

	MANUFACTURER'S NAME & ADDRESS :	<u>MANUFACTURING QUALITY PLAN</u> ITEM : Chain Pulley Block QP No.: PE-TS-XXX-XXX-A001 REV.: 0, Date.: , PAGE: 3 OF 4	PROJECT : PACKAGE : CHAIN PULLEY BLOCKS VOL IIB, SEC C
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Sr. No.	COMPONENT / OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
									M	C	N	
									10.			
1.	2.	3.	4.	5.	6.	7.	8.	9.				11.

		-SURFACE CRACK	MA	DPT	100 %	ASTM E165	NO DEFECT	IR	✓	P	V	V	
2.2	GEARS AND PINIONS AFTER MACHINING	SURFACE HARDNESS HEAT TREATMENT, SURFACE CRACK, CASE DEPTH	MA	HARDNESS HT CHART, DPT FOR SURFACE CRACK	RANDOM ASTM E 165 FOR DPT	MFG STANDARD NO DEFECT	MFG STANDARD	IR	✓	P	V	V	
								IR	✓	P	V	V	
3.0	<u>FINAL INSPECTION</u>												
3.1	COMPLETE ASSEMBLY	OVERALL DIMENSION	MA	MEASUREMENT	100 %	IS:3832 /APPD DRG	IS:3832 /APPD DRG	IR	✓	P	W	V	
		PROOF LOAD TEST	CR	LOAD TEST	100%	-DO-	No cracks, flaws & other defects	IR	✓	P	W	V	
		LIGHT LOAD TEST	MA	LOAD TEST	100%	IS 3832	IS 3832	IR	✓	P	W	V	
		HEIGHT OF LIFT	MA	MEASUREME NT	100%	-DO-	-DO –	IR	✓	P	W	V	
		SWIVELING OF HOOK	MA	VISUAL	100 %	-DO-	-DO-	IR	✓	P	W	V	
		EFFORT	MA	PULL ON CHAIN	100%	-DO-	-DO-	IR	✓	P	W	V	
3.2	PAINTING	-CLEANING	MA	VISUAL	AT RANDOM	APPROVED	APPROVED	IR		P	--	--	
		- SHADE & DFT OF PAINT (Blue / Black)	MI	VISUAL	AT RANDOM	DRAWING/ SPECIFICATION	DRAWING/ SPECIFICATION	IR		P	W	-	

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

	MANUFACTURER'S NAME & ADDRESS :	<u>MANUFACTURING QUALITY PLAN</u> ITEM : Chain Pulley Block QP No.: PE-TS-XXX-XXX-A001 REV.: 0, Date.: , PAGE: 4 OF 4	PROJECT : PACKAGE : CHAIN PULLEY BLOCKS VOL IIB, SEC C
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Sr. No.	COMPONENT / OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTU M OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
									M	C	N	
									10.			
1.	2.	3.	4.	5.	6.	7.	8.	9.				11.

3.3	NAME PLATE	VERIFICATION	MA	VISUAL	100%			IR		P	V	--	
3.4	PACKING	-VERIFICATION	MI	VISUAL	100%	SPECS.	SPECS.	IR		P	--	-	
3.5	REVIEW OF QA DOCUMENTATION	VERIFICATION	MA	VISUAL	100%	APPD. QP	APPD. QP		✓	V	V	V	
CR – CRITICAL, MA – MAJOR , MI – MINOR													

NOTE 1: BACK WALL ECHO SHALL BE ADJUSTED TO 100% OF FULL SCREEN HEIGHT IN SOUND (DEFECT FREE) AREA. DEFECT ECHO HEIGHT MORE THAN 20% OF SCREEN HEIGHT SHALL BE TREATED AS UNACCEPTABLE. BACK WALL ECHO SHALL NOT BE LESS THAN 80% OF SCREEN HEIGHT IN ANY CASE.

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

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

THIS IS A PART OF TECHNICAL SPECIFICATION NO. PE-TS-412-155A-A001

		MANUFACTURERS NAME & ADDRESS		STANDARD QUALITY PLAN			PROJECT						
		AS PER APPROVED VENDOR LIST		ITEM:	ELECTRIC WIRE ROPE	QP NO		PACKAGE	WIRE ROPE ELECTRIC HOIST				
						REV	0	CONTRACT No					
						DATE		CONTRACTOR	BHEL				
						PAGE	1 of 4						
Sl.No	COMPONENT & OPERATIONS	CHARACTERISTICS	CATEGORY	TYPE OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	D*	M	C	N	REMARKS
1	2	3	4	5	6	7	8	9		**	10		11
1.0	RAW-MATERIALS												
1.1	a) STRUCTURAL MATERIAL b) RAW MATERIAL FOR HOIST AND GEAR BOX HOUSEING, TROLLEY PLATE (AS APPLICABLE)	MECH. , CHEM. PROPS	MA	CHEMICAL COMPOSITION AND TENSILE STRENGTH	1 / lot	APPD. DRG./ DATA SHEET	APPD. DRG./ DATA SHEET	Mill.s TC	√	V	V	V	Test shall be carried out in absence of mill TC
1.2	GEARS, SHAFT/AXLES, WHEELS	MECH , CHEM. PROPS	MA	CHEMICAL COMPOSITION, HARDNESS (DURING IN-PROCESS)	1 / LOT	APPD. DRG./ DATA SHEET	APPD. DRG./ DATA SHEET / IS:3938	LAB. REPORT / MANUFACTURER'S TEST CERTIFICATE	√	P	V	V	In case the items are not manufactured in-house, the manufacturer's test certificate shall be submitted for chemical
		U.T FOR DIA/THK > 50mm	CR	NDT	100%	ASTM A 388	NOTE 4	INSPN. REPORT	√	P	V	V	
1.3	WIRE ROPE	Dimensional CHECK	MI	Dia.	100%	APPD. DRG./ DATA SHEET	APPD. DRG./ DATA SHEET	MFRS' TEST CERT.	√	P	V	V	
		BREAKING LOAD CAPACITY	CR	BREAKING LOAD	100%	APPROVED DRG/DATA SHEET / IS:3938 / IS: 2266	APPROVED DRG/DATA SHEET AND / IS:3938 /	MFRS' TEST CERT.	√	P	V	V	
1.4	HOOKS	PHYS./ MECH. , CHEM. PROPS.	MA	CHEMICAL COMPOSITION, HARDNESS	1 / LOT	APPROVED DRG/DATA SHEET / IS:3938 / IS:15560	APPROVED DRG/DATA SHEET / IS:3938 / IS:15560	MFRS' TEST CERT.	√	P	V	V	
		U.T IF SHANK DIA > 50mm	CR	NDT	100%	ASTM A 388	NOTE 1	INSPN. REPORT	√	P	W	V	SHANK PORTION ONLY
		PROOF LOAD CAPACITY	CR	PROOF LOAD TEST	100%	APPROVED DRG/DATA SHEET / IS:3938 / IS:15560	APPROVED DRG/DATA SHEET / IS:3938 / IS:15560	INSPN. REPORT	√	P	W	V	
		DP AFTER PROOF LOAD	CR	NDT	100%	ASTM E-165	NO CRACKS	INSPN. REPORT	√	P	V/W	V	
2.0	IN-PROCESS												
2.1*	WELDING PROCEDURE SPECIFICATION	CORRECTNESS	MA	SCRUTINY	100%	IS:7307 / ASME SEC IX	IS:7307 / ASME SEC IX	FORMAT OF IS / ASME SEC IX		P	V	V	
2.2*	PROCEDURE & WELDER QUALIFICATION	WEDLING PARAMETRES	MA	PHYS. TESTS/RT	100%	IS:7310 / ASME SEC IX	IS:7310 / ASME SEC IX	AS PER ASME SEC IX	√	P	W	W	IN CASE OF LLOYDS / EIL / TPL QUALIFIED WELDERS AVAILABLE, REQUALIFICATION OF WELDER IS NOT REQUIRED
			LEGND										
			* RECORDS IDENTIFIED WITH 'TICK(√) SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENTATION										
			** M: MANUFACTURER/SUBCONTRACTOR										
MANUFACTURER/ SUB CONTRACTOR	CONTRACTOR	C: CONTRACTOR NOMINATED INSPECTION AGENCY(BHEL) N: CUSTOMER											
SIGNATURE		INDICATE 'P' PERFORM 'W' WITNESS AND 'V' VERIFICATION AS APPROPRIATE " CHP" CUSTOMER SHALL IDENTIFY IN COLUMN "N"				REVIEWED BY	NAME & SIGN OF APPROVING AUTHORITY & SEAL						

THIS IS A PART OF TECHNICAL SPECIFICATION NO. PE-TS-412-155A-A001

		MANUFACTURERS NAME & ADDRESS		STANDARD QUALITY PLAN			PROJECT						
		AS PER APPROVED VENDOR LIST		ITEM:	ELECTRIC WIRE ROPE	QP NO		PACKAGE	WIRE ROPE ELECTRIC HOIST				
						REV	0	CONTRACT No					
						DATE		CONTRACTOR	BHEL				
						PAGE	1 of 4						
Sl.No	COMPONENT & OPERATIONS	CHARACTERISTICS	CATEGORY	TYPE OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	D*	M	C	N	REMARKS
1	2	3	4	5	6	7	8	9		**	10		11
2.3*	WELD SET UPS	DIMENSIONS	MA	MEAS. , VISUAL	100%	WPS, APPD. DRG.	WPS, APPD. DRG.	INSPN. REPORT		P	V		
2.4*	WELDMENTS –FINAL RUN	SURFACE DEFECTS	MA	PT	100%	IS:3658 / ASTM:165	ASME SEC. VIII DIV. I	INSPN. REPORT	√	P	V	V	
2.5	TRUNION / TROLLEY WHEELS, GEARS PINION	SURFACE & INTERNAL FLAWS (FOR DIA. / THICKNESS >50MM)	MA	PT / UT	100%	ASTME:165	NO LINEAR DEFECTS / NOTE-4	INSPN. REPORT	√	P	W	V	
2.6	NDT OF LOAD BEARING BUTT WELDS (IF ANY)	WELD QUALITY OF a)Butt weld on tension 100% RT and 100% DPT b)Butt weld oncompression 10% RT and 100% DPT c)Butt weld on rope drum 100% RT and 100% DPT d) Fillet weld - Random 10% DPT	CR	PT & RT	100%	ASME SEC. VIII DIV. I	ASME SEC. VIII DIV. 4 . CLUW-51 FOR RT APPENDIX -8 FOR PT	INSPN. REPORT ND FILM	√	P	V	V	FILMS TO BE REVIEWED BY BHEL & Customer. DPT SHALL BE CHP FOR Customer & BHEL
2.7	GEAR BOXES												
	COMPLETE ASSEMBLY	OVERALL DIMENSIONS	MA	MEAS.	100%	MFG. DRG.	MFG. DRG.	INSPN. REPORT	√	P	V		
	Gear shall be checked for reduction ratio, backlash & contact pattern.	CHECK FOR OIL LEAKAGE, VIBRATION, NOISE TEMP. RISE	MA	NO LOAD RUNNING FOR TWO HOURS	100%	MFG. DRG.	MFG. STD.	- DO -	√	P	V	V	
2.8	ELECTRICALS												
1	MOTORS	TYPE TESTS (INCLUDING DEGREE OF PROTECTION)	MA	TYPE TESTS	1 / TYPE, 100%	IS:3938	IS:3938	MFRS' TEST CERT., INSPN REPORT	√	P	V	V	
		ROUTINE TESTS		ROUTINE TESTS	100%	IS 325	IS 325	DO	√	P	V	V	
2	RESISTANCES (IF APPLICABLE)	TEMPERATURE RISE	MA	VERTIFICATION OF MNFRS' TEST CERT.	100%	IS:3938, RELV. ISS	IS:3938, RELV. ISS	MFRS' TEST CERT.	√	P	V	V	
3	CONTROLLER, LIMIT SWITCHES (IF APPLICABLE)	ROUTINE TESTS	MA	ROUTINE TEST	100%	IS:6975/TECH. SPEC.,	IS:6875/TECH. SPEC.,	MFRS' TEST CERT.	√	P	V	V	Rating and make to be verified.
4	BRAKES	ROUTINE TESTS	MA	ROUTINE TEST	100%	TECH. SPEC. / IS:15560	IS:3938/TECH. SPEC.	MFRS' TEST CERT.	√	P	V	V	
5	BRAKE DRUM (IF APPLICABLE)	VERIFICATION OF HT CHARTS, HARDNESS (IF APPLICABLE)	MA	VISUAL, HARDNESS TEST	100%	APPD. DRGS./TECH. SPC.	APPD. DRGS./TECH. SPEC.	HT. CHART /INSPN. REPORT	√	P	V	V	
6	CONTACTOR	ROUTINE TESTS	MA	ROUTINE TEST	100%	IS:2959 AND TECH. SPEC., IS:6547 / IS:3938	IS:2959 AND TECH. SPEC., IS:6547 / IS:3933	INSPN. REPORT	√	P	V	V	Rating and make to be verified.
7	CONTROL PANEL, PENDANT SWITCH	* FIXING OF COMPONENTS WIRING MARKING CONTINUITY * FUNCTIONAL TEST * IR & H.V. TEST * IP - PROTECTION TEST * PAINT SHADE, THICKNESS, SHEET THICKNESS	MA	VISUAL	100%	APPD.DRG. WIRING DIAGRAM,	APPD. DRG. WIRING DIAGRAM,	INSPN. REPORT	√	P	V	V	BOUGHT OUT ITEMS AS PER BHEL / CUSTOMER APPROVAL LIST
			LEGND										
			* RECORDS IDENTIFIED WITH 'TICK'(√) SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENTATION										
			** M: MANUFACTURER/SUBCONTRACTOR										
MANUFACTURER/ SUB CONTRACTOR	CONTRACTOR	C: CONTRACTOR NOMINATED INSPECTION AGENCY(BHEL) N: CUSTOMER											
SIGNATURE		INDICATE "P" PERFORM"W" WITNESS AND "V" VERIFICATION AS APPROPRIATE " CHP" CUSTOMER SHALL IDENTIFY IN COLUMN"N"				REVIEWED BY	NAME & SIGN OF APPROVING AUTHORITY &SEAL						

