	10 % of installed
11.	Networking components	01 set of each type
12.	Recorders of type/model used	01 set of each type
13.	Synchronizing device with all accessories	01 set of each type
14.	HMI	02 sets of each type
15.	Measuring transmitter of type/model used	02 sets of each type
16.	Sensors/transducers of type and model used	02 sets of each type
17.	Indicating instruments of type/model used	02 sets of each type

18.	Relays of type/model used	02 sets of each type
19.	Router/gateway with necessary firewall functionality	01 No. of each type
20.	Optical Fiber consumables requirement for 2 years for all networks	01 set of each type
21.	Programmable controller of type	02 sets of each type
22.	Splicing kit for fiber optic cables	01 No.
23.	Indicating Instruments	01 set of each type
24.	Control Switch, Selector Switches, Push Buttons, Indicating	20 % of each type
25.	Bulbs for indicating lamps	20 % of each type
26.	Heating resistor for thermostat for cubicle heater	02 sets of each type
27.	Operator Key board	One
28.	Terminals of each type	200
29.	Fuses of each type	200 each type
30.	Preloaded Engineering station	1 set
31.	Large screen display cube	1 No.

The bidder may review the above spares and may add the spares, which are essential

ally required for the satisfactory operation & maintenance of the equipment. The Bidder shall accordingly quote the itemized price of these spares in the price Schedule.

Recommended Spares

The bidder may recommend the spares in addition to the mandatory spares, the itemized prices of the spares shall be quoted in price Schedule.

8.37 WARRANTY: -

Warranty of the complete system including hardware & software shall be minimum 2 years from the date of handing over the system to the owner. It shall cover total maintenance of all hardware & software problems including software upgradations, if any and shall include free repair /replacement of spares /cards/modules/peripherals/cable components etc.

Any such spares shall not be counted as part of the schedule of spares to be provided. The fault shall be addressed within 48 hrs of reporting.

After handing over the complete system to owner, the Contractor shall post a system expert at site for at least 6 (six) months as a part of warranty.

8.38 Annual Maintenance Contract (AMC):

The Contractor shall provide maintenance services of complete Control & ~~SCADA~~ system under a comprehensive Annual Maintenance Contract (AMC) for period of three years after warranty period. Employer shall have the option of not renewing the AMC after end of each of first two years after giving a notice of one month.

The AMC shall cover total maintenance of all hardware & software problems under the scope of work and shall include free repair/replacement of cards Modules/peripherals/cables components etc., correction of system problems and supply of expendable items. The Contractor shall ensure better than 99.5% availability (failed redundant parts of the system will not be counted) of the system with the AMC.

Further, Contractor may note that during the AMC he will be allowed to use Employer's mandatory spares and has to replenish the same with three months time or before completion of AMC period whichever is earlier. However, if in the opinion of the Contractor, more spares than those included in the mandatory spare list are required to meet the availability requirement then Contractor shall stock the same.

The contractor shall prepare detailed list of faults corrected and parts, expendables utilized during AMC period and shall furnish the same to employer, properly documented at the end of AMC period. Further, during AMC period the details as required by Employer/Project Manager shall be made available by Contractor's personnel.

~~8.39 REMOTE SERVICE CENTRE FOR SCADA:-~~

~~Contractor shall provide the necessary hardware & software required for connecting the SCADA system to contractor's remote service centre, through which the diagnostics & fault analysis of the SCADA system can be carried out. The method of connection shall be as per contractor's standard practice. However it is preferred to have a connection through a single point in the plant's SCADA system. Any~~



**4x111MW VISHNUGAD PIPALKOTI HEP
HVAC
STANDARD TECHNICAL
SPECIFICATIONS**

SPECIFICATION No: PE-TS-413-571-11000A-A001

SECTION : I

SUB-SECTION : D

REV. 00

DATE: JAN 2020

SECTION: I

SUB-SECTION: D

STANDARD TECHNICAL SPECIFICATIONS



TITLE

AIR HANDLING UNIT
DATA SHEET - A

SPECIFICATION NO. PE-TS-413-571-11000-A001.

VOLUME - II-B

SECTION - D

REV 00

DATE JAN 2020

SHEET 1 OF 2

DESCRIPTION**DATA**

- | | |
|--|--|
| 1. Nos. required/working | : Refer to Section-C of Specific technical requirement. |
| 2. Location | : Refer to Section-C of Specific technical requirement. |
| 3. Service/type | : Ventilation /Double skin. |
| 4. Fan type | : Centrifugal (forward/backward curve Blade) limit load. |
| a) Capacity | : To Suit as per calculation. |
| b) Static pressure | : To suit but not less than 100 mm wc for AHU's with pre filters. |
| c) Discharge direction | : To suit layout. |
| d) Motor | : By Bidder, |
| e) Local push button station (Start/Stop) | : By Others |
| f) Motor location | : Inside AHU Casing. |
| g) Drive | : Belt, pulley, belt guard. |
| 5. Face and Bypass Damper | : Not Required |
| 6. Cooling coil | |
| a) Duty sensible heat | : To suit as per calculations |
| b) Duty latent heat | : -do- |
| c) Type of coil | : Cooling Water. |
| d) No. of rows | : To suit but not less than four (4) |
| e) Material of tube /Thickness | : Seamless Copper to ASTM E-75/Equivalent. |
| f) Material of fins | : Aluminium to SAE-1100-/1145-0 |
| g) Number of fins | : Not greater than 5 per cm (13 per inch). |
| h) Max. face velocity | : 2.5 m/sec. |
| i) Air flow quantity | : To suit as per tender drawings/documents. |
| 7. 3 - way motorised mixing valve with thermostat. | : Required with thermostat & actuator for cooling water system for each AHU. |

	TITLE	AIR HANDLING UNIT <u>DATA SHEET - A</u>	SPECIFICATION NO. PE-TS-413-571-11000-A001.	
			VOLUME - II-B	
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8. Damper at discharge	: Manually operated at discharge of each AHU outlet.			
a) Material of construction	: Mild Steel, galvanised.			
9. Filters				
a) Type & thickness	: Dry panel type/ 50 mm			
b) Filter area. as specied in section-c.	: To suit as per velocity requirements. "V" – Bank-			
c) Filter efficiency 20micron	: Average arrestance efficiency of 80 % down to			
d) Press drop (Clean)	: Not to exceed 2.5 mmwc when clean & 6.5 mmwc while dirty.			
10. Humidification section	: As per the System requirement.			
a) Type	: Pan type, unless otherwise specified.			
b) Operation	: Automatic with Humidification.			
11. Fresh air arrangement	: Required.			
a) Fresh air fan	: Tube axial flow fans with motor.			
b) Accessories	: i) Inlet cone with Bird screen. : ii) Dry panel pre-filters, : iii) High efficiency filters for control room areas. : iv) Volume Control Dampers, : v) Supports etc.			
12. Vibration isolator required.	: Yes			
13. Type of vibration isolator.	: Neoprene ribbed Rubber for AHU's.			
14. Any other requirement	: i) In addition to dry panel filters on AHU, High efficiency filters (average arrestance efficiency of 80-90 %) shall be provided in supply air duct side of AHU for all power house and transformer cavern and allied areas. : ii) Bidder to also provide suitable electrical strip heaters for winter heating & monsoon reheating with Contactor box etc. Heaters to be interlocked with astat.			
15. Instrument & controls	: Lot.(including Control box for strip heaters, pan humidifiers etc. in each AHU room.)			



TITLE

AIR HANDLING UNIT
DATA SHEET - A

SPECIFICATION NO. PE-TS-413-571-11000-A001.

VOLUME - II-B

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SHEET 3 OF 2

16. Insulation of drain piping : Lot.



TECHNICAL SPECIFICATION

AIR HANDLING UNITS

SPECIFICATION NO. PES- 571-11000-A002

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SECTION-D

AIR HANDLING UNITS

	TECHNICAL SPECIFICATION AIR HANDLING UNITS	SPECIFICATION NO.PES- 571-11000-A002	
		VOLUME II B	
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		SHEET 2 OF 5	

1.

GENERAL

1.1

This specification covers the design, manufacture, Construction features, installation, commissioning, inspection and performance testing at site of AHUs.

2.

CODES AND STANDARDS

2.1

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

2.1.1

IS-659 : Safety code for air conditioning

2.1.2

IS-660 : Safety code for mechanical refrigeration

2.1.3

ASHRAE : Method of testing forced circulation air-cooling and air heating coils. standard 33

2.1.4

ARI 41 : Standard for forced circulation air cooling and air heating coils.

2.1.5

ARI 430/435 : Air-cooling and air heating coils Central Station AHU / Application of Central Station AHU.

2.1.6

AMCA : 211 and 311

In case of any conflict in the standards and this specification the decision of PEM,BHEL shall be final and binding.

3.

CONSTRUCTION FEATURES

3.1

The casing of AHU shall be made of insulated double wall construction of min. 24 gauge galvanized sheet steel - IS 277 Gr. 120 (parent sheet: D/DD-IS-513) ribbed and reinforced for structural strength and rigidity with 25 mm thick polyurethane insulation of minimum 40 kg/m³ density in between. The external wall will be pre-plasticised over GI coating on the outside. Angle irons or channel sections made of 16 gauge galvanized sheet steel shall be used for reinforcing. The casing shall be of sectionalized construction with proper sealing at the joints to make them air tight. Fan section and panels with bearing support shall be reinforced with heavy gauge channels (min. 5 mm thick). Suitable number of forged hot dip galvanized (610 gm/sq.m) U brackets shall be provided for AHU suspended from ceiling/roof.

Necessary arrangement shall be provided on the casing for measuring temperature and pressure in cooling/heating coil. Class of instruments shall be min. 2.

3.2

Fan impeller shall be forwardly/backwardly inclined curved blade centrifugal type. Impeller shall be double width double inlet type. Fans shall be preferably low rpm (<=1500) to minimize vibration and noise. Noise shall be within 85 dB(A) at 1 metre distance from AHU casing. Max. Vibration level shall be acceptance and norms to be specified. Two to three wheels (impellers) shall be provided for each AHU. Impeller blades shall be fabricated from (min. 1.0 mm) galvanized/ epoxy powder coated sheet steel. Fan shall be of epoxy powder coated / galvanized sheet steel (min. 1.6 mm) scroll with die formed inlets for uniform air flow. Fan shafts shall be solid cold rolled carbon steel (EN8 normalised), ground and polished. Fan shaft bearings shall be of heavy duty type selected for average operating life of 100,00 hours. Bearings shall be self-aligning, permanently lubricated type. Make of Brgs(SKF/FAG/NORMA/TATA) to be specified. Bearing Housing shall be of casting of min. IS Gr. 210, split type and

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suitably supported. The V-belt drive with belt guard shall be provided. Motors shall have minimum 15% margin over maximum BHP in working range.			
3.3	Cooling water cooling coils and steam/hot water coils shall be internally corrugated copper/ cupronickel tubes (as per manufacturer's standard) with smooth non corrugated external fins of aluminium (thickness 0.14 mm and grade 1100 as per spec) unless specified otherwise in specification. At least 5 fins /per cm. shall be provided. The cooling water coils shall have suitable (standardize class, size, threading) drain and vent connections.		
3.4	The filters in the filter section shall be provided as detailed in data sheet A.		
3.5	Humidifier shall be Pan type/as specified in the specification. Pan type Humidifier consisting of SS304/316 tank, heater, geyserstat with piping connection to supply air duct shall be provided unless specified otherwise in data sheet A. Heaters and branch line shall be of galvanized steel and nozzles shall be of brass (matl. grade) /SS 304.		
3.6	Condenser water from coil or surplus water from spray humidifier shall be collected in 16 gauge SS-304 pan. Minimum 50mm dia GI pipe nipple shall be provided on each end for drain connection. The drains for these points shall be extended to the main drain in AHU room. Condensate drain pipe (GI) of required length with sealing loop shall be provided and insulated as specified in the specification for insulation. Minimum requirement For GI Pipes and fittings shall be ERW/Seamless of medium thickness as per IS-1239/3589 and Hot dip galvanized		
3.7	Suitable number of Spring type vibration isolators shall be provided for fan and motor assembly. Neoprene rubber pads shall be provided below the AHU. The AHU shall be provided with 18 G SS drain pan.		

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4. TESTING AND INSPECTION AT MANUFACTURERS WORKS:

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

- 4.1 Visual inspection of GI sheets and angles, channels etc. – dents, black spots, chipping of zinc coating, white dust on galvanised sheets shall be avoided. Pitting , lamination in angles and channels shall be avoided.
- 4.2 Galvanised sheets - Test certificate shall be furnished for visual check, coating thickness, adhesion test, sheet thickness, uniformity of coating. For pipes and fittings compliance report shall be furnished by Manufacturer for visual check, coating thickness, adhesion test, sheet thickness, uniformity of coating.
- 4.3 Shaft: Mechanical and chemical.
- 4.4 Motors (of approved make): Routine TC.
- 4.5 Workmanship and dimensional check as per manufacturing drg. and approved Drgs.
- 4.6 Balancing of impellers- Dynamic balancing certificates shall be furnished –grade 6.3 or better to ISO-1940. Balancing weights shall be positively locked to avoid loosening. Balancing weights and fasteners used shall be galvanized.
- 4.7 Performance test of one Centrifugal fan/per type/per size as per AMCA standard (for indigenous make).
- 4.8 Centrifugal fans for AHUs will be 100% run tested by main contractor of BHEL. One centrifugal fan/per type/per size will be run tested. Vibration shall be within good zone of VDI 2056 / ISO 10816-1(group- K) machines when measured on bearing housing and noise level <85 dbA at 1 metre distance. Max. Temp. on bearing housing- 40 degrees Centigrade + ambient.
- 4.9 Complete assembly of one AHU/per type/ per size (excluding cooling coil and filter) shall be witnessed.
- 4.10 Run test of one complete assembly/per type/per size (excluding cooling coil and filter). Vibration shall be within satisfactory zone of VDI 2056 / ISO 10816-1(group- K) machines when measured on bearing housing and noise level <85 dbA at 1 metre distance. Max. Temp. on bearing housing- 40 degrees Centigrade + ambient.

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5. <u>DRAWINGS/DOCUMENT/DATA REQUIRED AFTER AWARD OF CONTRACT</u>			
5.1	GA drawing of AHU & data- sheet to be submitted along with technical schedules enclosed in Volume III.		
5.2	Drawing including equipment layout, foundation & loading details etc. for civil works. These drawings must cover sufficient details so that design of civil works can be completed.		
5.3	Inspection, operation & Maintenance Manuals.		
5.4	Equipment description giving complete design calculations, basis of design, selection criteria etc.		
5.5	Test Certificates.		
5.6	Final as built documentation i.e. final-version of all drawings, data & information as per the requirement specified elsewhere.		
5.7	Performance Test Certificates.		



TITLE

CENTRIFUGAL PUMPS
DATA SHEET - A

SPECIFICATION NO. PE-TS-413-571-11000-A004.

VOLUME II-B

SECTION D

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SHEET 1 OF 2

DESCRIPTION**DATA**

- | | |
|---|---|
| 1. Designation | : Cooling Water pumps for Ventilation plant. |
| 2. Type | : Horizontal, Centrifugal pump or vertical split type casing pump . |
| 3. Quantity | : Refer to section-C of Specific Technical Requirements |
| 4. Installation | : On floating type foundation. |
| 5. Fluid to be handled | : Water |
| 6. Temperature of fluid | : To suit. |
| 7. Capacity M3/hr and TDH at rated | : To suit system requirements but head shall not be less than 25 MWC. |
| 8. Duty | : Continuous (24 hours / day) |
| 9. Suction condition | : Flooded |
| 10. Type of drive | : Direct |
| 11. Prime Mover | : LV AC motor |
| 12. Maximum speed | : 1500 RPM |
| 13. Type of lubrication | : Grease Lubrication |
| 14. Material | |
| a) Impeller Requirements | : Refer to section-C of Specific Technical |
| b) Pump shaft Requirements | : Refer to section-C of Specific Technical |
| c) Casing Requirements | : Refer to section-C of Specific Technical |
| d) Wearing ring Requirements | : Refer to section-C of Specific Technical |
| e) Shaft Sleeve Requirements | : Refer to section-C of Specific Technical |
| f) Base plate | : Refer to section-C of Specific Technical Requirements |
| g) Bolt and nuts. Requirements | : Refer to section-C of Specific Technical |
| h) Stuffing Box gland/bush Requirements | : Refer to section-C of Specific Technical |



TITLE

CENTRIFUGAL PUMPS
DATA SHEET - A

SPECIFICATION NO. PE-TS-413-571-11000-A004.