THIS IS A PART OF TECHNICAL SPECIFICATION NO. PE-TS-412-155A-A001

		MANUFACTURERS NAME & ADDRESS		STANDARD QUALITY PLAN			PROJECT						
		AS PER APPROVED VENDOR LIST		ITEM:	ELECTRIC WIRE ROPE	QP NO		PACKAGE	WIRE ROPE ELECTRIC HOIST				
					REV	0	CONTRACT No						
					DATE		CONTRACTOR	BHEL					
					PAGE	1 of 4							
Sl.No	COMPONENT & OPERATIONS	CHARACTERISTICS	CATEGORY	TYPE OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	D*	M	C	N	REMARKS
1	2	3	4	5	6	7	8	9		10			11
8	CABLES	TYPE AND ROUTINE TESTS	MA	TYPE & ROUTINE TESTS	100%	AS PER TECH. SPEC. IS:1554/IS:9968- PART - 1 / IS:694 / RELEVANT IS FOR FRLS CABLES	AS PER TECH. SPEC. IS:1554/IS:9968- PART - 1 / IS:694	MNFRS' TEST CERT.	Ø	P	V	V	
3.0	FINAL INSPECTION												
3.1	COMPLETELY ASSEMBLED HOIST	1. COMPLETENESS, CORRECTNESS, OVERALL DIMENSIONS	MA	VISUAL, MEAS	100%	APPD. DRG.	APPD. DRG.	MNFRS' TEST CERT.	√	P	W	V	
3.2	ASSEMBLED HOIST PERFORMANCE	1. LOAD TEST	CR	LOAD TEST at SWL	100%	IS:6547 / IS:3938	IS:6547 / IS:3938	MNFRS' TEST CERT.	√	P	W	V	
		2. HOISTING & LOWERING SPEED, PERFORMANCE OF CONTROLLERS SWITCHES CONTRACTORS, RELAYS AND OTHER CONTROL DEVICES CORRELATIONS OF CIRCUITS AND INTERLOCKS AND SEQUENCES OF OPERATION	CR	MEAS & VISUAL	100%	IS:6547 / IS:3938, TECH SPEC.	TECH SPEC.	MNFRS' TEST CERT.	√	P	W	V	
		3. OPERATION OF ALL PROTECTIVE DEVICES	CR	VISUAL	100%	TECH SPEC	TECH SPEC.	MNFRS' TEST CERT.	√	P	W	V	
3.3	OVER LOAD TEST	1. OVER LOAD	CR	TEST AT 125 % OF-SWL	100%	IS:6547/IS:3938	IS:6547/IS:3938	INSPN. REPORT	√	P	W	V	
4	PAINTING												
1	PRIMER & FINISHING AND SHADE	1. TO RELEVANT IS	MI	CORRECTNESS OF MFG. TEST CERT.	EACH CONSIGNMENT	DRG. & DATA SHEET & RELV. IS SPEC.	DRG. & DATA SHEET & RELV. IS SPEC.	MNFRS' TEST CERT.		P	V		
	NOTE:												
* 1.0 Clause from 2.1 to 2.4 shall be applicable for load bearing welded joints.													
2.0 Back Wall Echo shall be adjusted to 100% of Full Screen Height in sound (Defect Free) Area. Defect Echo Height more than 20% of Screen Height shall be treated as unacceptable. Back Wall Echo shall not be less than 80% of Screen Height in any case.													
			LEGND										
			* RECORDS IDENTIFIED WITH 'TICK(✓)' SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENTATION										
			** M: MANUFACTURER/SUBCONTRACTOR										
MANUFACTURER/ SUB CONTRACTOR	CONTRACTOR	C: CONTRACTOR NOMINATED INSPECTION AGENCY(BHEL) N: CUSTOMER											
SIGNATURE		INDICATE 'P' PERFORM 'W' WITNESS AND 'V' VERIFICATION AS APPROPRIATE " CHP" CUSTOMER SHALL IDENTIFY IN COLUMN"N"				REVIEWED BY	NAME & SIGN OF APPROVING AUTHORITY &SEAL						

		QUALITY PLAN		CUSTOMER : M/s TANGEDCO			PROJECT 2X 660 MW ENNORE SEZ STPP		SPECIFICATION : NUMBER :PE-TS-412-155A-A001			
				BIDDER/ : VENDOR			QUALITY PLAN NUMBER PED-506-00-Q-006, REV-01		SPECIFICATION TITLE			
		SHEET 1 OF 2		SYSTEM			ITEM AC ELECT. MOTORS BELOW 55KW (LV)		SECTION VOLUME III			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS 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
1.0	ASSEMBLY	1.WORKMANSHIP	MA	VISUAL	100%	MANUF'S SPEC	MANUF'S SPEC	-DO-	2	-	-	
		2.DIMENSIONS	MA	-DO-	-DO-	MFG. DRG./MFG. SPEC.	MFG. DRG./MFG. SPEC.	-DO-	2	-	-	
		3.CORRECTNESS COMPLETENESS TERMINATIONS/ MARKING/COLOUR CODE	MA	VISUAL	100%	MFG.SPEC./RELEVANT IS	MFG.SPEC. RELEVANT IS	-DO-	2	-	-	
2.0	PAINTING	1.SHADE	MA	VISUAL	SAMPLE	MANUFR'S SPEC/BHEL SPEC./RELEVANT STANDARD	BHEL SPEC. SAME AS COL.7	LOG BOOK	2	-	-	
3.0	TESTS	1.ROUTINE TEST INCLUDING SPECIAL TEST AS PER BHEL SPEC.	MA	-DO-	100%	IS-325/ BHEL SPEC./ DATA SHEET	SAME AS COL.7	TEST REPORT	2	1		NOTE -1 & NOTE-3
		2.OVERALL DIMENSIONS & ORIENTATION	MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPN. REPORT	2	1	-	NOTE -1 & NOTE-3
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE									
												BIDDER'S/VENDORS COMPANY SEAL

		QUALITY PLAN SHEET 2 OF 2		CUSTOMER : M/s TANGEDCO		PROJECT 2X 660 MW ENnore SEZ STPP		SPECIFICATION : NUMBER : PE-TS-412-155A-A001				
				BIDDER/ : VENDOR		TITLE QUALITY PLAN		SPECIFICATION : TITLE :				
				SYSTEM		NUMBER PED-506-00-Q-006, REV-01		SECTION VOLUME III				
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS 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	P	W	V	11
		3.NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPN. REPORT	2	1	-	
NOTES: 1 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON 2 WHERE EVER CUSTOMER IS INVOLVED IN INSPECTION, (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER. 3 FOR EXHAUST/VENTILATION FAN MOTORS OF RATING UPTO 1.5KW , ONLY ROUTINE TEST CERTIFICATES SHALL BE FURNISHED FOR SCRUTINY.												
<u>Legends for Inspection agency</u> 1. BHEL/CUSTOMER 2. VENDOR (MOTOR MANUFACTURER) 3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER) P. PERFORM W. WITNESS V. VERIFY												
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

THIS IS A PART OF TECHNICAL SPECIFICATION NO. PE-TS-412-155A-A001

		QUALITY PLAN		CUSTOMER : M/s TANGEDCO		PROJECT 2X 660 MW ENNORE SEZ STPP		SPECIFICATION : NUMBER : PE-TS-412-155A-A001				
				BIDDER/ VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03		SPECIFICATION : TITLE				
		SHEET 1 OF 9		SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		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	P	W	V	11
1.0	RAW MATERIAL & BOUGHT OUT CONTROL											
1.1	SHEET STEEL, PLATES, SECTION, EYEBOLTS	1.SURFACE CONDITION	MA	VISUAL	100%	-	FREE FROM BLINKS, CRACKS, WAVINESS ETC	LOG BOOK	3	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANFR'S DRG./SPEC	MANFR'S DRG./SPEC	-DO-	3	-	-	
		3.PROOF LOAD TEST (EYE BOLT)	MA	MECH. TEST	-DO-	-DO-	-DO-	INSPEC. REPORT	3	-	2	
1.2	HARDWARES	1.SURFACE CONDITION	MA	VISUAL	100%		FREE FROM CRACKS, UN-EVENNESS ETC.	-DO-	3	-	-	
		2.PROPERTY CLASS	MA	VISUAL	SAMPLES	MANFR'S DRG./SPEC BOOK	RELEVENT IS/SPEC.	SUPPLIERS TC & LOG	3	-	2	PROPERTY CLASS MARKING SHALL BE CHECKED BY THE VENDOR
1.3	CASTING	1.SURFACE CONDITION	MA	VISUAL	100%		FREE FROM CRACKS, BLOW HOLES ETC.	LOG BOOK	3	-	2	
		2.CHEM. & PHY. PROP.	MA	CHEM & MECH TEST	1/HEAT NO.	MANFR'S DRG./SPEC	RELEVENT IS/	SUPPLIER'S TC	3	-	2	HEAT NO. SHALL BE VERIFIED
		3.DIMENSIONS	MA	MEASUREMENT	100%	MANUFR'S DRG.	MANUFR'S DRG.	LOG BOOK	3	-	2	
1.4	PAINT & VARNISH	1.MAKE, SHADE, SHELF LIFE & TYPE	MA	VISUAL	100% CONTINUOUS	MANFR'S DRG./SPEC	MANFR'S DRG./SPEC	LOG BOOK	3	-	2	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

		QUALITY PLAN		CUSTOMER : M/s TANGEDCO		PROJECT 2X 660 MW ENNORE SEZ STPP TITLE		SPECIFICATION : NUMBER : PE-TS-412-155A-A001				
				BIDDER/ : VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03		SPECIFICATION : TITLE				
				SHEET 2 OF 9		SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		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	P	W	V	11
1.5	SHAFT (FORGED OR ROLLED)	1. SURFACE COND.	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	-	VENDOR'S APPROVAL IDENTIFICATION SHALL BE MAINTAINED
		2. CHEM. & PHYSICAL PROPERTIES	MA	CHEM. & PHYSICAL TESTS	1/HEAT NO. OR HEAT TREATMENT BATCH NO	MFG. DRG. SPEC.	RELEVANT IS	SUPPLIER'S TC	3	-	2	
		3. DIMENSIONS	MA	MEASUREMENT	100%	-DO-	MANUFR'S DRG.	LOG BOOK	3	-	2	
		4.INTERNAL FLAWS	CR	UT	-DO-	ASTM-A388	MANUFR'S SPEC. BHEL SPEC.	-DO-	3	2	1	
1.6	SPACE HEATERS, CONNNECTORS, TERMINAL BLOCKS, CABLES, CABLE LUGS, CARBON BRUSH TEMP. DETECTORS, RTD, BTD'S	1. MAKE & RATING	MA	VISUAL	-DO-	MANUFR'S DRG. SPEC.	MANUFR'S DRG. SPEC.	-DO-	3	-	2	FOR DIA OF 55 MM & ABOVE
		2. PHYSICAL COND.	MA	-DO-	-DO-	-	NO PHYS. DAMAGE, NO ELECTRICAL DISCONTINUITY	-DO-	3	-	2	
		3.DIMENSIONS (WHEREVER APPLICABLE)	MA	MEASUREMENT	SAMPLE	MANUFR'S DRG./ SPEC.	MANUFR'S DRG. / SPEC.	-DO-	3	-	2	
		4.PERFORMANCE/ CALIBRATION	MA	TEST	100%	-DO-	-DO-	INSP. REPORT	3	-	2	
BHEL			PARTICULARS		BIDDER/VENDOR							
			NAME									
			SIGNATURE									
			DATE					BIDDER'S/VENDORS COMPANY SEAL				

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THIS IS A PART OF TECHNICAL SPECIFICATION NO. PE-TS-412-155A-A001

		QUALITY PLAN		CUSTOMER : M/s TANGEDCO		PROJECT 2X 660 MW ENNORE SEZ STPP TITLE		SPECIFICATION : NUMBER : PE-TS-412-155A-A001				
				BIDDER/ : VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03		SPECIFICATION : TITLE				
		SHEET 4 OF 9		SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		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	
1.10	BEARINGS	3.DIMENSIONS	MA	MEASUREMENT	-DO-	-DO-	-DO-	Log Book	3	-	2	
		1.MAKE & TYPE	MA	VISUAL	100%	MANFR'S DRG./ APPROVED DATASHEET	MANFR'S DRG./ APPROVED DATASHEET	-DO-	3	-	2	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	BHEL DATA SHEET	BHEL DATA SHEET BEARING MANUF'S CATALOGUES	-DO-	3	-	2	
		3.SURFACE FINISH	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	2	
1.11	SLIP RING (WHEREVER APPLICABLE)	1.SURFACE COND.	MA	VISUAL	100%	-	-DO-	-DO-	3	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANUF'S DRG	MANUF'S DRG	-DO-	3	-	-	
		3.TEMP.WITH-STAND CAPACITY	MA	ELECT.TEST	-DO-	MANUF'S SPEC./ BHEL SPEC.	MANUF'S SPEC./ BHEL SPEC.	-DO-	3	-	2	
		4.HV/IR	MA	-DO-	100%	-DO-	-DO-	-DO-	3	-	2	
1.12	OIL SEALS & GASKETS	1.MATERIAL OF GASKET	MA	VISUAL	100%	MANUF'S DRG/SPECS	MANUF'S DRG./ SPECS.	-DO-	3	-	-	
		2.SURFACE COND.	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	-	
		3.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANUF'S DRG	MANUF'S DRG	-DO-	3	-	-	
BHEL			PARTICULARS		BIDDER/VENDOR							
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

		QUALITY PLAN SHEET 5 OF 9		CUSTOMER : M/s TANGEDCO		PROJECT 2X 660 MW ENnore SEZ STPP TITLE			SPECIFICATION : NUMBER : PE-TS-412-155A-A001			
				BIDDER/ : VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
				SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			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	P	W	V	11
2.0	IN PROCESS											
2.1	STATOR FRAME WELDING (IN CASE OF FABRICATED STATOR)	1.WORKMANSHIP & CLEANNESS	MA	VISUAL	100%	-DO-	GOOD FINISH	LOG BOOK	3/2	2	-	
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	MANUF'S DRG	MANUF'S DRG	-DO-	2	-	-	
2.2	MACHINING	1.FINISH	MA	VISUAL	100%	-DO-	GOOD FINISH	LOG BOOK	2	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	MANUF'S DRG	MANUF'S DRG	-DO-	2	-	-	
		3.SHAFT SURFACE FLOWS	MA	PT	-DO-	RELEVANT SPEC./ ASTM-E165	MANUF'S SPEC./ BHEL SPEC./	-DO-	2	-	1	
2.3	PAINTING	1.SURFACE PREPARATION	MA	VISUAL	100%	MANFR'S SPEC/BHEL SPEC./ RELEVANT STAND	BHEL SPEC. SAME AS COL.7	LOG BOOK	2	-	-	
		2.PAINT THICKNESS (BOTH PRIMER & FINISH COAT)	MA	MEASUREMENT BY ELCOMETER	SAMPLE	-DO-	-DO-	-DO-	2	-	-	
		3.SHADE	MA	VISUAL	-DO-	-DO-	-DO-	Log Book	2	-	-	
		4.ADHESION	MA	CROSS CUTTING & TAPE TEST	-DO-	-DO-	-DO-	Log Book	2	-	-	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

		QUALITY PLAN SHEET 6 OF 9		CUSTOMER : M/s TANGEDCO		PROJECT 2X 660 MW ENNORE SEZ STPP TITLE			SPECIFICATION : NUMBER : PE-TS-412-155A-A001				
				BIDDER/ : VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE				
				SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			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	SHEET STACKING	1.COMPLETENESS	MA	MEASUREMENT	SAMPLE	MANUFR'S SPEC.	MANUFR'S SPEC.	Log Book	2	-	-		(FOR MOTORS OF 2MW AND ABOVE) * ON 10% RANDOM SAMPLE
		2.COMPRESSION & TIGHTENING	MA	MEASUREMENT	100%	-DO-	-DO-	Log Book	2	-	-		
		3.CORE LOSS & HOTSPOT	MA	ELECT.TEST	-DO-	-DO-	-DO-	Log Book	2	1*	1		
2.5	WINDING	1.COMPLETENESS	CR	VISUAL	100%	MANUFR'S SPEC./BHEL SPEC.	MANUFR'S SPEC./BHEL SPEC.	Log Book	2	-	-		
		2.CLEANLINESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-		
		3.IR-HV-IR	CR	ELECT. TEST	-DO-	-DO-	-DO-	Log Book	2	-	1		
		4.RESISTANCE	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1		
		5.INTERTURN INSULATION	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-		
		6.SURGE WITH STAND AND TAN. DELTA TEST	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1		
2.6	IMPREGNATION	1.VISCOSCITY	MA	PHY. TEST	AT STARTING	-DO-	-DO-	Log Book	2	-	-		FOR MV MOTOR
		2.TEMP. PRESSURE VACCUM	MA	PROCESS CHECK	CONTINUOUS	-DO-	-DO-	Log Book	2	-	-		
		3.NO. OF DIPS	MA	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1		
BHEL			PARTICULARS			BIDDER/VENDOR							
			NAME										
			SIGNATURE										
			DATE						BIDDER'S/VENDORS COMPANY SEAL				