VOLUME II-B

SECTION D

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i) Stuffing box Packing. : Refer to section-C of Specific Technical Requirements

j) Pump motor coupling. : Refer to section-C of Specific Technical Requirements

15. **ACCESSORIES REQUIRED:-**

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

a) Suction & Discharge pressure gauges. : Yes.

b) Vent connection : Yes.

c) Drain piping up to common drain point in plant room. : Yes

d) Companion flanges. : Yes

e) Common base plate. : Yes.

f) Suction strainer. : Yes

g) Isolating valve : Yes

h) NRV at pump outlet at inlet/outlet : Yes

i) Any special requirements : The Cooling Water pumps shall be suitably insulated as per spec.

j) Inspection & Testing : As per specification enclosed elsewhere.



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SECTION-D
CENTRIFUGAL PUMPS



TECHNICAL SPECIFICATION

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1. GENERAL

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

2. CODES AND STANDARDS

- 2.1 The design, manufacture, inspection, testing & performance of the pumps as specified hereinafter, shall comply with the requirements of the latest revision of the following standards as indicated below (as applicable):
- 2.1.1 IS-1520 : Horizontal centrifugal pumps for clear, cold and fresh water.
 - 2.1.2 IS-5120 : Technical requirements - Rotodynamic special purpose pump.
 - 2.1.3 IS-1710 : Vertical turbine pumps for clear, cold and fresh water.
 - 2.1.4 BS - 599 : Method of testing Pumps.
 - 2.1.5 PTC - '6' : Centrifugal Pumps Power test code
 - 2.1.6 API - 610
 - 2.1.7 Hydraulic Institute Standards of USA

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

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

3. DESIGN REQUIREMENTS

- 3.1 The pumps shall be of heavy duty suitable for long periods of uninterrupted service and shall be standard product of the manufacturer thoroughly proven for satisfactory performance and reliability.
- 3.2 The materials of construction of various components shall be as indicated under Data Sheet-A and where not specified to the applicable Indian/British/American standards..
- 3.3 All pressure containing components including the pump casing, nozzles and stuffing box housing shall be designed, fabricated and tested in accordance with applicable Indian standards if not specified otherwise.
- 3.4 The pump shall be suitable for handling the fluid as specified in Data Sheet-A.

4. CONSTRUCTION FEATURES:

4.1 PUMP CASING

- 4.1.1 Pump casing may be axially or radially split or barrel type construction as specified in the pump data specification sheet. The casing shall be designed to withstand 1.5 times the maximum pressure developed by the pump at the pumping temperature.

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4.1.2	Pump casing shall be provided with adequate number of vent and priming connections with valves, unless the pump is made self venting & priming. Casing drain, as required, shall be provided complete with drain valves or plugged with threaded plugs as required.
4.1.3	Pump shall preferably be of such construction that it is possible to service the internals of the pump without disturbing suction and discharge piping connections.
4.1.4	Under certain conditions, the pump casing nozzles will be subjected to reactions from external piping. Pump design must ensure that the nozzles are capable of withstanding external reactions not less than those specified in API-610
4.2	IMPELLER
4.2.1	Unless specifically indicated under Data Sheet-A enclosed, the pump impellers shall be of closed vane type. The impellers shall be secured to the shaft and shall be retained against circumferential movement by keying, pinning or lock rings. Impellers shall be checked for eccentricity and statically and dynamically balanced individually. The assembled rotor shall be dynamically balanced and checked for eccentricity. Supplier shall ensure during balancing that wall thickness of impeller vane, shroud etc is maintained above the minimum thickness requirement as per design.
4.3	WEARING RING
4.3.1	Renewable wearing rings for the casing and/or the impellers and renewable shaft sleeves, shall be provided for all pumps. Length of the shaft sleeves must extend beyond the outer faces of gland packing or seal and plate so as to distinguish between the leakage between shaft & shaft sleeve and that past the seals/gland.
4.4	SHAFT
4.4.1	Shaft size selected shall take into consideration the critical speed which shall be away from the operating speed as recommended in applicable Code/Standard. The critical speed shall also be at least 10% away from runaway speed.
4.5	BEARING
4.5.1	Bearings and hydraulic devices, of approved make, (if provided for balancing axial thrust) of adequate design shall be furnished for taking the entire pump load arising from all probable conditions of continuous operation throughout its Range of Operation and also at the shut off condition. The bearing shall be designed on the basis of 20,000 working hrs minimum for the load corresponding to the duty point. Proper lubricating arrangement for the bearings shall be provided. The design shall be such that the bearing lubricating element does not contaminate the liquid being pumped. Where there is a possibility of liquid entering the bearing, suitable arrangement in the form of deflectors or otherwise shall be provided ahead of bearing assembly. Bearings shall be easily accessible without disturbing the pump assembly.
4.6	STUFFING BOX
4.6.1	Packed type stuffing boxes of adequate depth with lantern rings shall be provided to minimize the leakage. In all cases where the pump suction is below atmospheric pressure, the shaft packing shall be sealed by the liquid pumped by tapping off from the pump discharge itself and all pipes, valves, fittings etc., required for this shall be furnished by the manufacturer. Tubings used for connections shall be flexible metallic type preferably SS-304/316. PVC/ rubber tubings are not acceptable.



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4.7 SHAFT COUPLING

4.7.1 The pumps shall be directly coupled to their drives through heavy-duty flexible coupling. Suitable sturdy coupling guards of min. 1.5 mm MS sheet/ Aluminium sheet shall be provided along with the coupling. The pump and its drive motor shall be mounted on a common base plate.

4.8 BASE PLATE AND SOLE PLATE

4.8.1 Unless otherwise stated the data specification sheet, a common base plate mounting both for the pump and drive shall be furnished. The base plate shall be of rigid construction, suitably ribbed and reinforced. Base plate and pump supports shall be so constructed and the pumping unit so mounted as to minimize misalignment caused by mechanical forces such as normal piping strain, hydraulic piping thrust, etc. Suitable drain taps and drip lip shall be provided. The external corners of the base plate shall be rounded to avoid sharp corners. Drilled holes shall have sufficient space around for proper seating of washer with nut. If required in the data specification sheet, steel sole plates shall be provided, below the base plate.

4.9 PRIME MOVER

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

4.10 LIFTING ARRANGEMENT

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

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5.

PERFORMANCE REQUIREMENTS

5.1

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

5.2

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

5.3

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

5.4

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

6.

DRIVE RATING

6.1

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

6.2

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

6.3

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

7.

SCOPE OF INSPECTION AND TESTING

7.1

CASTING

7.1.1

The Witnessing pouring and thereafter physical testing of castings of 'Critical' nature such as casings, impellers, diffusers. Castings shall have 'as cast' heat numbers unless they require overall machining. For partially machined components manufacturer shall ensure availability of as cast heat nos. on unmachined area.

7.1.2

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

7.1.3

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

7.1.4

Verification of Heat treatment charts (as applicable)

7.1.5

Castings may be required to meet NDT requirements such as Radiography, Magnetic Particle Testing or Dye-penetrant testing prior to Hydro-test as per requirements specified in Quality Plan.

7.1.6

Surface finish of Steel castings shall meet MSS SP-55.

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7.2	FORGING
7.2.1	Identification and correlation with mill test certificates for all tests as per the relevant specifications for important forgings like casings, stage bodies, diffusers, shaft material.
7.2.2	Verification of heat treatment charts (time temperature) (as applicable).
7.2.3	Forgings may be required to meet NDT requirements such as Radiography, Magnetic Particle Testing or Dye-penetrant testing prior to Hydro-test as per requirements specified in Quality Plan.
7.3	FABRICATED ITEMS
7.3.1	Identification and correlation with mill test certificates for material of items such as discharge bellows, column pipes etc.
7.3.2	Approval of welding procedure specifications and qualifications of weld procedures and personnel as per ASME Sec IX.
7.3.3	Dye penetrant tests of weldment as per ASTM E-165 and acceptance norm as per ASME Sec.VIII, Div.1, Appendix 8
7.3.4	Verification of heat treatment charts (time temperature), (as applicable)
7.3.5	Note: For para 7.1.2, 7.2.1 and 7.3.1 above; in case correlating original test certificates are not available, material shall be identified by Main Vendor and test conducted at NABL approved Laboratory.
7.4	IN PROCESS INSPECTION AND TESTING
7.4.1	Identification Dye penetrant testing after machining for impellers including vanes, pump shaft, diffusers as per applicable code; in absence of which, as per ASTM E - 165. Permissible defects and acceptance norms need to be specified. On static parts acceptance norms are as per ASME Sec.III NB 2546.
7.4.2	Ultrasonic testing of dynamic duty component, i.e. pump shafts (50mm dia and above) and static duty forgings i.e. Barrel, casting (15mm and above wall thickness) as per applicable code, in absence of which as per ASTM E388 and acceptance norms as stipulated hereunder. Probe shall be of min. 2 MHz frequency.
7.4.3	Acceptance norms for UT for dynamic duty components. the following defects are unacceptable a) Cracks, flakes, seams and laps b) Defects giving indications longer than that from a 4mm equivalent flaw. c) Group of defects with maximum indications less than that from a 4mm equivalent flaw, which cannot be separated at testing sensitivity, if the back echo is reduced to less than 50%. d) Defects giving indications of 2 to 4mm dia. equivalent flaw separated by distance less than four times the size of the larger of the adjacent flaw.
7.4.4	For static duty components - as per NB 2542.2 of ASME Sec. III
7.4.5	Hydro tests of all pressure parts such as casings, column pipes, discharge elbows etc., at two times duty point pressure or 1.5 time shut off pressure, whichever is higher for 30 min., without any leakage. Note : In case the pump is required to boost certain pressure, the inlet pressure head shall also be taken into consideration to compute test pressures
7.4.6	Static and dynamic balancing of individual impellers and also assembled rotors as per V.D.I. 2060 Q 6.3 or ISO 1940 G 6.3.

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7.5

PERFORMANCE TEST

7.5.1

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

a) Capacity V/s Head

b) Capacity V/s Power absorbed by pump

c) Capacity V/s pump efficiency

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

7.5.2

NPSH test in case specifically mentioned elsewhere.

7.5.3

Vibration, noise level and temperature rise measurement. Noise level shall be within 85dB(A) at 1 metre distance. Vibration within satisfactory zone of VDI 2056 Group G machines. Temperature shall not exceed ambient + 40 deg. C.

7.5.4

Overall dimensions as per GA drawings. One pump/type/size assembly with job motor shall be mounted on base plate, provided the components are ordered on the same manufacturer.

7.5.5

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

7.5.6

Painting and packing as per technical specification.

7.6

TEST AT SITE

7.6.1

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

7.7

PERFORMANCE GUARANTEE

7.7.1

The vendor shall guarantee the material and workmanship of all components as well as the operation of the pump as per requirement of this specification. The vendor shall also guarantee for each pump the total dynamic head at the specified rated capacity and also corresponding efficiency, brake horse power and shut off head

8.

CLEANING, PROTECTION , PAINTING & PACKING

8.1

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

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9.

DRAWINGS, TECHNICAL DOCUMENTS AND OTHER INFORMATION REQUIRED WITH THE PROPOSAL

9.1

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

a)

Foundation base plate and sole plate details as applicable

b)

Civil foundation and anchor bolts details and loading data

c)

Minimum submergence required for the pump (if applicable)

9.2

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

9.3

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

9.4

Motor speed torque curve superimposed on pump speed torque curve. Required NPSH of pump.

9.5

Experience list about the supply and successful operation of similar pumps for similar application.

9.6

A comprehensive write up or brochure on the details of manufacturing and testing facilities in the shop of the manufacturer.

9.7

Quality plan for the equipment being offered, in BHEL format as practiced in the manufacturer's works and Field Quality Plan for receipt, storage erection, commissioning & testing at site.

9.8

Data sheet-B with all the particulars filled in.

10.

MANUFACTURERS NAME AND TAG. PLATES

10.1

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

a)

Manufacturer's name and trade mark.

b)

Design Capacity and Head.

c)

Design.

d)

Purchaser's tag no. as furnished during the contract. The purchaser's tag no. will be indicated by the Purchaser on the drawing submitted for approval by the vendor.

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



TITLE

LOW PRESSURE AIR DISTRIBUTION SYSTEM**DATA SHEET - A**

SPECIFICATION NO. PE-TS-413-571-11000-A007

VOLUME II-B

SECTION D

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Description**Data**

- | | |
|----------------------------------|---|
| 1. General (List of areas) | : As per Specification/Tender drawing. |
| 2. GSS Duct Work | |
| a) Type | : GSS as per IS: 277
(Zinc coating as per Section-C of Specific Technical Requirements.) |
| b) Size | : As per Section-C of Specific Technical Requirements and bill of quantity. |
| 3. Acoustic lining
AC Outlet. | : Up to 5m length from Ductable split |
| 4. Special painting | : Galvanised. |
| 5. Thermal Insulation | : Required in supply air duct in AC entire length. |
| 6. Diffusers (Circular/Square) | |
| 300 mm size | |
| 350 mm size | |
| 450 mm size | |
| 550 mm size | |
| 600 mm size | |
| Any other size | |
| 7. SA grilles (for each size) | : Bidder to estimate as per drawings./specification.
All grille frame and louvers shall be manufactured of at least 16 SWG Aluminium |
| 8. RA grilles (for each size) | : To suit air flow as per System requirements / Tender Drawings. |
| | : -do- |

NOTE:

- Duct sheet thickness shall be as per IS-655
- Opposed blade type volume control damper shall be provided at each supply air diffusers/grilles.
- Bidder to provide suitable gasketing at each duct flange.
- Fire damper shall be motor operated type, when otherwise specified under Section-C.
- Access door in ducting system shall be provided as required.
- MS Angle (painted) shall be used for duct supports etc.
- Velocity thru duct shall normally not exceed 9.0 M/sec for Air conditioning system and 12 M/sec for Ventilation duct. Maximum velocity (outlet) for supply air diffuser shall not exceed 2.5 m/sec.



TITLE

LOW PRESSURE AIR DISTRIBUTION SYSTEM**DATA SHEET - A**

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8. All Grilles & diffusers shall be supported with frame. Frame etc. shall be supplied by bidder.



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SECTION-D
LOW PRESSURE AIR DISTRIBUTION SYSTEM



TECHNICAL SPECIFICATION
LOW PRESSURE AIR DISTRIBUTION
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1. GENERAL

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

2. CODES AND STANDARDS

- 2.1 The design, construction and performance of complete system shall conform to all currently applicable statutes, regulations, safety codes in the locality where the equipment are to installed
- 2.2 Unless specified otherwise the equipments shall generally conform to latest applicable Indian Standards. Nothing in this specification shall be construed to relieve the vendor of this responsibility. In particular the equipment shall generally conform to latest editions by the following standards:-
- a) IS: 655 - Specifications for metal air ducts.
 - b) IS:277 - Specifications for galvanised steel sheets.
 - c) IS:737 - Specification for wrought aluminium and aluminium alloy sheet and strip.

3. MATERIAL

- 3.1 Metal air ducts shall be either of galvanised steel sheets or aluminium sheets, as indicated in data sheet-A.
- 3.2 The rolled steel sheets before galvanising shall be properly annealed or normalised so as to allow fabrication of ducts without developing cracks. Zinc coating on the steel shall be as per technical requirement refer to Section-C of Specific Technical Requirements.
- 3.3 The aluminium sheets shall be of grade S1C or NS3 and shall be suitable for duct fabrication work as per IS-737 latest

4. CONSTRUCTION/FABRICATION

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

4.2 RECTANGULAR DUCTS

4.2.1

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



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b)	601 to 750	0.63 (24G)	0.80	S-drive, 25mm pocket or 25mm bar slips or flanged joints on 2.5m centres	25x25x3 mm MS angles, 1.2m from joints
c)	751 to 1000	0.80 (22G)	1.00	S-drive, 25mm pocket or 25mm bar slips or flanged joints on 2.5m centres	25x25x3 mm MS angles, 1.2m from joints
d)	1001 to1500	0.80 (22G)	1.00	40x40x3mm MS angle, flanged connections or 40mm pocket or40mm bar slips with 35x3mm bar reinforcing on 2.5m centres	40x40x3 mm MS angles, 1.2m from joints
e)	1501 to2250	1.00 (20G)	1.50	40x40x3mm MS angle, flanged connections or 40mm pocket or40mm bar slips, 1M maximum centres, with 35x3mm bar reinforcing	40x40x3 mm diagonal angles or 40x40x3mm angles, 600mm from joints
f)	2251 & above	1.25 (18G)	1.80	50x50x3mm MS angles,connections or 40mm pocket or 40 mm bar slips, 1M maximum centres with 35x3mm bar reinforcing.	50x50x3mm diagonal angles or 50x50x3mm angles 600 mm from joints.
g)	No bracing is required if transverse joints are less than 600mm apart				
h)	For ducts larger than 2250mm, special handling and supporting methods shall be provided as per the approval of Purchaser				

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



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4.3 ROUND DUCTS

4.3.1

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

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

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

4.4 DUCT SUPPORTS

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

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

4.5 FLEXIBLE CONNECTIONS

Wherever the sheet metal ducts connects to intake or discharge of fan units a flexible connection of at least 150mm width made by closely woven double layer Fire resistant or canvas shall be provided. The same shall be attached to angle iron frames on equipment and to similar frame on duct or casing by means of a steel band 9r (or) collar fitting over the end of the flexible connection and bolted through angle iron frame so as to clamp securely between the band and the angle frame.