THIS IS A PART OF TECHNICAL SPECIFICATION NO. PE-TS-412-155A-A001

		QUALITY PLAN		CUSTOMER :		PROJECT 2X 660 MW ENNORE SEZ STPP			SPECIFICATION :			
				M/s TANGEDCO		TITLE			NUMBER : PE-TS-412-155A-A001			
				BIDDER/ VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
SHEET 7 OF 9		SYSTEM		ITEM: AC ELECT. 2X 660 MW ENNORE SEZ STPP			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	
2.7	COMPLETE STATOR ASSEMBLY	4.DURATION	MA	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	VERIFICATION FOR MV MOTOR ONLY
		1.COMPACTNESS & CLEANLINESS	MA	VISUAL	100%	-DO-	-DO-	Log Book	2	-	-	
2.8	BRAZING/COMPRESSION JOINT	1.COMPLETENESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-	
		2.SOUNDNESS	CR	MALLET TEST & UT	-DO-	-DO-	-DO-	Log Book	2		1	
		3.HV	MA	ELECT. TEST	-DO-	-DO-	-DO-	Log Book	2		1	
2.9	COMPLETE ROTOR ASSEMBLY	1.RESIDUAL UNBALANCE	CR	DYN. BALANCE	-DO-	MFG SPEC./ ISO 1940	MFG. DWG.	Log Book	2		1	
		2.SOUNDNESS OF DIE CASTING	CR	ELECT. (GROWLER TEST)	-DO-	MFG. SPEC.	MFG. SPEC.	Log Book	2		1	
2.10	ASSEMBLY	1.ALIGNMENT	MA	MEAS.	-DO-	-DO-	-DO-	Log Book	2	-	-	
		2.WORKMANSHIP	MA	VISUAL	-DO-	-DO-	-DO-	Log Book	2	-	-	
		3.AXIAL PLAY	MA	MEAS.	-DO-	-DO-	-DO-	Log Book	2	-	1	
		4.DIMENSIONS	MA	-DO-	-DO-	MFG.DRG./ MFG SPEC.	MFG. DRG/ RELEVANT IS	Log Book	2	-	-	
		5.CORRECTNESS, COMPLETENESS TERMINATIONS/ MARKING/ COLOUR CODE	MA	VISUAL	100%	MFG SPEC. RELEVANT IS	MFG SPEC. RELEVANT IS	Log Book	2	-	-	
		6. RTD, BTD & SPACE HEATER MOUNTING.	MA	VISUAL	100%	MFG SPEC. RELEVANT IS	MFG SPEC. RELEVANT IS	Log Book	2		1	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE									
												BIDDER'S/VENDORS COMPANY SEAL

THIS IS A PART OF TECHNICAL SPECIFICATION NO. PE-TS-412-155A-A001

		QUALITY PLAN SHEET 8 OF 9		CUSTOMER : M/s TANGEDCO		PROJECT 2X 660 MW ENNORE SEZ STPP TITLE		SPECIFICATION : NUMBER : PE-TS-412-155A-A001				
				BIDDER/ : VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03		SPECIFICATION : TITLE				
				SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		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
3.0	TESTS	1.TYPE TESTS INCLUDING SPECIAL TESTS AS PER BHEL SPEC.	MA	ELECT.TEST	1/TYPE/SIZE	IS-325/ BHEL SPEC./ DATA SHEET	IS-325/ BHEL SPEC./ DATA SHEET	TEST REPORT	2	1*	1	* NOTE - 1
		2.ROUTINE TESTS INCLUDING SPECIAL TEST AS PER BHEL SPEC.	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1 ^{\$}	1	^{\$} NOTE - 2
		3.VIBRATION & NOISE LEVEL	MA	-DO-	100%	IS-12075 & IS-12065	IS-12075 & IS-12065	-DO-	2	1 ^{\$}	1	^{\$} NOTE - 2
		4.OVERALL DIMENSIONS AND ORIENTATION	MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPC. REPORT	2	1	-	
		5.DEGREE OF PROTECTION	MA	ELECT. & MECH. TEST	1/TYPE/ SIZE	RELEVANT IS	BHEL SPEC. AND DATA SHEET	TC	2	-	1	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3
		6. MEASUREMENT OF RESISTANCE OF RTD & BTD	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1 ^{\$}	1	^{\$} NOTE - 2
		7. MEASUREMENT OF RESISTANCE, IR OF SPACE HEATER	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1 ^{\$}	1	^{\$} NOTE - 2
		8. NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPC. REPORT	2	1 ^{\$}	1	^{\$} NOTE - 2
		9.EXPLOSION FLAME PROOF NESS (IF SPECIFIED)	MA	EXPLOSION FLAME PROOF TEST	1/TYPE	IS-3682 IS-8239 IS-8240	IS-3682 IS-8239 IS-8240	TC	2	-	1	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3
		10. PAINT SHADE, THICKNESS & FINISH	MA	VISUAL & MEASUREMENT BY ELKOMETER	SAMPLE	BHEL SPEC. & DATA SHEET	BHEL SPEC. & DATA SHEET	TC	2	1 ^{\$}	1	SAMPLING PLAN TO BE DECIDED BY INSPECTION AGENCY ^{\$} NOTE - 2
BHEL			PARTICULARS		BIDDER/VENDOR							
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

		QUALITY PLAN SHEET 9 OF 9		CUSTOMER : M/s TANGEDCO		PROJECT 2X 660 MW ENnore SEZ STPP TITLE		SPECIFICATION : NUMBER : PE-TS-412-155A-A001				
				BIDDER/ : VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03		SPECIFICATION : TITLE				
				SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		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 P W V			REMARKS
1	2	3	4	5	6	7	8	9	10			11
NOTES: 1 DEPENDING UPON THE SIZE AND CRITICALLY, WITNESSING BY BHEL SHALL BE DECIDED. 2 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON. 3 IN CASE TEST CERTIFICATES FOR THESE TESTS ON SIMILAR TYPE, SIZE AND DESIGN OF MOTOR FROM INDEPENDENT LABORATORY ARE AVAILABLE, THESE TEST MAY NOT BE REPEATED. 4 WHEREVER CUSTOMER IS INVOLVED IN INSPECTION, AGENCY (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER. <u>Legends for Inspection agency</u> 1. BHEL/CUSTOMER 2. VENDOR (MOTOR MANUFACTURER) 3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER) P. PERFORM W. WITNESS V. VERIFY												
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE									
												BIDDER'S/VENDORS COMPANY SEAL

**I.SPECIFICATION
FOR
QUALITY ASSURANCE
&
TESTING**

CHAPTER-14

QUALITY ASSURANCE AND TESTING AND GUARANTEES

14.01.00 GENERAL REQUIREMENT

- 14.01.01** All equipment furnished under this specification shall be subject to test by authorized quality assurance personnel of the Bidder, representatives of the Owner during manufacture, erection and on completion. Bidder's quality assurance personnel for these shop and site tests shall be identified in advance and shall be acceptable to the Owner. The approval of the Owner or passing of such inspection of tests will not, however, prejudice the right of the owner to reject the equipment if it does not comply with the specifications when erected or fails to give complete satisfaction in service.
- 14.01.02** The Bidder shall furnish details of shop and site tests proposed to be conducted by him at various stages to meet the specification requirements for each type of instrument/system along with his proposal. Bidder shall also furnish details of his proposed shop and site quality assurance organization for this contract
- 14.01.03** Bidder shall prepare a detailed shop and site 'Quality Assurance Programme' to meet the requirements of these specifications for Owner's approval. This document shall also contain the formats for reports and maintenance of test records specification of test equipment to be used for site tests.
- 14.01.04** All equipment and systems furnished under this specification shall be subjected to shop & site tests in accordance with the Quality Assurance Program approved by the Owner and shall be adequate to ensure full compliance with these specification, all applicable codes & standards and detailed engineering drawings and documents approved by the Owner.
- 14.01.05** The Bidder shall provide all required test equipment and simulation devices for performing all shop and site tests. All test equipment shall be of reputed make, required accuracy class and shall be recently calibrated. The record of calibration of test equipment shall be made available to the Owner on demand.
- 14.01.06** The cost of all tests as per the requirements of this specification and approved quality assurance programme shall be included in Bidder's lump sum price for this package and no extra price shall be payable by the Owner for conducting any test as per the intent and requirements of this specification.

14.01.07 All approval/Inspection are to be carried out by the Owner only.

14.02.00 SHOP TESTS

14.02.01 General Requirement

- 14.02.01.00 Shop tests shall include all tests to be carried out at Bidder's works at of this sub-bidder and at works where raw materials used for manufacture of equipment is produced.

14.02.01.01 Individual components, instruments and devices furnished in accordance with specification sheets, and I&C device list enclosed with these specifications shall be shop tested by manufacturer prior to shipment. The manufacturer shall conduct these tests for certifying compliance with published specifications for the equipment and provide test results to the Owner in writing. These tests and test certificates shall be in accordance with the agreed 'QA' programme for major systems/equipments. However, manufacturer's standard methods shall be followed if details of tests for any equipment are not covered under this agreed 'QA Programme'.

14.02.01.02 Whenever tested quality material is specified and wherever called upon by Indian Boilers Regulations or by the design code, the test pieces are to be prepared and tested to Owner's satisfaction.

14.02.01.03 In the event of Owner being furnished with certified particulars of tests, which have been carried out by the suppliers of material, the Owner may, at his discretion, dispense with these tests.

14.02.02 Material Tests

14.02.02.01 Whenever tested quality material specified and whenever called upon by Indian Boilers Regulations or by design code, the test pieces, are to be prepared and tested to Owner's satisfaction.

14.02.02.02 In the event of Owner being furnished with certified particulars of tests, which have been carried out by the suppliers of material, the Owner may, at his discretion, dispense with these tests.

14.02.03 Test at Manufacturer's Works

14.02.03.01 Works tests are to include electrical, mechanical performance and hydraulic tests in accordance with relevant IS, IBR or any other approved standard or any other tests called for by the Owner under these specifications to ensure that the equipment being supplied fulfills the requirements of these specifications. For equipments not covered by any IS or other approved standards, the tests to be carried out shall be in accordance with Bidders' quality assurance programme approved by the Owner.

14.02.03.02 Control systems, monitoring systems, control panels, instrument enclosures, and power supply systems shall be shop tested according to unique requirements specified in the applicable section of these specifications for each item and quality assurance program approved by the owner.

14.02.03.03 All shop tests shall be performed prior to shipment and the Owner shall be given the opportunity to witness these tests. The Bidder shall notify the Owner regarding readiness for shop test at least 10 days before the scheduled date if the tests to be conducted within Indian and at least 60 days before the schedule date if the test is to be conducted abroad.

14.02.04 Factory Tests

14.02.04.01 Automatic Control and Monitoring system (DDCMIS, PLC & any other microprocessor based control system) including alarm annunciation system furnished as per this specification shall be subject to shop and site tests as per the requirements of this specification, applicable codes and Owner approved Quantity Assurance Program so as to demonstrate to the Owner that the equipment furnished by the Bidder meets the intent and requirement of this specification. These tests shall include but shall not be limited to the tests indicated in the subsequent clauses.

14.02.04.02 **Surge Protection Test for Solid State Equipment**

All solid state equipment shall be able to withstand the noise and surge inherent in a Power House, and shall strictly comply with SWC tests ANSI C 37.90A, 1974 for IEEE-472 (1974). Complete details of the features incorporated in electronic system to meet this requirement, the relevant test carried out, and the test certificates shall be submitted along with the proposal.

14.02.04.03 **Burn-in and Elevated Temperature Test**

All solid state electronic equipment shall be tested as a complete system/equipment with all devices connected for a minimum of 168 hours continuously under energized conditions prior to shipment from manufacturer's works, as per the following cycle :-

During the first 48 hours of testing the ambient temperature shall be maintained at 50 deg.C and relative humidity at 95%. The equipment shall be interconnected with all devices, which will cause it to repeatedly perform all operations; it is supposed to perform in actual service, with load on various components being equal to those, which will be experienced in actual service.

The 48 hours tests period shall be continuous but shall be divided into four 12 hours segments. The input voltage during each 12-hour segment shall be nominal voltage for 11 hours, followed by 110% of normal voltage for 30 minutes followed by 90 percent of nominal voltage for 30 minutes.

The 48 hours elevated temp test shall be followed by 120 hours of burn in test as specified in the above paragraphs except that the temperature is reduced to ambient temperature prevalent at that time. Alternatively copy of type test certificate for burn-in test shall be submitted.

14.02.04.04 The Bidder shall furnish full details regarding shop tests and site tests, as per good engineering practices. The Owner shall approve all such tests and the supplier shall conduct all such tests without calling for additional price.

The tests shall cover factory tests, burn-in and elevated temperature tests, simulation and functional tests, insulation tests as applicable, the rating of the contact devices and components, surge withstand capability test, conformity of interconnection cables, testing and checking of other conditions deemed to be necessary with the system/equipment items.

14.02.04.05 All instruments and control equipment supplied against this contract shall be factory calibrated at least at five (5) points throughout the range and checked for their

functional/performance requirements. The instruments shall also be calibrated at site prior to commissioning.

- 14.02.04.06 All panels, instruments enclosures, junction boxes, etc. shall be type tested for degree of protection and applicable in accordance with IS: 2147. 8.02.04
- 14.02.04.07 Type, routine and acceptance testing of all equipments, supplied under this contract, shall be in accordance with relevant NEEA/IS/IEC/ANSI/BS/ISA standards, in addition to the requirements of Owner approved Quality Plans. Six (6) copies of test reports shall be submitted to the Owner for approval prior to dispatch of respective equipment
- 14.02.04.08 The representative of Owner shall be given opportunity to witness the factory tests which shall be mutually finalized during the progress of the contract.
- 14.02.04.09 All control systems to be furnished for this project, shall be factory tested for circuit continuity and direction of response. The Components to be tested shall include all controllers, HAND/AUTO station, other system modules, alarm contactors and multi-conductor interconnecting cables. The tests shall be performed with all of the system components supplied by the Bidder connected to form a complete system with the sole exception of transmitters. The tests shall include a means of confirming the mathematical design response of the control system by simulating changes in system input. The tests shall be a qualitative functional test of each component of control system, which simulates dynamic inputs and monitors system outputs.
- 14.02.04.10 Certain control loops shall be factory tested using closed loop mathematical simulation techniques. Control loops to be tested by closed loop methods are broadly as under. However, owner has discretion to test and all control loops during simulation testing.
- ii) Firing rate control (fuel and air flow control)
 - iii) Furnace draft control
 - iv) Boiler separator level control
 - (d) **Response time for Turbine Control System.**
- The input simulation equipment shall be designed to produce effects from control system outputs based on mathematical model of the predicted performance and process dynamics of the main unit equipment. The control constants of various control loop components shall be adjusted to produce a stable and optimum control adjusted to produce a stable and optimum control when connected to the simulation equipment.
- 14.02.04.11 Simulation data including factory adjustment of control system constants, and simulation equations shall be tabulated and shall be made available by the Bidder for owner's use during field check out and the start up of the control system.
- 14.02.04.12 Availability of a simulated type test for automatic control loops specified with a detailed description of testing methods utilized, shall be indicated.