4.6 TRANSFORMATIONS AND BREACHES

All curves, bends, offsets and other transformations shall be made for easy and noiseless flow of air. The throat of every branch duct shall be sized to have a velocity not exceeding that in the main duct to which the branch is connected.

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4.7	CAULKING Wherever duct passes through wall, the opening between masonry and duct work shall be neatly caulked or sealed to prevent movement of air from one space to adjoin by space with a rated fire resistant material.		
4.8	EASEMENT Normally pipe hangers, light fitting rods etc. shall not be allowed to pass through the ducts. Wherever, It becomes absolutely essential to pass these hangers/rods etc. Through the ducts, prior approval of purchaser shall be taken and light streamlines easement around the same shall be provided to maintain smooth air flow.		
4.9	ACCESS DOORS Access doors shall be provided in ducts, plenums etc. on both sides to allow access and servicing of equipment viz. pipes, dampers, coils, valves, heaters etc. All access doors shall be adequately sized and lined suitably with felt to prevent air leakage. The doors shall be of built-up construction, structurally strong and shall have at least two hinges each, and shall be with two rust proof window sash locks of approved type. All doors shall be so set as to flush with outer finish of duct insulation etc.		
4.10	DAMPERS AND SPLITTERS		
4.10.1	Dampers and splitters shall be provided at suitable points for proportional volume control of the system. Splitters and dampers shall be made of minimum 18 gauge GSS of quadrant type with locking device mounted outside the duct at accessible location.		
4.10.2	FIRE DAMPERS Fire dampers shall be provided as specified in Data Sheet -A and shall be installed at locations indicated on drawings and/or as required/approved by purchaser, including all openings in passage of duct work through fire walls and floors etc. The fire damper shall be of electrical type with damper motor actuated by thermal sensor or fusible link type.		
4.10.3	VANES Unless otherwise shown in the drawings all elbows shall be such that the throat radius is 75% of the duct width. In case throat radius is smaller, suitable single thickness vanes of approved details shall be provided.		
4.10.4	FLASHING For the ducts penetrating roofs or outside walls, provision of flashing shall be made by the ducting vendor.		
4.11	DIFFUSERS AND GRILLS The type and quantity of diffusers and grills is indicated on enclosed drawings/data sheet A. The size/quantity of diffusers/ grills indicated in the drawing/data sheet is indicative and is for vendor's reference purpose only. Vendor shall ensure that the diffusers/grills offered are of requisite capacity, throw and terminal velocity. The pressure drop and noise levels shall be as per data sheet. A enclosed. The diffusers/grills shall be approved by purchaser. Unless specified otherwise the diffusers/grills shall be of mild steel land painted with two coats of primer paint. Supply air grills shall be complete with volume control dampers. Supply air grills shall be double deflection type while Return Air grills can be		



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LOW PRESSURE AIR DISTRIBUTION
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single deflection type. Ceiling outlets/diffusers shall have volume control dampers, fixed grids and blanking baffles. All volume control dampers shall be operated by a key from the front of grills/diffusers.

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

4.12 PLENUMS AND RA BOXING

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

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

4.13 ACCOUSTIC LINING

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

4.14 PAINTING

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

4.15 THERMAL INSULATION

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

5. INSPECTION AND TESTING

5.1 INSPECTION & TESTING DURING FABRICATION

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

5.1.2 Galvanised sheets - Test certificate shall be furnished for visual check, coating thickness, adhesion test, sheet thickness, uniformity of coating.

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

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

5.1.5 Bend test & wrapping test as per IS-277.

5.1.6 Zinc coating test on samples as per IS-6745.

5.2 INSPECTION & TESTING AT SITE.

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

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



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6. BALANCING

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



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7. DATA TO BE FURNISHED BY VENDOR AFTER THE AWARD OF CONTRACT

- 7.1 Fabrication drawings of ducts and grilles, louvers, dampers, etc, including typical details of grilles dampers etc.
- 7.2 Test certificates in line with scope of inspection.
- 7.3 Other dimensional drawings & documents as may be required by purchaser for better understanding of the system & for preparation of operation, maintenance & instruction manual.



TITLE

AIR FILTER
DATA SHEET - A

SPECIFICATION NO. PE-TS-407-571-11000-A006

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DESCRIPTION**DATA****1) General**

- | | |
|------------------------------|--|
| 1.1 Service | : Air Conditioning & Ventilation. |
| 1.2 Location | : Ventilation plant, & Ductable Split AC plant, fresh air fan system. Also for split AC. |
| 1.3 Nos. | : Refer Section 'C' of Specification. |
| 1.4 Total air flow/type | : Refer Section 'C' of Specification. |
| 1.5 Temperature | : As per project information. |
| 1.6 Relative Humidity | : 100% |
| 1.7 Gas Composition | : Atmospheric Air (Dusty) as prevalent in power Station. |
| 1.8 Filter Media | : Synthetic non-woven |
| 1.9 Efficiency | : Average arrestance efficiency of 65-80 % for Dry Panel filter (pre-filters) and average arrestance Efficiency of 80 % down to 20 micron for filters. |
| 1.10 Allowable pressure drop | : 2.5 mm & 6.5 mm in clean and dirty condition respectively for dry panel filters(prefilters). 12 mm in clean condition for fine filters. |
| 1.11 Frame Work | : 18 G, GSS. |
| 1.12 Mounting | : Ladder Type M.S Angles (galvanised) |
| 1.13 Size | : 600 x 600 mm |

Note:-

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



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AIR FILTER

SPECIFICATION NO. PES- 571-11000-A006

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SECTION-D

AIR FILTER



TECHNICAL SPECIFICATION

AIR FILTER

SPECIFICATION NO. PES- 571-11000-A006

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1. GENERAL

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

2. CODES AND STANDARDS

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

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

3. GENERAL

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

3.1 POLY FIBRE AIR FILTERS

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

3.2 DRY FABRIC AIR FILTERS

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

3.3 PANEL TYPE METALLIC FILTERS (DRY/VISCOUS)

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

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

3.4 AUTOMATIC CLEANING FILTERS

This shall consist of a filter mat and drop eliminator, driven by a suitably rated geared



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AIR FILTER

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motor unit being supported on a steel framework. The filter mat shall consist of an endless steel wire mat insets of steel mesh held between an upper & a lower shall drop eliminator shall consist of an endless steel wire without insets of steel mesh. The unit shall include a suitable oil pump, gludge raking mechanism and sludge container and tensioning device. Pressure drop shall be limited to 0.5 / mm WG when clean & 10 mm when dirty. Air velocity across filter shall not exceed 3 M/sec.

3.5 ABSOLUTE FILTERS

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

3.6 WATER REPELLANT NYLON FILTERS

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

4. INSPECTION & TESTING

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

4.1 Dimensional inspection of frame & filter media.

4.2 Witnessing of type tests on one per type per size air filters for the following properties.

- Gravimetric efficiency.
- Pressure drop in clean & dirty (choked - %age to be specified) condition.
- Efficiency as per BS EN - 779.

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



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AIR FILTER

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5. DATA TO BE FURNISHED BY VENDOR AFTER AWARD OF CONTRACT

- 5.1 GA Drawing.
- 5.2 Drawing showing material/construction detail
- 5.3 Installation and\service manual
- 5.4 Rating curves/charts
- 5.5 Test certificates
- 5.6 Elect. diagrams (when automatic cleaning type)

	TITLE CENTRIFUGAL FAN <u>DATA SHEET - A</u>	SPECIFICATION NO. PE-TS-413-571-11000-A009	
		VOLUME II-B	
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<u>No.</u>	<u>Particulars</u>	<u>Data</u>	
1	<u>General Information</u>		
1.1	Fan Designation/application.	Refer schedule of Ventilation system.	
1.2	Nos. required/capacity	Refer Section-C of Specific Technical Requirement	
1.3	Location	Refer layout drg. Attached.	
2.0	<u>Design Data</u>		
2.1	Type	DIDW for Ventilation	
2.2	Type of blades	backward curved	
2.3	Arrangement	To suit application as per layout.	
2.4	Discharge direction	To suit application as per layout.	
2.5	Duty	Continuous	
2.6	Capacity at site (Cubic Meter/hr) & static pressure.	Refer Section-C of Specific Technical Requirement	
2.7	Suction pressure (mm Wg)	As per system requirement.	
2.8	Fluid	Atmospheric Air.	
2.9	Suction Temperature	Refer weather data attached.	
2.10	Suction humidity	Refer weather data attached.	
3.0	<u>Materials</u>		
3.1	Fan Scroll	Heavy Gauge Mild Steet to IS: 2062 with galvanised	
3.2	Fan Casing (side plates & stiffeners)	Heavy Gauge Mild Steet to IS: 2062 / IS: 1079 / Eq. Minimum 3 mm thick casing.	
3.3	Impeller	Mild Steel/plate to IS: 2062	
3.4	Impeller hub	Mild Steet/plate to IS: 2062	
3.5	Impeller back plate blade & shroud	Mild Steet to IS: 2062 / IS: 1079 / Eq.	
3.6	a) Shaft b) Shaft sleeve	EN-8 or eqv. -do-	
3.7	Support frame and structure.	Mild Steet to IS: 2062	
3.8	Flexible connection at outlet canvas with MS Flanges and cleats (3mm thick).	Fire resistant type plastic impregnated	

	TITLE CENTRIFUGAL FAN <u>DATA SHEET - A</u>	SPECIFICATION NO. PE-TS-413-571-11000-A009	
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3.9	V Belt	ISI marked (Reinforced rubber section to IS: 4776)	
3.10	V Pulley	Cast Iron multi groove to grade FG 20 as per IS: 210. Having taper lock type	
3.11	Slide rails	M.S./C.I.	
3.12	Connection pieces	G.I. according to supplier’s design	
3.13	Bolts & nuts	M.S. Galvanized / Epoxy painted.	
3.14	Vibration isolating pads, washers and spring if any.	Hard synthetic rubber	
4.0	<u>ACCESSORIES</u>		
4.1	Common base plate	Required.	
4.2	Anchor bolts	-do-	
4.3	Vibration Isolators	Hard synthetic rubber	
4.4	V-belt pulleys	-do-	
4.5	V-belts	Reinforced rubber of appropriate section	
4.6	Belt guard	Required.	
4.7	Outlet damper	Required(M.S. Heavy Gauge)	
4.8	Inlet guard	Required.	
4.9	Inlet Vane (variable)	Not required.	
4.10	Drain valve	Required.	
4.11	Acoustic silencers	Not required.	
5.0	<u>Motor</u>		
5.1	Motor by	Bidder	
5.2	Starter by	BHEL	
6.0	Painting of fans including base frame	Galvanized / epoxy painting (as per Section-C & painting specifications)	
<u>NOTE:</u>			
1) Motors shall have 15 % margin on duty power point.			
2) Fan shall be designed to operate with in 9% and 25% of system throttling line.			
3) Opposed Multiple louvers damper shall be provided at fan outlet.Louvres shall be of 2 mm thick MS (galvanized). Casing shall be of 3.15 mm thick MS (galvanized).			

	TITLE Ventilation Fan (Axial Flow Type) <u>DATA SHEET - A</u>	SPECIFICATION NO. PE-TS-413- 571-11000-A001	
		VOLUME II-B	
		SECTION D	
		REV 00	JAN 2020
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No.	Particulars	Data	
	<u>General Information</u>		
1)	Designation	Supply/Exhaust Fans.	
2)	Nos. required	Refer schedule of Ventilation system in section-C under specific technical requirement.	
3)	Service	To exhaust warm air/to supply fresh air.	
4)	Location	Wall mounted.	
5)	Area	Same as above in 2.	
	<u>Design Data</u>		
6)	Type supply	Axial fans suitable for 415V/3 phase for Motor.	
7)	Air delivery capacity	As per schedule of ventilation system.	
8)	Fluid	Atmospheric Air.	
9)	Temperature	Refer Section of specific technical requirement	
10)	Static Pressure required	As per Section 'C' schedule of ventilation system.	
11)	Outlet Air Velocity	Not more than 12 m/sec.	
	<u>Materials</u>		
12)	Casing	M.S. (IS-2062)	
13)	Impeller	Cast Aluminium. (Alloy A-6M, IS-617)	
14)	Hub	Al Alloy.	
15)	Support frame and structure.	M.S. of adequate thickness (Galvanized/ Painted) IS-2062.	
16)	Neoprene rubber pads	As required.	
17)	Coned inlet for wall exhausters/supply fans	MS (IS-2062)	
18)	Supporting frame for mounting.	Required.	
19)	Protective screen at inlet.	Yes (Min 14 SWG Galvanized wire knitted in 1" square mesh.	
20)	Rain Protection Cowl	Aluminum or hot dip Galvanized after fabrication from M.S.	



TITLE

Ventilation Fan (Axial Flow Type)**DATA SHEET - A**

SPECIFICATION NO. PE-TS-413- 571-11000-A001

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Motor

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

NOTE:

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



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VENTILATION FANS

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SECTION-D

VENTILATION FANS



TECHNICAL SPECIFICATION

VENTILATION FANS

SPECIFICATION NO.PES-554-03

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1. GENERAL

This specification covers the design, manufacture, testing of performance at manufacturer's/sub-contractors works, delivery at site, handling at site, erection and commissioning of ventilation fans.

2. CODE AND STANDARDS

The design, manufacture and performance of equipment shall comply with all currently applicable statutes, regulations and safety codes in the locality where it is to be installed. The equipment shall conform to latest edition of applicable Indian Standards or their equivalent standards. Nothing in this specification shall be construed to relieve the vendor of this responsibility. In particular the equipment shall conform to the latest editions of the Following standards.

- 2.1.1 IS:4894 -Centrifugal fans
- 2.1.2 IS:3588 -Electric Axial Flow fans
- 2.1.3 IS:2312 -Propeller type A.C. ventilation fans
- 2.1.4 IS-3963 -Roof extractor units
- 2.1.5 BS:848 -Method of performance test for fans.
- 2.1.6 AMCA publication 99 standards handbook
- 2.1.7 AMCA standard 210, Test code for air moving devices.

3. DESIGN AND CONSTRUCTION

3.1 THE ENCLOSED DATA SHEET A GIVES THE NECESSARY DETAILS FOR CENTRIFUGAL/AXIAL/ROOF EXTRACTOR UNITS ETC.

3.2 WELDING PROCESS AND WELDERS EMPLOYED FOR FABRICATION SHALL BE QUALIFIED AS PER ASME SEC. IX

3.3 CASING

3.3.1 The centrifugal fans casing shall be of welded construction fabricated with heavy gauge material (min 3 mm) with flanges (min. 5 mm) on inlet and out let side for direct connection and shall be rigidly reinforced and supported by structural angles. The seams shall be permanently sealed airtight. Horizontal Split casings shall be provided on large size fans. Casing drain (at bottom) with threaded plug/ with valve shall be provided, as required. All mounting/ connecting holes shall be drilled off centre.

3.3.2 The axial flow casing for supply fans/roof extractors shall be of heavy gauge construction (min 3 mm) properly reinforced for rigidity and shall be complete with suitable supports. Access doors with suitable locking arrangement shall be provided in the casing for easy access to the motor and impeller. External junction box/ Terminal box on casing with IP-55 protection shall be provided, if required. Wiring for motor from external junction box/ Terminal box shall be through flexible conduit.

3.3.3 Suitable motor brackets designed for rigid mounting of motors, shall be provided for roof extractors and wall mounted exhaust/ supply fans.