- 14.02.04.13 The availability of facilities for carrying out the model test for the control systems shall be indicated by the bidder. Also details of test procedures and copies of test results conducted for a similar fossil fuel fired unit shall be furnished. The data required from Boiler and Turbo generator supplies shall also be furnished by the Bidder.
- 14.02.04.14 Brief description of all tests proposed to be conducted on each control system components during various stages of manufacture, installation and commissioning shall be furnished. Copies of test data accumulated during the tests shall be submitted to the mutually agreed formats.
- 14.02.04.15 The owner shall witness the factory tests which shall be performed at a time mutually agreeable to the Bidder and the owner.

14.02.04.16 Factory Acceptance Tests for DDCMIS, DCS, Simulator & PLC

GENERAL	1	FACTORY ACCEPTANCE TEST (FAT): REF NOTE-1	✓
	2	FACTORY ACCEPTANCE TEST (FAT) PROCEDURE: REF.NOTE -2	✓
	3		
	4		
	5		
TEST REQUIREMENTS	6	TEST SHALL BE PERFORMED WITH THE COMPLETELY ASSEMBLED SYSTEM AND ALSO WITH COMPLETE	✓
	7	I&C SOFTWARE AND PERFORMING ALL FUNCTIONS EXPECTED OUT WHILE IN ACTUAL SERVICE AND	
	8	WITH STSTEM CONFIGURATION AS FINALISED.	
	9	PROCESS INPUT/OUTPUT CONDITIONS AND OTHER LOAD ON THE SYSTEM TO BE STIMULATED	✓
	10	EITHER BY HARDWARE/SOFTWARE.	
	11	ALL SYSTEM SOFTWARE and APPLICATION SOFTWARE TO BE LOADED AND OPERATIONAL ON THE	✓
	12	SYSTEM PRIOR TO FAT	
	13	FAT TO BE CONDUCTED AT ELEVATED TEMP. OF 45 DEG C FOR MINIMUM 48 HOURS	✓
	14	FAT UNDER FOUR CYLES OF VOLTAGE FLUCATIONS VIZ NOMINAL AT 110 % OF RATED VOLTAGE	✓
	15	PERFORMANCE TEST:	✓
	16	-	
	17	-	
TEST DOCUMENTS	18	TOTAL SYSTEM CONFIGARATION DRAWINGS	
	19	FAT PROCEDURE CONSITING OF:	
	20	(i) TEST EQUIPMENT	
	21	(ii) TEST ENVIRONMENT	
	22	(iii) TEST CONFIGURATION	✓
	23	(iv) TEST PROCEDURE	
	24	(v) TEST SCHEDULE	
	25	(vi) TEST VENUE	
	26	(vii) TEST REPORTS- SPECIMEN COPIES	
	27	FUNCTION DESIGN SPECIFICATION FOR EACH EQUIPMENT / SYSTEM	
	28	-	
	29	-	
PR ELIMINARY CHECKS	30	GENERAL APPEARENCE CHECK and BILL OF MATERIALS CHECK	✓
	31	CONSTRUCTION CHECK AS PER OVER ALL GENERAL ARRANGEMENT DRAWINGS	✓
	32	DIMENSIONAL CHECK	✓
	33	LABELLING, TERMINAL ARRANGEMENT AND EQUIPMENT IDENTIFICATION CHECK	✓
	34	POWER SUPPLY VOLTAGE LEVEL CHECK and POWER 'LEDs -ON CHECK	✓
	35	COOLING FAN OPERATION CHECK	✓
	36	GROUNDING NETWORK CHECK	✓
TE M	1	POWER SUPPLY UNDER VOLTAGE AND OVER VOLTAGE CHECK ($\pm 10\%$)	✓
	2	PROCESSOR and MAIN DATA BUS NETWORK REDUNDANCY CHECK, IF APPLICABLE	✓
	3	COMMUNICATION COUPLER IF APPLICABLE REDUNDANCY CHECK	✓
	4	COMMUNICATION MODULE OF THE CONTROLLER TO NETWORK REDUNDANCY CHECK, IF APPLICABLE	✓
	5	POWER SUPPLY REDUNDANCY CHECK	✓
	6	HARDWARE ON-LINE MAINTAINABILITY CHECK,	✓
	7	-	
	8	-	
CONTROL ENGINEERING	9	CLOSED LOOP CONTROL SIMULATION CHECK	✓
	10	OPEN LOOP CONTROL SIMULATION CHECK	✓
	11	CONTROL LOOP RESPONSE CHECK	✓
	12	BUMPLESS AUTO MANUAL TRANSFER CHECK	✓
	13	OPERATING STATION – GRAPHIC OVERVIEW CHECK	✓
	14	OPERATING STATION- TREND CHECK	✓
	15	OPERATING STATION- REAL TIME TREND CHECK	✓
	16	OPERATING STATION- MIMICS CHECK	✓
	17	OPERATING STATION- CHECK FOR OPERATING CONTROL DIRECTLY FROM MIMICS	✓
	18	OPERATING STATION- FUNCTION KEYS CHECK	✓
	19	OPERATING STATION- TOUCH SCREEN FUNCTION CHECK	✓
	20	OPERATING STATION- ANALOG CONTROL DISPLAY CHECK	✓
	21	OPERATING STATION- SEQUENCE CONTROL DISPLAY CHECK	✓
	22	OPERATING STATION- OPERATOR GUIDENCE MESSAGE CHECK	✓
	23	OPERATING STATION- ALARM MANAGEMENT FUNCTION CHECK	✓

	24	OPERATING STATION LOGGING FUNCTION CHECK	✓
	25	OPERATING STATION / RESPONSE / UPDATING CHECK	✓
	26	KEYBOARD LOCK FUNCTION CHECK	✓
	27	OPERATING STATION INTERCHANGEABILITY and ASSIGNABILITY CHECK	✓
	28	PRINTER ASSIGNABILITY and BACK-UP FUNCTION CHECK	✓
	29	FLOPPY DISK/ STD / OPTICAL DISK UNIT STORAGE and RETRIEVAL CHECK	✓
	30	OPERATING STATION ASSIGNABILITY CHECK FOR HARD COPIER FUNCTION	✓
	31	PLANT PERFORMANCE CALCULATION CHECK	✓
	32	COMMUNICATION INTERFACE TO OTHER'S SYSTEM SIMULATION CHECK	✓
	33	-	
M A I N T E N A N C E	34	DATA BUS DISTANCE BUILDING CHECK (REFER NOTE- 3)	✓
	35	GRAPHIC DISPLAY BUILDING FUNCTION CHECK	✓
	36	CLOSED LOOP CONTROL SYSTEM MODIFICATION CHECK	✓
	37	OPEN LOOP CONTROL SYSTEM MODIFICATION CHECK	✓
	38	ALARM DISPLAY PRIORITISATION CHECK	✓
	39	SYSTEM SECURITY CHECK	✓
	40	SYSTEM ALARM CHECK	✓
	41	SYSTEM DIAGNOSTIC FUNCTION CHECK	✓
	42	POINT DETAIL CONFIGURATION CHECK	✓
	43	CONTROL LOOP TUNING CHECK	✓
N O T E S	44	SYSTEM SELF DOCUMENTATION CHECK	✓
	1. THE INTENT OF THE FAT IS TO DEMONSTRATE AND ENSURE THAT THE I&C SYSTEM MEETS ALL THE FUNCTIONAL REQUIREMENTS AS INTENDED IN THE SPECIFICATION / CONTRACT. A COMPLETED INTEGRATED TEST OF THE SYSTEM SHALL BE CARRIED OUT AT VENDOR'S WORKS IN THE PRESENCE OF OWNER, ON COMPLETION OF INTEGRATION/MANUFACTURING OF THE SYSTEM. THE SHIPMENT OF I&C EQUIPMENT TO SITE WILL BE EFFECTED ONLY AFTER THE FAT HAS BEEN ACCEPTED BY THE OWNER.		
	2. FAT PROCEDURE SHALL BE PREPARED BY VENDOR AND TO BE SUBMITTED FOR OWNER'S/ APPROVAL WELL IN ADVANCE PRIOR TO THE COMMENCEMENT OF FAT		
	3. FAT SHALL BE CONDUCTED WITH THE DISTANCE BETWEEN THE PROCESSOR AND OTHER SUPPORTING PERIPHERALS AS PER THE FINAL LAYOUT IN THE CONTROL ROOM.		
	4. ALL THE RELEVANT APPROVED DOCUMENTS REQUIRED FOR FAT SHALL BE SUBMITTED BY THE BIDDER IN ADVANCE PRIOR TO COMMENCEMENT OF FAT.		

14.02.04.17 Tests to be performed during FAT of PLC system

Following minimum tests shall be performed during FAT at manufacturer's place of PLC system:

- 1) Hardware Inspection of PLC Sub System
 - i) Heat run test
 - ii) Hardware check / physical software package check
 - iii) I/O loading specification
 - iv) PLC start-up and power fail restart
 - v) PLC processor back-up function
 - vi) Communication redundancy
- 2) Application Inspection for Logic Functions
 - i) Ladder logic functional check and graphic screen check
- 3) Application Inspection for PLC Panels
 - i) General arrangement
 - ii) Appearance and construction
 - iii) Panel wiring
 - iv) Panel functional check
 - v) Power supply redundancy check

- 4) PLC System Checks
- i) PLC Scan time functional test
 - ii) PLC/IO panel/Engineering station functions
 - iii) Diagnostic and process alarm test
 - iv) Controller redundancy test
 - v. I/O cards redundancy test.
 - vi) Controller loading test

In addition to above test, Bidder shall also perform other tests as per approved QAP & FAT procedure. Also bidder shall submit "Type Test" report as per IEC – 61131.2 along with FAT report for PLC.

14.02.04.19 FACTORY ACCEPTANCE TEST FOR SIMULATOR

Factory Acceptance Test (FAT) shall include all required tests to fully demonstrate to Owner's satisfaction that each equipment/sub-system/system software modules etc. furnished as per this specification, as well as Simulator as a whole, fully meets the functional, parametric and other requirements of this specification and Owner's approved drawings/documents under all operating regimes.

Bidder to note that FAT procedure given below in subsequent clauses are only indicative in order to help the Bidder in understanding the requirements and help him in submitting a detailed procedure based on these guidelines meeting all the specification requirements.

The Bidder shall also carry out the tests included in subsequent clause as pre FAT and submit its results before inviting Owner for FAT.

The Factory Acceptance Test (FAT) shall include all reasonable exercises, which the combination of equipment and software can be expected to perform. These tests shall be divided into, as a minimum, but not limited to the following categories:

- i. Pre power on checks
- ii. Power on check
- iii. Hardware tests
- iv. Functional tests
- v. Parametric tests
- vi. Specific tests on Electronic hardware

14.02.04.19.1 The major Functional Tests shall include but not limited to the following:

- a) Verification of individual modules in line with approved documents.
- b) Verification of adherence to parameters for various plant configurations at different initial conditions.
- c) **Functional test for C&I Model**

Verification of proper realization of Control and Logic functions as per input documents and approved functional design specification (FDS).

d) Functional tests for HMIPIS

- i. Verification of all types of displays, logs including their formats, bar graphs, X-Y plots etc. Verification of all function keys on keyboards and availability of all operator functions.
- ii. Verification of event generation and handling capabilities of HMIPIS processors by simulating various types of events / data and observing associated event sequence display and alarm signaling boxes.
- iii. Calculations:

All calculations shall be tested to demonstrate that these are in accordance with the specification and I/O schedule. The Bidder shall prepare all test cases for calculations (3 for each calculation at low, mid and upper ranges of inputs) and submit them for the owner's approval. Test cases shall include performance calculations, flow and level calculations, pressure and temperature compensations, etc.
- iv. Checking historical storage and retrieval functions including long-term storage.
- v. Checking healthiness of processor, main memory. Testing of initialization and loading of configuration data, etc.
- vi. Verification of all programmers' stations functions for HMIPIS and Control System, as well as for documentation facility as specified.
- vii. Various display response time / System accuracy etc.
- viii. Display update time on OWS

e) Functional test for networking & communication devices

- i. Verification of various features as per approved documents.
- ii. Verification of throughput after creating high communication traffic.

f) Instructor's workstation Functions

Verification of all features of instructor functions like malfunction, initial conditions, snapshots, trainee exercises etc. in line with specification & approved documentation.

g) Programming and Documentation functions

- i. Verification of all programming function like, modification of application software, database, administrator's function etc. in line with specification and approved documents.
- ii. Verification of all documentation functions in line with specification and approved documents.

14.02.04.19.2 FAT Procedure

The Bidder shall submit a detailed FAT procedure for owner's approval during detailed engineering stage based on the above guidelines. The FAT procedure to be submitted by the Bidder shall be detailed and exhaustive enough such that owner is satisfied that all the Simulator System specification requirements and features are being tested and the system meets these requirements.

14.02.04.20 Tests to be performed during FAT of Peripherals & other control system

1. Colour Graphic Video Display Unit (OWS)
 - i. Functional tests (As per FAT procedure. Note-1)
 - ii. Test for capabilities of OWS including error detection for the complete system (Both hardware & software) simulating worst conditions
 - iii. Noise test
 - iv. Surge withstanding capacity as per IEEE or equivalent
 - v. Quality assurance as governed by BS 5750 or equivalent
 - vi. Design, construction, components, finishes and testing of electronic equipment as per EES-1980 (General specification of electronic equipment) or equivalent

Note-1: Test to be witnessed by Owner.
2. Keyboard
 - i. Test for satisfactory operation of keyboard controls, push buttons and all associated functions (As per FAT procedure. Note-1)
 - ii. Quality assurance as governed by BS 5750 or equivalent for functional test for the complete system simulating worst conditions
 - iii. Design, construction, components, finishes and testing of electronic equipment as per EES-1980 (General specification of electronic equipment) or equivalent

Note-1: Test to be witnessed by Owner.
3. Printers
 - i. Noise level test for the printer
 - ii. Test of interlock performance and error detection feature.
 - iii. Quality assurance as governed by BS 5750 or equivalent
 - iv. Design, construction, components, finishes and testing of electronic equipment as per EES-1980 (General specification of electronic equipment) or equivalent

4. Floppy / Tape Drive Unit / Bulk Memory Unit / DVD, CD drive Unit / DAT Drive
 - i. Noise test
 - ii. Surge withstanding capacity as per IEEE or equivalent
 - iii. Quality assurance as governed by BS 5750 or equivalent
 - iv. Design, construction, components, finishes and testing of electronic equipment as per EES-1980 (General specification of electronic equipment) or equivalent
 - v. Test of Control unit and drive for all features, date checking features.
5. Vibration Monitoring & Analysis System
 - i. Simulated functional test (Note-1)
 - ii. Tests for server, LED monitor, Printer, Keyboard

Note-1: Test to be witnessed by Owner.
6. PADO (Performance & Optimization System)
 - i. Simulated functional test (Note-1)
 - ii. Tests for server, LED monitor, Printer, Keyboard

Note-1: Test to be witnessed by Owner.
7. ERP System
 - i. Simulated functional test (Note-1)
 - ii. Tests for server, LED monitor, Printer, Keyboard

Note-1: Test to be witnessed by Owner.
8. MIS System
 - i. Simulated functional test (Note-1)
 - ii. Tests for server, LED monitor, Printer, Keyboard

Note-1: Test to be witnessed by Owner.
9. HMS System
 - i. Simulated functional test (Note-1)
 - ii. Tests for server, LED monitor, Printer, Keyboard

Note-1: Test to be witnessed by Owner.