3.4 IMPELLER

3.4.1 Centrifugal fan impeller shall have die formed, aerofoil or laminar blades welded to the rim and back plate and shall have non-overloading, self cleaning characteristics. Rim shall be spun to have smooth contour. If required, intermediate stiffening rings



TECHNICAL SPECIFICATION

VENTILATION FANS

SPECIFICATION NO.PES-554-03

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shall be provided. Shaft sleeves shall be furnished, if specified. The impeller, pulley and shaft sleeve shall be secured to the shaft by key and/or nuts (threaded opposite to direction of rotation of impeller). The impeller shall be statically and dynamically balanced.

3.4.2 The axial fan impeller shall be of high efficiency aerofoil design. The blades shall be mounted on a streamlined hub and the impeller shall be mounted directly on the motor shaft. Impeller shall be in one piece however; fabricated blades will be acceptable up to 450 mm impeller diameter.

3.4.3 Roof ventilator impeller may either be centrifugal or axial type. Backward inclined blades shall be provided for centrifugal impellers. Blades may be die-formed or cast. Axial flow impeller shall be directly mounted to motor shaft whereas centrifugal impeller may either be direct-driven or belt-driven. The shaft of belt-driven centrifugal fan shall be solid cold rolled carbon steel, ground and polished. However, direct mounted impellers are preferred.

3.5 BEARINGS:

3.5.1 The centrifugal fan bearing may be ball, roller or sleeve bearings of self-aligning heavy duty type with adequate capacity and life. Make of Bearings to be specified. Bearings shall be oil/grease lubricated and provided with fittings for lubrication from outside and shall be located in easily accessible position to facilitate maintenance.

3.6 INLET CONES AND GUARDS

3.6.1 Centrifugal fans inlet shall be spun to have a smooth contour. Inlet screen, if provided, shall be galvanised wire mesh of 25 mm square with wire thickness of min. 1.5 mm.

3.6.2 Inlet cone, outlet bell and suitably designed guards shall be provided.

3.7 GUIDE VANES:

3.7.1 In case of vane axial fans guide vanes shall be provided on discharge side.

3.8 BASE PLATE AND VIBRATION ISOLATORS

3.8.1 Base plate and vibration isolators, which may be double deflection rubber in shear or rubber in compression type or spring type shall be provided. With each fan rubber bushes, washers wherever needed for vibration isolator in sufficient nos. shall be included, as required, to ensure isolation of foundation from vibration of equipment. For roof ventilators suitable mounting arrangement shall be provided such that there is no ingress of rain water into the building.

3.9 HOOD AND COWL

3.9.1 Roof exhaustors shall be provided with hinge type hood providing easy access to motor and impeller. Weather proof lockable type disconnect switch shall be provided such that hood can open only when the disconnect switch is in 'off' position. On larger size of roof ventilators hoods may be of split construction. 15 mm mesh galvanised bird screen shall be provided.

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

3.10 SPEED

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



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VENTILATION FANS

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4. MOTORS

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

5. ACCESSORIES

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

TESTING AND INSPECTION

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

- Visual inspection of sheets/plates, angles, channels etc. – Pitting, lamination in sheets/ plates, angles and channels shall be avoided.- visual inspection by main contractor of BHEL.
- Sheets/ Plates - Test certificate shall be furnished for physical and chemical properties for sheets / plates- for review by BHEL
- Shaft: Mechanical and chemical— review by BHEL
- Motors (of approved make): Routine TC ,FLP TC if applicable
- Workmanship and dimensional check as per manufacturing drg. and approved Drgs.- by main contractor of BHEL.- Shall be checked by BHEL/ Customer during final inspection.
- Balancing of impellers- Dynamic balancing certificates shall be furnished –grade 6.3 or better to ISO-1940. Balancing weights shall be positively locked/ welded to avoid loosening. - witness by manufacturer - TC to be furnished for review by BHEL(consisting of weight of impeller, radius of correction and balancing rpm). For spare impellers Dynamic Balancing shall be witnessed by BHEL.
- Performance test of one Centrifugal fan or Axial Fan /per type/per size as per applicable standard – by BHEL.
- Centrifugal/ Axial fans 100% run tested by main contractor of BHEL. Run test by BHEL/Customer may be at random or 100%- Vibration shall be within satisfactory zone of VDI 2056 (group- G) machines when measured on bearing housing and noise level <85 dbA at 1 metre distance. Max. Temp. on bearing housing- 40 degrees Centigrade + ambient



**4x111MW VISHNUGAD PIPALKOTI HEP
HVAC SYSTEM
LIST OF MAKES-HVAC**

SPECIFICATION No: PE-TS-413-571-11000A-A001

SECTION : I

SUB-SECTION : E

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**SECTION-I
SUB SECTION E
ANNEXURE-I
LIST OF MAKES-HVAC SYSTEM**



AIR CONDITIONING SYSTEM

LIST OF MAKES OF SUB-VENDOR ITEMS-AS APPLICABLE

LIST OF MAKES OF SUB-VENDOR ITEMS



AIR CONDITIONING SYSTEM

LIST OF MAKES OF SUB-VENDOR ITEMS-AS APPLICABLE

Sl. NO.	ITEM / EQUIPMENT	SUB SUPPLIER
1	SCREW CHILLER	YORK / TRANE / CARRIER / KIRLOSKAR / DUNHAM BUSH / MCQUAY (DAIKIN) / BLUE STAR / VOLTAS
2	VAPOUR ABSORPTION MACHINE	VOLTAS / THERMAX
3	PRECISION PACKAGE UNITS	STULZ / UNIFLAIR / EMERSON / BLUEBOX / CLIMADENTA
4	PACKAGE UNIT	VOLTAS / BLUE STAR / CARRIER
5	SPLIT AIR CONDITIONER	VOLTAS / BLUE STAR / CARRIER / HITACHI / LG
6	AIR HANDLING UNITS	VOLTAS / BLUE STAR / ZECO / CARRIAIRE (FLAKT) / EDGETECH / ETHOS / SYSTEM AIR / WAVES AIRCON
7	AHU FAN (CENTRIFUGAL FAN)	CB.DOCTOR / FLAKT / KRUGER / NICOTRA / COMEFRI / MARATHON / PATEL AIR
8	CHILLED & CONDENSER WATER PUMP	BEST & CROMPTON / JYOTI / SAM TURBO / KBL / KSB / M&P / VOLTAS / BEACON-WEIR / WORTHINGTON / FLOWMORE / SULZER / BHARAT PUMPS & COMPRESSORS LTD / FLOWSERVE INDIA CONTROL PVT LTD / V-FLOW PUMPS & SYSTEMS CO
9	COOLING TOWER	PAHARPUR / MIHIR / PCT / FLOWTECH / BELL
10	INDUCTION MOTORS (LT)	SIEMENS / ABB / CGL / MARATHON / KEC / BHARAT BIJLEE / NGEF / JYOTI / LHP
11	AIR FILTER	PUROLATOR / FMI / ANFILCO / TENACITY / JOHN FOWLER / SPECTRUM / AIR TECH / PUROMATIC
12	AXIAL FANS / F.A. FANS	FLAKT / KHAITAN / PATEL / NICOTRA / SARLA / KRUGER / MARATHON / C DOCTOR
13	INSULTATION MATERIAL	BEARDSHELL / K-FLEX / PARAMONT / ARMAFLEX / SUPREME / LLOYDS / UP TWIGA
14	BALANCING VALVE	ADVANCE
15	BUTTERFLY VALVE	AUDCO / FOURESS / INTER VALVE / BDK / WEIR BDK / TYCO / CRANE PROCESS / KEYSTONE / ADVANCE
16	NON RETURN VALVE	LEADER / H.SARKAR / FLUID LINE / HI -TECH / CRESENT / A V VALVES / BANKIM & COMPANY / SHIVADURGA
17	GATE/GLOBE VALVES	CRESENT / BDK / AUDCO / FOURESS / KIRLOSKAR / SANT / BOMBAY METAL & ALLOYS / BANKIM / LEADER / H SARKAR / AV VALVES / VENUS PUMPS AND ENGG
18	3 WAY MIXING VALVE WITH ACTUATING MOTOR	SIEMENS BUILDING TECHNOLOGY / JOHNSON / BELIMO / HONEYWELL / RAPID CONTROL / ALC
19	MOTORIZED BUTTERFLY VALVE	ANERGY / / BELIMO / JOHNSON / HONEYWELL / SIEMENS