NOTES:

1. The intent of the FAT is to demonstrate and ensure that the I & C system meets all the functional requirements as intended in the specification / contract. A completed integrated test of the system shall be carried out at vendor's works in the presence of Owner or Owner's representative, on

completion of integration / manufacturing of the system. The shipment of I&C equipment to site will be effected only after the FAT has been accepted by Owner.

2. FAT procedure shall be prepared by vendor and to be submitted for Owners approval well in advance prior to the commencement of FAT.

14.02.04.21 Calibration of Instruments

The Bidder shall carry out the calibration of instruments as indicated below by submitting the test procedure and quality assurance plan for the Owner's approval. Bidder shall also prepare detailed checklist/calibration sheets for each of the systems/equipment clearly indicating the step-by-step procedures to be carried out for calibration pre commissioning, loop checking, powering and commissioning.

The calibration of all instruments shall be checked and calibration records prepared for the Owner's use. If the instruments require recalibration, Bidder shall recalibrate the instruments and revise the calibration records and submit to the Owner.

i TESTS TO BE PERFORMED FOR FIELD INSTRUMENTS

1.	Pressure Gauges
	Calibration Hydro test (1.5 times max. pr.)
2.	Pressure switches
	Calibration test / Hydro test / Contact rating test / Accuracy test / Repeatability
3.	Differential Pressure Gauges
	Calibration test / Hydro test / Leak test / Over range test / Accuracy test / Repeatability test.
4.	Differential Pressure Switches
	Calibration test / Hydro test / Contact rating test / Leak test / Accuracy test / Repeatability test.
5.	Thermometers
	Calibration / Material test / Accuracy test / Bore concentricity : $\pm 5\%$ of wall thickness / Hydrostatic test for TW (1.5 times max. pr.)
6.	Temperature switch
	Calibration / Material test / Accuracy test / Bore concentricity : 1.5% of wall thickness / Hydrostatic test for TW (1.5 times max. pr.) / Contact rating test.
7.	Resistance temperature detector assembly.
	Calibration / Material test / Bore concentricity test / Insulation test ($\leq 500 \text{ M}\Omega$ at 500V DC) as per ISA, Hydro test for TW. Bore concentricity: $\pm 5\%$ of wall thickness, Accuracy test.
8.	Thermocouple assembly
	Calibration / Material test, Insulation test ($\geq 500 \Omega$ at 500 V, DC) as per ISA, Hydro static test (1.5 times max. pr.), Bore concentricity : $\pm 5\%$ of wall thickness.
9.	Thermowells
	Material test / Bore concentricity : $\pm 5\%$ of wall thickness / Hydrostatic test for TW (1.5 times max. pr.)

10.	Level Guages
	Hydrostatic test / Material test / Seat leakage test / Ball check test.
11.	Level switches (Magnetic)
	Material test / Contact rating test / Hydro test / Calibration test.
12.	Flow Switch
	Material test / Hydro static test (1.5 times max. pr.) / function test.
13.	Flow glasses
	Material test / Hydrostatic test (1.5 times max. pr.) / function test.
14.	Variable area flow meters
	Calibration test / Material test / Hydrostatic test (1.5 times max. pr.)
15.	Flow element
	100% Radiography test / Hydro test / Calibration test, IBR Certificate.
	Calibration test for flow element shall be witnessed by Owner.
16.	Control valves/Pneumatic block valve/Pressure regulating valve – Refer chapter 11.
17.	Position transmitters
	Calibration / hysteresis and Accuracy test
18.	Electro Pneumatic Convertors
	Calibration test / Accuracy test
19.	Solenoid valves
	Hydrotest / Seat leakage test / CV test / Coil insulation test
20.	Air filter regulators
	Calibration test / Accuracy test
21.	Junction Boxes
	Test for degree of protection / Material test
22.	Tests for terminal blocks
	Test for moulding for flame resistant, Non-hygroscopic and Decarbonised / Insulation test between terminals / Insulation between terminal block and frame.
23.	Thermocouple extension cable
	Thermo-emf characteristic / Continuity test / Measurement on capacitance, inductance and loop resistance / Insulation resistance / High voltage test as per latest IS / Tensile and elongation test / Oxygen index test / Any other test applicable.
24.	Mass flow meter
	Performance test / Calibration test / Hydrostatic test.
25.	Boiler Level Gauge
	Hydrostatic test / Material test / Seat leakage test / IBR Certificate
26.	pH/Conductivity measurement / Silica / Dissolved oxygen analysers:
	Calibration test, Accuracy test
27.	Sample cooler :

	Hydro test, IBR Certificate
28.	Sampling racks :
	Hydro test, IBR Certificate for tubes and fittings.
29.	S02 / Nox analyser / SPM analyser:
	Calibration test, accuracy test
30.	Interposing relay
	Functional test, temperature rise test, H.V test, Insulation test
31.	Transmitter Racks :
	Hydro test, air leak test for piping / tubing and fittings. IBR certification as required for tubing / piping and fittings.
32.	Pressure Transmitter
	Calibration test / Hydro test / Leak test / Over range test / Accuracy test / Repeatability test.
33.	Differential pressure transmitter
	Calibration test / Hydro test / Leak test / Over range test / Accuracy test / Repeatability test.
34.	Temperature Transmitter
	Calibration test / Accuracy test / Ambient temperature error test
35	Pneumatic Block Valves
	a) IBR certificate form III C b) Hydrostatic test : ANSI B 16.34 c) Seat leakage test : As per ANSI B 16-104 d) CV test: As per ISA procedure e) Magnetic particle test ANSI B 16.34 special class (applicable for pr.>70 bar & temp< 400 DegC) f) Liquid penetration test: ANSI B 16.34 special class (applicable for pr.>70 bar & temp< 400 DegC) g) Radiography test: ANSI B 16.34 special class h) Calibration and Hysteresis test i) Actuator leakage test
36.	Pressure Regulating Valve

	a) IBR certificate form III C b) Hydrostatic test : ANSI B 16.34 c) Seat leakage test : As per ANSI B 16-104 d) CV test: As per ISA procedure e) Magnetic particle test ANSI B 16.34 special class (applicable for pr.>70 bar & temp< 400 DegC) f) Liquid penetration test: ANSI B 16.34 special class (applicable for pr.>70 bar & temp< 400 DegC) g) Radiography test: ANSI B 16.34 special class h) Calibration and Hysteresis test i) Actuator leakage test
37.	Local Panels : Visual inspection, wiring & continuity check, H.V. and I.R. tests on panels, checking of bill of materials, functional tests.
38	Wiring Termination & Accessories
	Routine test: Conductor resistance test/High voltage test/Impulse dielectric test/insulation test/Humidity test/Temperature rise test on power circuits/short time current test on power circuits.
	Type test:Annealing test/Test for insulation and sheath/ Flame retardance test - a) Oxygen index, b) Flammability / Test for acid gas generation/test for water absorption/wet dielectric test
39	Marshalling/System cabinets
	Verification of degree of protection/Electrical tests as detailed under wiring Termination& accessories/Type test and routine test as per relevant Indian standards.
	Notes:
	1. Test Certificates in addition to inspection at manufacturers works shall be furnished for all the instruments for Owner's review.
	2. Above Test to be witnessed shall be finalized by Owner.
	3. In addition to above test, test as per approved QAP shall also be witnessed by owner.

17.02.05 TYPE TESTING

The BIDDER shall furnish the Type test reports of all type tests as per relevant standards and codes. As well as other specific tests indicated in the specification. A list of such tests are given for various equipment in the table titled, TYPE TEST REQUIREMENT FOR C&I SYSTEM and under the item special requirement for solid state requirements/systems. For the balance equipments/instruments, type test may be conducted as per manufacturer standards or if required by relevant standards.

A. Out of these tests listed, the bidder/subvendor/manufacturer is required

to conduct certain type test specifically for this contract (and witnessed by employer or his authorized representative). Even if the same have been conducted earlier as clearly indicated subsequently such tests.

- B. For the rest, submission of type test, results, and certificates shall be acceptable provided following points
- i. The same have been carried out by the bidder/ subvendor on exactly the same model/rating of equipment. (For control valves this shall be same size, type & design).
 - ii. There has been no change in the components from the offered equipments and tested equipments.
 - iii. The test has been carried out as per the latest standards along with amendments as on the date of bid opening.
- C. In case the approved equipment is different from the one on which the type test had been conducted earlier or any of the above grounds, then the tests have to be repeated and the cost of such tests shall be borne by the bidder/sub-vendor within the quoted price and no extra cost will be payable by the owner on this account.

17.02.05.1 As mentioned against certain items, the test certificates for some of the items shall be reviewed and approved by the main bidder or his authorized representative and balanced have to be approved by the employer.

The schedule of conduction of type test/submission of reports shall be submitted and finalized during pre award discussion.

17.02.05.2 For the type test to be conducted, bidder shall submit detailed test procedure for approval by owner. This shall clearly specify test setup, instruments to be used, procedure, acceptance norms (wherever applicable), recording of different parameters, intervals of recording precaution to be taken etc. for the test to be carried out.

17.02.05.3 SPECIAL REQUIREMENTS FOR SOLID STATE EQUIPEMNTS /SYSTEMS

The minimum type test report, over and above the requirements of above clause which are to be submitted for each of the major C&I systems like DDCMIS, DCS, PLC etc shall be as indicated below:

- i. Surge Withstand Capability (SWC) for solid state equipments/equipments

All solid state systems/equipments shall be able to withstand the electrical noise and the surges as encountered in actual service conditions and inherent in the power plant. All the solid states systems /equipments shall be provided with all required protection that needs the surge withstand capability as defined in ANSI 37.90.1/IEEE 472. Hence, all front end cards which receive external signals like analog input and output modules, Binary input and output modules etc including power supply, data highway, data links shall be provided with protection that meets the surge withstand capability as

defined in ANSI 37.90.1/IEEE 472. Complete details of the features incorporated in the electronic system to meet this requirement the relevant test carried out, the test certificates, etc shall be submitted along with the proposal. As an alternative to the above, suitable class of EN 61000-4-12 which is equivalent to ANSI 37.90.1/IEEE 472 may also be adapted for SWC test.

- ii. The dry heat test as per IEC-68-2-2 or equivalent
- iii. Damp heat test as per IEC 68-2-3 or equivalent
- iv. Vibration test as per IEC 68-2-6 or equivalent
- v. Electrostatic Discharge test as per EN 61000-4-2 or equivalent
- vi. Radio frequency immunity test as per EN 61000-4-6 or equivalent
- vii. Electromagnetic Field Immunity test as per EN 61000-4-3 or equivalent

Test listed at Item no v, vi, vii above are applicable for electronic cards only as defined under item no. (i) above

17.02.05.4 **TYPE TEST REQUIREMENTS FOR C&I SYSTEMS**

S.No.	Item	Test requirement	Standard	Test to be specifically conducted	Owner's Approval required on Test Certificate
1	Electrical metering instruments	As per standards	IS 1248	No	Yes
2	Thermocouple	Degree of Protection Test	IS - 13947	No	No.
3	Junction Box	Degree of Protection Test	IS - 13947	Yes	Yes
4	RTD	As per standards	IEC-60751	No	No
5	Electronic Transmitter	As per standards	BS 6447/ IEC 60770	No	Yes
6	E/P convertor	As per standards	Manufacturing standard	No	Yes
7	Instrumentation cable (Twisted and shielded) (Refer Vol. V, Chapter 9)				
8	Battery	As per standard	IS 10918	Yes	YES
9.	Voltage stabiliser	Over load test	Approved procedure	No	YES
		Temp. rise test without redundant fans	Approved procedure	No	YES
		Input voltage variation test	Approved procedure	No	YES
10	DDCMIS				
	CLCS	Model Test	Approved	No	No

	system		procedure		
	BMS & MFT	Safety requirement	VDE 0116, SEC 8.7	No	YES
11	Conductivity type level switch	Degree of protection test	IS 13947	No	No
12	Local gauges	Degree of protection test	IS 13947	No	No
13	Process actuated switches	Degree of protection test	IS 13947	No	No
14	Control valves	CV test	ISA 75.02	No	YES
15	PLCs	As per Standard	IEC 1131	No	YES
16	LIE/LIR	Degree of protection test	IS 13947	YES	YES
17	Flue gas O ₂ analyser, other Flue gas Analysers	Degree of protection test	IS 13947	No	YES
18	Flow nozzles & Orifice plates	calibration	ASME PT C BS 1042	YES	YES

Note:

Type test are to be conducted only for the items, which are being supplied as part of this package.

- A. For batteries with electric power supply system of main plant C&I, the bidder shall submit for owner's approval the reports of all the type tests as per IS-10918 carried out within last 5 years from the date of bid opening and the test should have been either conducted at an independent laboratory or should have been witnessed by a owner/client. The complete type test report shall be for any rating of battery in a particular group, based on plate dimensions being manufactured by supplier.

For batteries with electric power system of auxiliary plants, type test reports for batteries shall be as per standard –practice of manufacturer.

14.02.06 Testing at Site [Prior to commercial operation]

- a. All equipment shall be checked thoroughly in respect of the following:
 - i. Visual and mechanical testing
 - ii. Complete system configuration loading functions; system diagnostics; system proper operation specified power supply specifications.