AIR CONDITIONING SYSTEM

LIST OF MAKES OF SUB-VENDOR ITEMS-AS APPLICABLE

20	Y / POT STRAINER	MULTITEX / GREAVES COTTON / JAYPEE / SANT / OTOKLIN / GRAND PRIX / GUJARAT OTOLIFT / DS ENGG / SAROJINI ENTERPRISE / BHATIA ENGINEERING / FILTERATION ENGINEERS INDIA PVT LTD / SUNGOV ENGINEERING
21	PIPING - ERW	SURYA ROSHNI / TISCO / DADU PIPES / INDUS TUBE / WELSPUN / TATA / BST / JINDAL / SAIL
22	PIPING - CS SEAMLESS (ASTM A 106)	ISMT / MAHARASHTRA SEAMLESS
23	GI SHEETS FOR DUCTING	TISCO / INDIAN IRON & STEEL CO LTD. / RASHITRYA ISPAT NIGAM LTD. / ESSAR/ ISPAT INDUSTRIES / JSW STEEL / LLOYDS STEEL / BHUSHAN / TATA / SAIL / JINDAL
24	FIRE DAMPER	TSC / CARRYAIRE / RAVISTAR (SYSTEM AIR)
25	GRILL/DIFFUSER/VOLUME CONTROL DAMPER	AIR FLOW/ TSC /AIR MASTER/ CARYAIRE/RAVI STAR (SYSTEM AIR)
26	STRIP HEATER	ESCORTS / RACOLD / DASPASS/ ALCO/ HEATCO / HOTSET
27	PAN HUMIDIFIER	RAPID COOL/ HOTSET /ALCO
28	RELIEF / PURGE VALVE	BRASSOMATIC
29	THERMOSTATS	HONEYWELL / RANCO / PENN / DANFOSS / INDFOSS / JHONSON CONTROL /RANUTROL
30	HUMID STAT	JHONSON CONTROL / HONEYWELL / PENN
31	ANTI FREEZE THERMOSTAT	RANCO / HONEYWELL / PENN / DANFOSS / INDFOSS
32	PRESSURE GAUGE	GENERAL INST CONSORTIUM / BELL / H.GURU INST P. LTD. / WAAREE INSTRUMENTS / H. GURU IND / FORBES MARSHALL / MANOMETER / A.N. INST / GAUGES BOURDON / GLUCK / WIKA / ASHCROFT / BAUMER TECHNOLOGIES/ PRECISION MASS PRODUCTS PVT. LTD. / BOSE PANDA INSTT. PVT. LTD.
33	TEMPERATURE GAUGE	H. GURU IND/ H.GURU INST/ FORBES MARSHALL/DETRIVE INST & ELECTRONICS / PYRO ELECTRIC /TOSHNIWAL BROSS / WAREE INSTRUMENTS / A.N.INST / GOA INSTRUMENTS / WIKA/ ASHCROFT / H GURU (SI)/ BAUMER TECHNOLOGIES/ GOA THERMOSTATIC/ GAUGE BOURDON/ BUDENBERG GAUGE/ PRECISION MASS PRODUCTS
34	LEVEL GAUGE	GENERAL INSTRUMENTS / CHEMTROLS / SBEM, PUNE/ AUTOMAT MUMBAI /SIGMA / TOSHNIWAL / TECHNOMATIC / TELACO /LEVCON / D K INSTRUMENTS / PUNE TECHTROL / FLOW STAR/ BLISS ANAND
35	PRESSURE SWITCH / DP SWITCHES	BELLS / DANFOSS / DK INSTRUMENTS/ DRESSER / SOR INC / VASU / SWITZER / INDFOSS / TRAFAG / GIC / ASHCROFT/ KASTURBA UDYOG/ BARKSDALE/ PRECISION MASS PRODUCTS/ MITTAL REFRIGERATION
36	TEMPERATURE SWITCH	INDFOSS/ SEIMENS / DANFOSS/ DK INSTRUMENTS/ SOR INC / VASU / DRESSER / TOSHNIWAL / SWITZER



AIR CONDITIONING SYSTEM

LIST OF MAKES OF SUB-VENDOR ITEMS-AS APPLICABLE

37	FLOW SWITCH	SWITZER / LEVCON / DK INSTRUMENT / SBEM / V. AUTOMATE/ SIEMENS
38	LEVEL SWITCH	SBEM / BLISS ANAND / HI TECH / RAMAN INST / SIGMA / SOR INC / WAREE INST / LEVCON / DK INSTRUMENT / V. AUTOMATE / CHEMTROLS / SIEMENS / FLOW STAR / TRAC/ FLOW TECH/ NIVO CONTROLS/ PUNE TECHTROL/ SAPCON/ BAUMER TECHNOLOGIES/ GIC/ SBEM
39	TRANSMITTERS	TAYLOR / ABB/BRISTOL BABCOCK / BIRLA KENT TAYLOR / BLISS ANAND /SBEM/ SMART INST / V. AUTOMATION & INST / FISHER-ROSEMOUNT/ SIEMENS/ TATA HONEYWELL/ PUNE TECHTROL/ NIVO CONTROLS/ PANAM ENGINEERS/ EMERSON/ MOORE INDUSTRIES/ TOSHNIWAL INDUSTRIES/ YOKOGAWA/ E&H/ ABB
40	SIGHT FLOW INDICATORS	SIGMA / LEVCON /V. AUTOMAT / TELLACE /EUREKA / TATA HONEYWELL/BLISS ANAND/ SCIENTIFIC DEVICES/ BK EQUIPMENTS/ INSTRUMENTATION ENGINEERS
41	FLOW ELEMENT	BRISTOL BABCOCK / BALIGA /LIGHTING EQUIP /ENGINEERING SPECIALITIES /IL / MINCO/ MICRO PRECISION / STAR MECH
42	TEMPERATURE ELEMENT	GENERAL INST CONSORTIUM/ PYRO ELECTRIC /WAAREE INSTRUMENTS/ DETRIVE INST & ELECTRONICS / TOSHNIWAL/ GOA INSTRUMENTS/ GAUGE BOURDON/ TECHNO INSTRUMENTS/ TEMPSENS INSTRUMENTS/ THERMAL INSTRUMENTS/ TM TECHNOMATIC/ BAUMER TECHNOLOGIES
43	FLOW METER	EUREKA / INSTRUMENTATION ENGINEERS PVT LTD / PLACKA /TRAC / FLOW STAR/ SCIENTIFIC DEVICE
44	RH SENSOR/TEMP SENSOR	HONEY WELL /JOHNSON /SIEMENS / GENERAL INSTRUMENTS
45	PLC BASED PANEL	SIEMENS / SCHENIEDER / ROCKWELL / GE INTELLIGENT / HONEYWELL AUTOMATION / ABB/ MITSUBISHI ELECTRIC
46	OWS / PC	HP / COMPAQ / DELL / HCL / IBM / LENOVO
47	PRINTER	HP / CANON / EPSON / XEROX / IBM / LEXMARK
48	UPS	HITACHI-HIREL / APC / DELTA / EMERSON / DB POWER / APLAB
49	FIBRE OPTIC CABLE	BIRLA ERICSON / FINOLEX / AKSH FIBRE
50	ANNUNCIATOR FOR PANEL	ICC / PECON/ PROCON
51	LT ADAPTER BOX FOR AL TO CU CABLE CONVERTOR	CONTROL DEVICE / SYSTEM POWER CONTROL / JACKSON / UNILEC / ELECTRIC ALLIED PRODUCT
52	METERING PUMP	SHAPO TOOLS / VK PUMPS
53	WATER SOFTENING PLANT	THERMAX / ION EXCHANGE / DOSI ION
54	PRESSURE TRANSMITTER	ABB / ENDRESS + HAUSER (INDIA) / MOORE / SIEMENS / SMART INSTRUMENT BRAZIL / SBEM / TOSHNIWAL / V. AUTOMAT / EMERSON / YOKOGAWA / HONEYWELL / FUJI
55	TEMPERATURE TRANSMITTER	ABB / ENDRESS + HAUSER (INDIA) / MOORE / SIEMENS / SMART INSTRUMENT BRAZIL / SBEM / TOSHNIWAL / V. AUTOMAT / EMERSON / YOKOGAWA / HONEYWELL