		STANDARD QUALITY PLAN FOR PROGRAMMABLE LOGIC CONTROLLER						QUALITY PLAN NO.: PE-QP-999-145-I036 ____				
								VOLUME IIB				
								SECTION D				
								REV. NO. 01		DATE: 24.08.2007		
								SHEET 1		OF 8		
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records P	Agency \$			Remarks
										W	V	
1.0	Materials /Components											
1.1	Panels & Control Desks	Physical Inspection for Dimensions, Painting, Cutouts, Lifting / Locking Arrangements, Components, Drawing Pocket, Mounting accessories, Plinth & AV Pads, Cable Gland Plates, Hardwares, Hinges, Louvers & Filters, Fans & Panel Lamps	MA Visua	I	100%	Contract specifications, Approved GA Drawings, BOQ	As per ref documents. No physical damage.	BHEL Quality Inspection Report.	3/2 2		1	
1.2	Power Supply/Packs, Battery & Battery charger, Transformer, UPS.	Physical Inspection Physical Damages Dimensions Mounting Accessories	MA Visua	I	100%	Contract specifications, BOQ.	As per reference documents, Test Report	BHEL Quality Inspection Report.	3/2 2		1	
1.3	Indicating Lamp, Annunciator, Meters, Transducers, Signal Converters, Instruments, Single Loop Controllers	Physical Verification Physical Damages Dimensions Accessories	MA Visua	I	100%	Contract specifications, BOQ.	As per ref documents No physical damage. Test/ Calibration report.	BHEL Quality Inspection Report	3/2 2		1	
1.4	PLC processors, I/O modules, Power Supply modules, Communication modules, Mounting Racks, Ethernet	Physical Inspection - Identification Labels - Physical Damages - Quantity - Spare Capacity	MA Visua	I	100%	Product Catalogue, Data sheets, Approved Configuration diagram, BOQ	As per ref documents. Test Certificates	BHEL Quality Inspection Report.	3/2 2		1	

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

\$

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

1 - BHEL
2 - Vendor
3 - Sub-vendor

(बीएचएल) BHEL PEM :: C&I		STANDARD QUALITY PLAN FOR PROGRAMMABLE LOGIC CONTROLLER						QUALITY PLAN NO.: PE-QP-999-145-I036__				
								VOLUME IIB				
								SECTION D				
								REV. NO. 01		DATE: 24.08.2007		
								SHEET 2		OF 8		
Sl. No.	Component / operation	Characteristics Checked	* Cate gory	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records P	Agency \$			Remarks
									W	V		
1.5	CPU, Monitor, Keyboard, Mouse, CD Drives, Printers, OS, System Software, Engineering software in the form of Licensed CD.	Physical Inspection Identification Labels, Tech. Specification Physical Damages Accessories Installation arrangements for Computers & Printers	MA	Visual	100%	Contract specifications, Product Catalogue, Approved GA / Configuration drawing, BOQ.	As per reference documents.	BHEL Quality Inspection Report.	3/2	2	1	

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

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

1 - BHEL
 2 - Vendor
 3 - Sub-vendor

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Sl. No.	Component / operation	Characteristics Checked	* Cate gory	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records P	Agency \$			Remarks
										W	V	

2.0 Assembly												
2.1	Functional Test for HMI/OVS devices such as Monitors, Keyboards, Mouse, Printers etc.	Operation	MA	Functional	100%	Approved Configuration Diagram & BOQ and FAT	Correct Operation of interconnected Devices of HMI system.	BHEL Quality Inspection Report.	2 1		1	
2.2	Hardware Functional Verification.	Physical arrangement, Wiring check & labeling, Continuity Checking, IR & HV test	MA	Visual/ Electrical	100%	Approved GA Drawing, Panel Wiring Diagram, IR & HV as per relevant International standard	Test Certification	BHEL Quality Inspection Report.	2 2		1	
2.3	Powering Up	Healthiness of all the modules/equipment, associated with Powering of PLC system	MA	Visual /Electrical	100%	Approved power supply scheme	All equipment to be healthy on power ON	BHEL Quality Inspection Report.	2 1		1	
2.4	Burn in test for PLC modules	Healthiness of PLC modules on Continuous Energisation, Temperature maintenance	MA	Visual/ Electrical	100% F	AT Procedure	Test certification as per FAT	BHEL Quality Inspection Report.	2 2		1	

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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records P	Agency ^s			Remarks
										W	V	

3.0	Factory Acceptance Test (FAT)											
3.1	Input Output Functional Verification	I/O configuration, I/O operation	MA	Visual/ Eletrical	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2 1		1	
3.2	Processor Verification	Processor configuration, Powering up, standby operation (as applicable) and Loading	MA	Visual	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2 1		1	
3.3	Power Supply Module Verification	Redundancy Operation	MA	Electrical	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2 1		1	
3.4	Communication System Verification	Redundancy operation of Communication System, Measurement of Response Time, Communication with third party system	MA	Electrical	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2 1		1	
3.5	Diagnostic Verification	Self Diagnostic features of PLC system	MA	Visual	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2 1		1	
3.6	Control Panel/Desk Verification	Operation of PLC driven annunciation system, Mosaic, Push buttons & selector switches, Indicating lamps	MA	Visual	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2 1		1	
3.7	Software Verification	(i) Control Logics (ii) Engineering Features (iii) HMI Features	MA	Visual	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2 1		1	

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FACTORY ACCEPTANCE TEST (FAT) PROCEDURE

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

- a) Technical Specification of PLC.
- b) PLC System Configuration
- c) General Assembly Drawings.
- d) Panel Wiring Diagrams.
- e) Bill of Quantity for PLC System.
- f) Logic Diagram.
- g) HMI Schematics.
- h) Input / Output List.

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

APPLICABLE TEST PROCEDURE:

1. Input/Output Functional Verification.

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

2. Processor Verification

PLC Configuration drawing to be referred for ascertaining

- i) Redundancy

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ii) Type (Hot or Cold)

Both the processors are to be checked for healthiness in case of redundant configuration as per vendor's standard practice. In case of hot redundancy, switchover of control from primary processor to standby processor shall be demonstrated for uninterrupted control and data processing as per vendor's standard practice. Switchover shall be witnessed, by manual power off or resetting the Primary CPU or simulating failure of primary processor. Checking should be by witnessing the lighting up of Processor's LEDs as per manufacturer's product standard.

Vendor shall demonstrate, as per Vendor's standard practice, adequate Loading (Spare Capacity) of Processors, as mentioned in contract specs. This shall be done, by simulating worst load operation of fully integrated PLC system.

3. Power Supply Module Verification

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

4. Communication System Verification

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

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

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

5. Diagnostic Verification

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

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6. Control Panel /Desk Verification

- i) PLC driven annunciation system should be checked by alarm signal simulation.
- ii) Push Button and selector switch operation should be checked by verification of corresponding change of status of Data Base point.
- iii) Indicating lamp / MIMIC should be checked by corresponding Data Base point simulation.

7. Software Verification

- i). Control Logics:– Software switches, lamps and Analog sources shall be used for simulation of field conditions .Control logics shall be checked for its correct functionality as per approved logic schemes
- ii). Engineering features:-
 - a) Online changing of parameters, set points.
 - b) Online modification in Control Logic Diagrams.
 - c) Online configuration of Graphics, Trends, Logs, HSR.
- iii). HMI features:-
Check for configuration & operation of Graphics, Trends, Logs, HSR and Alarms, in the form of Displays and Printouts, by simulation of Inputs as per approved documents.

8. Burn in Elevated Temperature test

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

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

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

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

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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^{\$}			Remarks
									P	W	V	
1.0	INCOMING Sheet Steel (CRCA & HR)	1. Chemical Composition	MA	Chemical analysis	Sample	Relevant standard	Relevant standard	Test Certificate	3	---	2	
		2. Bend Test	CR	Mech. test	Sample	Relevant standard	Relevant standard	Log Book	2	---	---	
		3. Surface finish	MA	Visual	100%	Factory Standard / Sample	Factory Standard / Sample	Log Book	2	---	---	
		4. Waviness	MA	Visual	100%	Factory Standard	No Waviness	Log Book	2	---	---	
		5. Thickness	MA	Measurement	100%	BHEL Spec.	BHEL Spec.	Log Book	2	---	---	
		6. Mill marking	MA	Visual	100%	Factory Standard	Factory Standard	Log Book	2	---	1	
2.0	Flats / Angles / Channels	1. Dimensions	MA	Measurement	Sample	Relevant standard	Relevant standard	Log Book	2	---	---	
		2. Surface Defects	MA	Visual	100%	Factory Standard / Sample	Factory Standard / Sample	Log Book	2	---	---	
		3. Straightness	MA	Measurement	100%	Factory Std.	Factory Std.	Log Book	2	---	---	
		4. Mill marking	MA	Visual	100%	Relevant standard	Relevant standard	Log Book	2	---	1	
3.0	Cables / Wires	1. Visual / Surface defects	MA	Visual	100%	BHEL Spec. and Relevant standard	BHEL Spec. and Relevant standard	Log Book	2	---	---	
		2. IR and HV	MA	Electrical	100%	BHEL Spec. and Relevant standard	BHEL Spec. and Relevant standard	Log Book	2	---	---	
LEGEND: * CR - Critical characteristics MA - Major characteristics MI - Minor characteristics ^{\$} P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test. 1 - BHEL 2 - Vendor 3 - Sub-vendor												

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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^{\$}			Remarks
									P	W	V	
		3. Conductor a) Resistance b) Size c) Sheet colour	MA MA MA	Electrical Measurement Visual	100% 100% 100%	BHEL Spec. and Relevant standard	BHEL Spec. and Relevant standard	Log Book	2	---	---	
		4. Type / Routine Test Certificates	MA	Verification	100%	BHEL Spec. and Relevant standard	BHEL Spec. and Relevant standard	Log Book	3	---	2	
4.0	Electrical Components like Annunciator Transformers Lamps Switches PBs Contactors Relays Timers Space Heaters Thermostat Indicating meters etc.	1. Verification at make and Type 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 Electrical	Sample 100% Sample+ 100% 100% 100% 100% 100%	BHEL Spec. and BOM Relevant standard Relevant standard & Catalogue Relevant standard & Catalogue Relevant standard & Catalogue Relevant standard & Catalogue Relevant standard & Catalogue	BHEL Spec. and BOM Relevant standard Relevant standard & Catalogue Relevant standard & Catalogue Relevant standard & Catalogue Relevant standard & Catalogue Relevant standard & 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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									P	W	V		
5.0	Misc. Components like Gaskets, Terminal Blocks etc.	1. Verification of Type / Make	MA	Visual	Sample	BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue	Log Book	2	---	---		
		2. Surface defects	MA	Visual	Sample	BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue	Log Book	2	---	---		
		3. IR / HV on Terminal Blocks	MA	Electrical	Sample	BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue	Log Book	2	---	---		
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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Sl. No.	Component / operation	Characteristics Checked	* Cate gory	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^{\$}			Remarks	
9.0	Pre-treatment and Painting	1. Pretreatment Process	MA	Visual	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1		
		2. Process parameters like bath temp. concentration etc.	MA	Measurement	Periodic	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1		
		3. Dipping / Removal Time	MA	Measurement	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1		
		4. Surface quality after every dip	MA	Visual	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1		
		5. Primer after phosphating	MA	Visual, Thickness	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1		
		6. Putty Application & Rubbing after primer	MA	Visual	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1		
		7. Paint first coat	MA	Visual, Thickness	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1		
		8. Putty Application and Rubbing after first coat of paint	MA	Visual	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1		
		9. Paint second coat	MA	Visual, Thickness, Scratch test Colour adhesion	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1		
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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^{\$}			Remarks
									P	W	V	
10.	Panel Wiring	1. Wiring Layout	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	
		2. Wiring Termination (Crimped Lugs)	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	
		3. Ferrule numbers	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	
		4. Colour of wiring	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	1	
		5. Size of Conductor	MA	Measurement	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	1	
11.	Component Mounting	1. Correct components	MA	Visual	100%	Approved drgs., Specs. & BOM	Approved drgs., Specs. & BOM	Log Book	2	---	---	
		2. Fixing	MA	Visual	100%	Approved drgs., Specs. & BOM	Approved drgs., Specs. & BOM	Log Book	2	---	---	
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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									P	W	V		
		5. Dimensions	MA	Measurement	100%	BHEL approved drg. / Spec., BOM	BHEL approved drg. / Spec., BOM	Inspection Report	2	1	1	At Random by BHEL, based on 100 % internal test reports by Mfr.	
		6. Door functioning	MA	Functional	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1		
		7. Paint Shade	CR	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1		
		8. Paint Thickness	CR	Measurement	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1		
		9. Workmanship of Gaskets	MA	Visual	100%	Factory Standard	Factory Standard	Inspection Report	2	1	1		
		10. Wiring Layout	MA	Visual	100%	BHEL approved drg.	BHEL approved drg.	Inspection Report	2	1	1		
		11. Wire Termination	MA	Pulling manually	Sample	-----	Firm termination	Inspection Report	2	1	1		
		12. Continuity	MA	Electrical	100%	-----	Continuity OK	Inspection Report	2	1	1		

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									P	W	V	
13.	TYPE TEST	Degree of Protection	CR	Mech. Protection	Sample	BHEL approved spec., drg relevant IEC-60947, IEC-60079	BHEL approved spec., drg relevant IEC-60947, IEC-60079	Type Test Certificate	3	---	1	
14	ROUTINE TEST	IR before & after HV Test	CR	Electrical	100%	BHEL approved spec., drg., BOM & relevant standard	BHEL approved spec., drg., BOM & relevant standard	Test Report	2	1	1	
15	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 standard	BHEL approved spec/drg & relevant standard	Inspection Report	2	1	1	

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**TITLE**

2X 660 MW ENNORE SEZ STPP
TECHNICAL SPECIFICATION FOR
CONDENSATE POLISHING UNIT

SPECIFICATION NO : PE-TS-412-155A-A001

VOLUME: II B

REV 00

SHEET

SECTION C1 – E
PAINTING SPECIFICATION

CHAPTER - 6

PAINTING

1.0 SCOPE

This section defines the technical requirements for surface preparation, selection and application of paints on equipment, vessels, machinery, piping, ducts etc. However, manufacturers shall follow their standard procedures for painting their equipment. The bidder shall submit a detailed painting procedure for approval of owner/ owner's representative after the award of contract.

The following surface and material shall require painting:

- a. All un-insulated carbon steel and alloy steel equipment like columns, vessels, storage tanks, pumps, heat exchangers etc.
- b. All un-insulated carbon steel and low alloy piping, fitting and valves (including painting of identification marks).
- c. All pipe structural steel supports, walkways, platforms, handrails, ladders etc.

The following surfaces and materials shall not require painting :

- a. Non-ferrous materials
- b. Austenitic stainless steel
- c. Plastic and / or plastic coated materials
- d. Insulated surface of equipment and pipes except color coating wherever required.
- e. Painted equipment like blowers, pumps, valves etc. with finishing coats in good condition and with matching color code.

2.0 CODES AND STANDARDS

Painting of equipment shall be carried out as per the specifications indicated below and shall conform to the relevant IS specification for the material and workmanship.

The following Indian Standards may be referred to for carrying out the painting job :

IS:5	:	Colours for ready mixed paints and enamels
IS:1303	:	Glossary of terms relating to paints
IS:2379	:	Colour code for identification of pipelines
IS:1477	:	Code of practice for painting of ferrous metals in buildings (Parts I & II)
IS:2524	:	Code of practice for painting of non-ferrous metals in buildings (Parts I & II)
IS:2395	:	Code of practice for painting of concrete, masonry and plaster surfaces (Parts I & II)

IS:2338	:	Code of practice for finishing of wood and wood based materials (Parts I & II)
IS:158	:	Ready mixed paint, brushing, bituminous, black, lead free, acid, alkali, water and heat resisting.
IS:2074	:	Ready mixed paint, air drying, red Oxide Zinc Chrome, priming
IS:104	:	Ready mixed paint, brushing, Zinc Chrome, priming
IS:2932	:	Enamel Synthetic exterior (a) Undercoating (b) finishing
IS:4682	:	Code of practice for lining of vessels & equipment
SIS 559000	:	Swedish standard for blasting
ISO 8504-2	:	Preparation of steel substrates before application of paints and related products. Surface preparation methods Part 2 Abrasive blast cleaning
ISO 8501-1	:	Preparation of steel substrates before application of paints and related products. Visual assessment of surface cleanliness. Part 1 : Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings.
SIS 05 5800	:	Surface preparation by acid pickling
SSPC SP08	:	Surface preparation by acid pickling
IS 2629	:	Recommended practice for hot dip galvanizing of iron and steel
ASTM A780	:	Standard practice for repair of damaged galvanized coatings
SSPC	:	Steel structures painting council
NACE	:	National association of Corrosion Engineers
DIN	:	Deutsehes Institute for Normung
BS	:	British Standard
ASTM	:	American Society for Testing material
AWWA	:	American Water works association

3.0 SURFACE PREPARATION

The surface shall be prepared in a manner suitable for coatings. Chemical derusters or rust converters shall not be applied. Acid cleaning is subject to approval of Purchaser/ Purchaser's representative.

3.1 BLASTING

The surface of the part/ component shall be blasted before the coating material is applied.

Compressed air supply for blast cleaning shall be free of water and oil. Air compressors shall not be allowed to deliver air above 1100C. Blasting activity shall be performed at temperatures 30C above dew point and substrata temperature between 50C & 500C and relative humidity not exceeding 85% shall be maintained during painting. Necessary safety precautions for equipment and operator shall be adhered to and shall comply with applicable laws, regulations, ordinances etc., of the local authority, state or the nation pertains to the work.

Abrasive used for blast cleaning carbon steel and alloy steel shall be as per ISO 8504-2 and SSPC painting manual. Suggested abrasives are chilled iron grit, shot steel, malleable iron grit and shots of non metallic abrasive (aluminum oxide, copper slag, garnet etc.).

The grade of blasting shall be performed in line with the approved painting scheme.

The nature, quality and grain size of abrasives and the parameter of their use are to be chosen to obtain the required surface profile depth and cleanliness.

Surfaces prepared for coating shall be coated the same day and before any visible rusting occurs (the time elapsed between blast cleaning and commencement of painting shall under no circumstances exceed 4 hours, but in any case must commence before signs of degradation occur).

The grades of surface finish

	ISO 8501-1	SIS 055900	SSPC	NACE
White metal	Sa3	Sa3	SP5	1
Near White metal	Sa 2½	Sa 2½	SP10	2
Commercial Blast	Sa2	Sa2	SP6	3
Brush off blast	Sa1	Sa1	SP7	4

Unless otherwise specified in the documents, the surface shall satisfy the following requirements after blasting

(a) Blasting according to SIS 055900, Grade Sa 2½

Primer paint shall be Zinc Silicate of approved brand. Dry film thickness of each primer coat shall be 15-25 µm.

3.2 Manual Rust Removal

Manual rust removal shall be allowed for welded zones and for touching up installed components.

3.3 Cleaning

Removal of impurity

	Impurity	Removal
a)	Dust, Loose deposits	Vacuum cleaning, brushing
b)	Adhesive deposits	Power brushing
c)	Oils, greasy impurities	Wet Blasting, Use of Detergent Additives by agreement
d)	Salt deposits	Rinsing
e)	Markings (eg felt up pen)	Organic solvents to manufacturer's specifications eg Trichloro trifluoro ethane and solvents containing acetone (renew solvent and rag frequently)

3.4 Acid Pickling

Prior to galvanizing the surface preparation shall be done by acid pickling as per SSPC-SP-08.

4.0 PROCESSING

4.1 General Application Conditions

The primer shall be applied to properly prepared surfaces only. The specifications of the coating material manufacturers shall be observed. The minimum temperature shall be + 5°C and the relative humidity shall not exceed 80%. The temperature of the work piece shall be at least 3°C above dew point.

4.2 Application Procedure

The primer shall be applied by means of brush or by spary. The top coats shall be applied by means of brush, roller or spray.

At points where coating application is interrupted, the individual layers shall be adequately stepped to ensure proper layer sequence when coating operations are resumed.

4.3 Touching Up

Before each layer is applied, previous coating shall be touched up where necessary by way of rust removal and cleaning according coating manufacturers specification. The final top shall be reapplies completely.

4.4 Uncoated Surfaces

Moving parts of machines (e.g stems, shafts, sliding and locating bearings), nameplates, instruments and sealing surface shall not be coated. Welds shall be left free of coating upto a distance of 30 mm on each side of the weld edge until erection and weld examinations, if any, have been completed.

4.5 Bond Strength

The pill off stress determined using the pull off test method for adhesion shall not be less than 1.5 N/mm², according to ISO 4624.

5.0 SURFACE CONDITIONS OF COATING SURFACES

The coating surface shall have a uniform film thickness, shade and gloss and shall be free from inclusions, sags and wrinkles.

6.0 COATING SYSTEMS

6.1 General Requirements for Coating Systems

Coating materials according to SSPC, BS 5493 or DIN 55 928 shall be used. Intermediate coats are to be pigmented with micaceous iron oxide. The materials shall be matched with each other so that they are compatible. Coatings deviating this

specification shall be subject to approval. Standards of surface preparation and painting shall give a time to first maintenance of 10 years.

The colour and gloss of top coats shall be in accordance with sub clause suggested colour codes for painting (Sub Clause 6.8)

6.2 Standard Coating System (External Coatings)

(a) Steel Surfaces

- (i) All steel structures shall receive two primer coats and two sandwich coat of MIO Epoxy paint and one finish coat of painting. First coat of primer shall be given in shop after fabrication before dispatch to erection site after surface preparation as described below. The second coat of primer shall be applied after erection and final alignment of the erected structures. Two intermediate coats and one finished coat shall also be applied after erection.
- (ii) Steel surface which is to be painted shall be cleaned of dust and grease and the heavier layers of rust shall be removed by chipping prior to actual surface preparation. The surface shall be abrasive blasted as explained in clause 3.1 to Sa 2½ finish as per SIS05-5900. Primer paint shall be Zinc Silicate of approved brand. Dry film thickness of each primer shall be 60 microns.
- (iii) Two intermediate MIO Epoxy paint, and one top polyurethane coating of approved brand shall be applied. Dry film thickness of each intermediate coat shall be 90 microns and top polyurethane coating shall be 30 microns. The under coat and finish coat shall be of different tint to distinguish the same from finish paint. The total dry film thickness shall be 330 microns. All paints shall be of approved brand and shade as per owner's requirement.
- (iv) Joints to be site welded shall have weldable primer applied within 100 mm of welding zone. Similarly where friction grip fasteners are to be used removable anti corrosive coating shall be provided. On completion of the joint the surfaces shall receive the paint as specified.
- (v) Surfaces inaccessible after assembly shall receive two coats of primer prior to assembly. Surfaces inaccessible after erection including top surfaces of floor beams, supporting gratings or chequered plate shall receive one additional coat of finish paint over the above number of coats specified before erection. Portion of steel member embedded/ to be encased in concrete shall not be painted.

(b) Gratings and Step Threads

(i) Surface Preparation

Gratings and step threads shall be cleared by acid pickling as per SSPC-SP-08

(ii) Hot Dip galvanizing

The hot dip galvanizing shall be done as per IS 2629. The average mass of coating shall be 610 gm/m².

(iii) Post Treatment

Immediately after galvanizing post treatment such as chromating shall be applied to retard white rust attack.

(iv) Touch up mechanical damages

The repair of damages coatings shall be done as per the recommended practice ASTM A780.

6.3 Painting of Indoor components such as valves, pumps, motors, electrical parts, tanks etc.

At Works

Surface Preparation

Blasting according to SIS 055900 grade Sa 2½. Depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer of minimum dry film thickness 25 µm may be used.

Prime Coat

Two (2) layers of Zinc phosphate epoxy, total dry film thickness 75µm.

At Site

Thorough cleaning to remove oil, grease, dirt and any other contaminants. Derusting of all mechanical damages according to SIS 055900 Grade ST3. Touch up with dry film thickness 50 µm.

Finish Coat

Application of two (2) finishing coats of chlorinated rubber paint in approved shades at 30-40 microns DFT each coat in approved shades.

Remarks

Equipment coated with a standard application system can be accepted if the quality of this application system is corresponding with the quality of the above mentioned system.

6.4 Painting of Outdoor equipment (external surfaces) such as piping, valves, pumps, motors, electrical parts, tanks etc.

Weather exposure, weather resistance, temperature upto 120°C as per clause 6.1 & 6.3. However

Surface Preparation

Blasting according to SIS 055900 grade Sa 2½. Depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer of minimum dry film thickness 15-25 µm may be used.

Prime Coat

Two (2) layers of Zinc phosphate epoxy, total dry film thickness 75µm.

Intermediate Coat

One (1) layer 2 pack high build epoxy polyamide MIO, DFT 100µm.

Finish Coat

Application of two (2) finishing coats of chlorinated rubber paint in approved shades at 50 microns DFT each coat in approved shades.

6.5

Special Coating

(a) Parts exposed to temperatures above 120°C, upto 200°C, not insulated

(i) At Works

Surface Preparation

Blasting according to SIS 055900 grade Sa 2½ and ISO 8501-1:1958. Depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer of minimum dry film thickness 15-25 µm may be used.

Prime Coat

Inorganic ethyl Zinc silicate, total dry film thickness 75µm.

(ii) At Site

Pretreatment

Dersuting of all mechanical damages, according to ISO 8501-1:1989, grade St 3 touch up with 1 pack inorganic ethyl zinc silicate, dry film thickness 50µm.

Intermediate Coat

1 pack silicon acrylic dry film thickness 35 µm.

Final Coat

1 pack silicon acrylic, dry film thickness as 35µm.
Total system dry film thickness 145µm.
Final coat according to colour code.

(b) **Parts exposed to temperatures above 200⁰C, upto 400⁰C, not insulated**

(i) At Works

Surface Preparation

Blasting according to ISO 8501-1:1958 grade Sa-2½. Depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer of minimum dry film thickness 15-25 µm may be used.

Prime Coat

Inorganic ethyl Zinc silicate, total dry film thickness 75µm.

(ii) At Site

Pretreatment

Derusting of all mechanical damages, according to standard Sa 2½ to ISO 8501-1:1988. Touch up with coating system according to manufacturer's recommendations.

(c) **Insulated parts continuously exposed to condensing water or parts exposed to temperatures**

For parts that are provided with insulation on site.

(i) **Insulated parts exposed to condensing water**

At Works

Surface Preparation

Blasting according to Sa 2½ to ISO 8501-1:1988. Depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer of minimum dry film thickness 15-25 µm shall be used.

Prime Coat

Inorganic ethyl Zinc silicate, total dry film thickness 75µm

(ii) **Insulated parts exposed to temperatures**

Parts exposed to temperatures upto < 400⁰C

Surface Preparation

Blasting according to Sa 2½ to ISO 8501-1:1988. Depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer of minimum dry film thickness 15-25 µm shall be used.

Parts exposed to temperature above 400⁰C at works (Steam pipes, pressure tubes and parts for the HRSG, such as heating surfaces, heaters and superheaters, reheaters etc)

Temporary Primer

Varnish

(d) Intermittent exposure due to condensing water/ chemicals (Indoors)

(i) At Works

Surface Preparation

Blasting according to Sa 2½ and ISO 8501-1:1988. Depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer of minimum dry film thickness 15-25 µm may be used.

Prime Coat

Two layers of Zinc phosphate primer, total dry film thickness 75µm.

(ii) At Site

Pretreatment

Dersuting of all mechanical damages, according to standard Sa3 to ISO 8501-1:1988, touch up with 2 pack high build epoxy with volume solid content of more than 85%, 75µm.

Intermediate Coat

2 pack high build epoxy, dry film thickness 80 µm.

Finish Coat

2 pack silicon acrylic, dry film thickness of 50µm.

Total system dry film thickness 205µm.

When exposed o weathering, weather resistance finish coat shall be applied.

(e) Water Exposure

(i) At Site/ Works

Pretreatment

Removal of all welding pearls.

Blasting according to Sa 3 to ISO 8501-1:1988

Coat

4 coats 2 pack coal tar epoxy, dry film thickness 125 µm each.

Total system dry film thickness 500µm

Touch up after erection as required.

6.6 Painting of Pipes

6.6.1 Buried Piping

Internal surfaces

- (i) Surface cleaning by sand blasting.
- (ii) Two (2) coats of epoxy primer coats. The minimum DFT of each coat shall be 35 microns.
- (iii) Finish coat-Two (2) coats of high build epoxy paint. The minimum DFT of each coat shall be 35 microns.

The total dry film thickness of 150 microns.

Note : All steel pipes carrying sea water shall be internally coated with corrocoat/ polyurea coating having thickness 1500 DFT.

Tests to be carried out after application : Bond/ Adhesion test, Holiday test

External surfaces

- (i) Surface cleaning by Sand Blasting.
- (ii) Coal tar primer compatible with coal tar enamel grade. The number of coats shall be two with a DFT of 35 microns each.
- (iii) Coal tar enamel shall be applied. A single spiral inner wrap of glass fibre tissues shall be applied overlapping at least 25 mm ensuring impregnation of glass fibre tissues in the first coat. The second coat of enamel and second outer wrap of glass fibre felt, Type – I to IS: 7193-1974 will be applied in the same way confirming to Table – 10 of IS – 10221 – 1982.

The total thickness of the coating will not be less than 4.0 mm

- (iv) Alternatively Wrapping with coal tar based anticorrosion tape conforming to IS 15337: 2003 is also acceptable in lieu of s.no. (iii) above. Wrapping thickness shall be 4.0 mm.

Tests to be carried out after application : Bond/ Adhesion test, Holiday test

6.6.2 Overground Piping

Internal surfaces

- (i) Surface cleaning by sand blasting.
- (ii) Two (2) coats of epoxy primer coats. The minimum DFT of each coat shall be 35 microns.
- (iii) Finish coat-Two (2) coats of high build epoxy paint. The minimum DFT of each coat shall be 35 microns.

The total dry film thickness of 150 microns.

Note : All steel pipes carrying sea water shall be internally coated with corrocoat/ polyurea coating having thickness 1500 DFT.

External surfaces

- (i) Surface cleaning by Sand Blasting.
- (ii) Two (2) coats of epoxy primer coats. The minimum DFT of each coat shall be 35 microns.
- (iii) Finish coat-Two (2) coats of high build epoxy paint. The minimum DFT of each coat shall be 35 microns.

6.7 Internal Coatings

6.7.1 Tanks (Internal surfaces) as specified in relevant sections of specification

Industrial deionised, demineralised and potable water upto 60°C pH range 4.5-9.5

Blasting according to Sa 2½ and ISO 8501-1:1988.

Prime Coat

Two layers of Zinc phosphate epoxy primer, total dry film thickness >75µm.

Pretreatment

Repairing of all mechanical damages, according to standard Sa3 to ISO 8501-1:1988, touch up with 2 pack high build epoxy with volume solid content of more than 85%, 75µm.

Intermediate Coat

2 pack high build epoxy, dry film thickness 80 µm.

Finish Coat

2 pack silicon acrylic, dry film thickness of 150µm per coat.

In case of service or potable water tanks, the coating material selected shall not taint the water. The paint system shall confirm to regulations issued by Food & drug administration/ National Public Health service/ AWWA/ OSHA and comply with applicable laws, regulations, ordinances etc. of the local authority, state or the nation pertains to work.

QA/ QC Procedure including pinhole inspection, shall be submitted for approval by Owner/ Owner's representative.

6.6.2 Rubber Lining of Pipes, Valves and Tanks for DM Water

Pretreatment

Blasting according to Sa 2½ and ISO 8501-1:1988

Rubber Lining

Hard rubber 5 mm for DM water applications as IS – 4682

6.7 Painting for Electrical items

6.7.1 All the steel work shall be thoroughly cleaned of rust, scale, oil, grease, dirt and swarf by pickling, emulsion cleaning etc. The sheet steel shall be phosphate/ oven dried and then painted with two coats of zinc rich primer paint. After application of the primer, two coats of finishing epoxy paint shall be applied. The colour of the finishing coats inside shall be glossy white and exterior of the treated sheet steel shall be shade 631 of IS-5/ RAL 7032 for all switchboard/ MCC/ Distribution boards, control panels etc.

6.7.2 All electrical equipment shall be given tropical and fungicidal treatment and outdoor equipment shall be provided with rain hood to prevent entry of rain water into the equipment.

6.7.3 Painting of I & C equipment : Epoxy coating required for all I & C equipment.

6.8 SUGGESTED COLOUR CODES FOR PAINTING

SL. NO.	ITEM/SERVICE	COLOUR	IS-5	COLOUR (BAND)	IS-5
1.	Structures, platforms, galleries, ladders and handrails	Dark Admiralty Grey	632	-	-
2.	Boiler casing, ducting	Nut Brown	413	-	-

SL. NO.	ITEM/SERVICE	COLOUR	IS-5	COLOUR (BAND)	IS-5
3.	Crane				
3.1	Crane structure	Golden Yellow	356	Black	-
3.2	Trolley & hook	Crimson	540	-	-
4.	Fans, pumps, motors, compressors	Light Grey	631	-	-
5.	Tanks (without insulation and cladding)				
5.1	Outdoor	Aluminium	-	-	-
5.2	Indoor	Light grey	631	-	-
6.	Vessels & all other proprietary equipment (without insulation & cladding)	Light grey	631	-	-
7.	Switchgear	Light grey (Powder coated)		-	-
8.	Control & relay panels	Light grey (Powder coated)	631/7078 of IS 1650	-	-
9.	Turbines	Light Grey	631	-	-
10.	Generators & Exciter	Light Grey	631	-	-
11.	Transformers	Aluminum	-	-	-
12.	Machinery guards	Signal red	537	-	-
13.	Piping (without insulation and cladding)				
13.1	Water System				
a	Boiler feed	Sea Green	217	-	-

SL. NO.	ITEM/SERVICE	COLOUR	IS-5	COLOUR (BAND)	IS-5
b	Condensate	Sea Green	217	Light Brown	410
c	DM Water	Sea Green	217	Light Orange	557
d	Soft Water	Sea Green	217	French Blue	166
e	Bearing Cooling Water	Sea Green	217	French Blue	166
f	Potable & filtered Water	Sea Green	217	French Blue	166
g	Service and clarified water	Sea Green	217	French Blue	166
h	Cooling water	Sea Green	217	French Blue	166
l	Sea Water	Sea Green	217	White	-
14.	Ash Transmitting Vessels and pipe lines	Aluminium	-	-	
15.	Air System				
15.1	Station air	Sky blue	101	-	-
15.2	Control air	Sky blue	101	White	-
16.	Oil system				
16.1	Fuel oil	Light brown	410	French	166
16.2	Light oil (HSD)	Light Brown	410	Brilliant green	221
16.3	Lubricating oil	Light brown	410	Light grey	631
16.4	Transformer oil	Light brown	410	Light orange	557
17.	Gas System				
17.1	Carbon dioxide	Canary yellow	309	Light grey	631
17.2	Hydrogen	Canary yellow	309	Signal red	537
18.	Fire services	Fire red	536	-	-
19.	Effluent pipes	Black	-	-	-
20.	Vacuum pipes	Sky blue	101	Black	-

Notes :

1. This colour code basically refers to IS:2379 for piping with necessary modifications

2. Where band colour is specified, same shall be provided at 30 meter intervals on long uninterrupted lines and also adjacent to valves and junctions.

Bidder shall furnish his painting specification to suit corrosive atmosphere of coastal area along with the bid. The specification shall in general be in line with the above requirements.

3. Bidder shall provide one final coat additionally of same DFT as specified in SECTION C1 - E (painting specification) of tender specification at site after completion of erection of each equipment / item. Bidder to adhere the same.

**TITLE**

2X 660 MW ENNORE SEZ STPP
TECHNICAL SPECIFICATION FOR
CONDENSATE POLISHING UNIT

SPECIFICATION NO : PE-TS-412-155A-A001

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SECTION C1 – F

DATASHEET A


TITLE

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DATASHEET –A

1.0	DESCRIPTION OF TURBO GENERATOR UNIT (TG) FOR WHICH CONDENSATE POLISHING IS TO BE PROVIDED :	
(i)	No. of units	Two (2)
(ii)	Capacity of each unit	660 MW
(iii)	Total flow in all the service vessels of each units	1548.8 Tons/hr (VWO, 1% Make Up condition) & 1581.5 Tons/hr (for All HP heaters out condition)
2.0	CONDENSATE POLISHER SERVICE VESSELS PER UNIT :	
(i)	No. of condensate polisher service vessel	Three (3X50%)
(ii)	Capacity of each condensate polisher service vessel	50% of total condensate flow per unit
(iii)	Flow through each condensate polisher service vessel per unit	790.75 Tones per hour
(iv)	Operating pressure of each condensate polisher service vessel	30 kg/cm ² (a)
(v)	Design pressure of each condensate polisher service vessel	47 kg/cm ² (a)
(vi)	Design code of each condensate polisher service vessel	ASME Sec VIII div 1 Ed-2010/ IS 2825 as applicable
(vii)	Working Temp.	55 °C
(viii)	Design temperature of service vessel, its internals and accessories	65 °C
(ix)	Type of vessels	Vertical (Spherical)
(x)	Material of construction	
	Shell	Carbon steel plates to SA 516 Gr. 70
(xi)	Inside protection	Inside lined with Natural Rubber [4.5 mm thick in (3) layers]
(xii)	Resin traps at the outlet of each condensate polisher service vessel & rinse outlet	SS with SS 316 Internals
2.2	AIR-BLOWERS FOR RESIN MIXING (SERVICE VESSELS AREA) PER UNIT	
(i)	Number per unit	Two (2x100%)
(ii)	Type	Rotary, Centrifugal /Twin Lobe, oil free, positive displacement
(iii)	Duty	Intermittent
(iv)	Capacity and head	As required
(v)	Noise level	80 dB (A) Max. at one meter
(vi)	Pressure gauge	One per blower
(vii)	Location	Indoor
(viii)	Material of construction	Casing – Cast Iron GR FG 260 to IS 210 Lobe – Cast Iron GR FG 260 to IS 210 Shaft – Carbon Steel to EN 8
(ix)	Drive motor	Energy Efficient-1 as per IS : 12615
3.0	EXTERNAL REGENERATION FACILITIES	
3.1	REGENERATION VESSELS	
a.	RESIN SEPARATION AND CATION RESIN REGENERATION VESSEL	
(i)	Number	One (1) no. vessel common for 2 x 660 MW Units
(ii)	Design Temperature	60°C
(iii)	Minimum Design Pressure	10 Kg/cm ² (g)
(iv)	Type	Vertical (Cylindrical)


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(v)	Material of construction	
	Shell	SA 516 Gr. 60 or 70 / SA 282 Gr. C
	Dished ends	SA 516 Gr. 60 or 70 / SA 282 Gr. C
(vi)	Inside protection	Inside lined with Natural Rubber [4.5 mm thick in (3) layers]
(vii)	Design code	ASME Sec VIII div 1 Ed-2010/ IS 2825 as applicable
b.	CATION RESIN REGENERATION VESSEL	
(i)	Number	One (1) no. vessel common for 2 x 660 MW Units
(ii)	Design Temperature	60°C
(iii)	Minimum Design Pressure	10 Kg/cm ² (g)
(iv)	Type	Vertical (Cylindrical)
(v)	Material of construction	
	Shell	SA 516 Gr. 60 or 70 / SA 282 Gr. C
	Dished ends	SA 516 Gr. 60 or 70 / SA 282 Gr. C
(vi)	Inside protection	Inside lined with Natural Rubber [4.5 mm thick in (3) layers]
(vii)	Design code	ASME Sec VIII div 1 Ed-2010/ IS 2825 as applicable
c.	MIXED RESIN STORAGE VESSEL	
(i)	Number	One (1) no. vessel common for 2 x 660 MW Units
(ii)	Design Temperature	60°C
(iii)	Minimum Design Pressure	10 Kg/cm ² (g)
(iv)	Type	Vertical (Cylindrical)
(v)	Material of construction	
	Shell	SA 516 Gr. 60 or 70 / SA 282 Gr. C
	Dished ends	SA 516 Gr. 60 or 70 / SA 282 Gr. C
(vi)	Inside protection	Inside lined with Natural Rubber [4.5 mm thick in (3) layers]
(vii)	Design code	ASME Sec VIII div 1 Ed-2010/ IS 2825 as applicable
d.	Resin traps at the common outlet header of regeneration vessels	SS with SS 316 Internals
e.	Accessories	Operating platforms, ladders, supports, lifting lugs (4 nos. minimum), handhold (1 no. of 150mm dia) & manhole (Minimum-2 nos. of 500mm dia) etc. For each vessel shall be provided.
	The vessels indicated against sr. no. a, b and c above is for reference only. Please note that number and type of regeneration vessels shall be as per supplier recommendation only.	
3.2	BULK ACID AND ALKALI STORAGE TANKS	
(i)	CHEMICAL TANKS	ACID STORAGE TANKS ALKALI STORAGE TANKS
(ii)	Number required	Two (2) Two (2)
(iii)	Design code	-----As per BS-2594 or equivalent-----
(iv)	Dimensions (diameter, length & thickness)	-----As per BS-2594 or equivalent-----
(v)	Location	-----Outdoor-----
(vi)	Useful capacity (each)	30 m ³ 20 m ³
(vii)	Type and Pressure class	--Horizontal cylindrical with dished (torishpherical) ends, atmospheric, above ground--
(viii)	Material of construction	FRP -----Carbon steel (IS 2062 Gr A/B) with rubber lining inside -----
(ix)	Protection – Inside	----- 4.5 mm thk rubber lining (in three layers 1.5 mm each)
(x)	Protection – Outside	----- Chlorinated rubber paint DFT 500 microns.


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(xi)	Concentration	30 -33 % HCl	48 % NaOH
(xii)	Accessories	Vent, overflow, Drain, fume absorber, CO2 absorber ,seal pot, sample connection ,spare connection ,Manhole etc.	
(xiii)	Pipe & flanges M.O.C.	CPVC Sch.40	
(xiv)	Valve M.O.C.	CPVC PN 10	
(xv)	Manhole, staircase, operating platforms	Provided	Provided
3.3	ACID AND ALKALI UNLOADING / TRANSFER PUMPS		
(i)	PUMPS	ACID UNLOADING/TRANSFER PUMPS	ALKALI UNLOADING/TRANSFER PUMPS
(ii)	Number required	Two (2x100%) nos. (1W+1S)	Two (2x100%) nos. (1W+1S)
(iii)	Type	-----Horizontal Centrifugal-----	
(iv)	Location	-----Outdoor-----	
(v)	Service	-----Intermittent-----	
(vi)	Pressure gauge	One per pump with teflon diaphragm seal	
(vii)	Capacity and head	-----10 m3 / hr and 15 MWC (minimum)-----	
(viii)	Liquid to be handled	30 -33 % HCL	45-48% NaOH
(ix)	Material of construction		
	Casing	Polypropylene	Polypropylene
	Impeller	Polypropylene	Polypropylene
	Shaft	BS-970 Hardened Steel EN8	BS-970 Hardened Steel EN8
	Shaft Sleeves	Ceramic	Alloy 20
	Types of shaft sealing	Mechanical seal	Mechanical seal
(x)	Pump speed	1450 rpm	1450 rpm
(xi)	Drive motor	415V, 3Φ, 50 HZ TEFC.	
(xii)	Accessories required	Coupling guard, drain plug, vent valve ,suction hoses, isolation valves, y- type strainers etc.	
(xiii)	Type of coupling between motor and pump	Flexible coupling	
(xiv)	Reinforced rubber house with coupling and isolation valve	One (1) No. of each application size 80NB, minimum 20 meter with isolation valve, Reinforced Chemical Resistant Rubber.	
(xv)	MOC for piping, valves & fittings in acid/alkali handling	For valve -CPVC PN10, For piping, flanges & fittings –CPVC Sch. 40	
3.4	CHEMICAL HANDLING, PREPARATION & DOSING SYSTEM		
a)	ALKALI TRANSFER CUM RECIRCULATION PUMPS WITH MOTOR		
(i)	Nos. required	Two (2x100%) (1 W+ 1 S)	
(ii)	Type	Horizontal, centrifugal	
(iii)	Service	Intermittent	
(iv)	Location	Outdoor	
(v)	Pressure gauge	One per pump with teflon diaphragm seal	
(vi)	Maximum Pump Speed	1500 rpm	
(vii)	Type of Coupling between pump & motor drive	As per manufacturer's standard practice	
(viii)	Type of Sealing	Mechanical Seal	
(ix)	Type of Suction Strainer	Y- Type	
(x)	Concentration of working media.	5-48% Sodium Hydroxide (NaOH)	
(xi)	Capacity & head of each pump	10 m3/hr & Head as per system requirement	
(xii)	Suction condition	Flooded	
(xiii)	Materials of construction		
a.	Casing, impeller	Stainless Steel – 316	
b.	Shaft & shaft sleeve	Stainless Steel -410	
(xiv)	Drive motor	415V, 3Φ, 50 HZ TEFC.	
(xv)	Accessories required	Coupling guard, drain plug, vent valve , isolation valves, etc.	


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(xvi)	Type of coupling between motor and pump	Flexible coupling		
(xvii)	MOC for piping, valves & fittings in acid/alkali handling	For valve -CPVC PN10, For piping, flanges & fittings –CPVC Sch. 40		
b)	CHEMICAL TANKS	ALKALI MEASURING TANK	ALKALI PREPARATION TANK	ACID MEASURING TANK
(i)	Number required	One (1)	One (1)	Two (2)
(ii)	Type	-Vertical Cylindrical Atmospheric with dished bottom and cover at top -		
(iii)	Liquid to be handled	NaOH	NaOH	HCL
(iv)	Location	----- To be designed for outdoor duty -----		
(v)	Useful capacity (each tank)	Adequate to hold quantity of alkali required (48% NaOH) for single regeneration of a condensate polisher mixed bed with 20% overall margin.	2 m3	Adequate to hold quantity of acid required (30-33% HCL) for single regeneration of a condensate polisher mixed bed with 20% overall margin.
(vi)	Material (Shell, Dished end & top cover)	IS 2062 Gr A/B	IS 2062 Gr A/B	FRP
(vii)	Internal protection	-----Rubber lined & minimum 4.5 mm thick in three layers -----	-----Rubber lined & minimum 4.5 mm thick in three layers-----	Not Applicable
(viii)	External painting	-----Chlorinated Rubber Paint -----	-----Chlorinated Rubber Paint -----	Not Applicable
(ix)	Level indicator	Provided	Provided	Provided
(x)	Level transmitter per tank	One (1)	One (1)	One (1)
(xi)	Stirrer per tank	Slow speed stirrer driven by motor drive and reduction gear. Speed of stirrer = 200 RPM Max.	Slow speed stirrer driven by motor drive and reduction gear. Speed of stirrer = 200 RPM Max.	Not Applicable
(xii)	MOC of Agitator	SS – 316	SS – 316	Not Applicable
(xiii)	Drive motor of stirrer	Energy Efficient – 1 as per IS : 12615	Energy Efficient – 1 as per IS : 12615	Not Applicable
(xiv)	Dissolving Basket	Provide (50-60 mesh B.S.)	Provide (50-60 mesh B.S.)	Not Applicable
(xv)	MOC of Basket	SS – 316	SS – 316	Not Applicable
(xvi)	Accessories	Fume absorbers, carbon dioxide absorber, vent, overflow, drain connection, overflow seal pot, sample connection, level transmitter, operating platform, ladders, lifting lugs (4 Nos. minimum), hand hole etc.		
c)	DOSING PUMPS	ACID DOSING PUMPS	ALKALI DOSING PUMPS	
(i)	Number	Two (2x100%) nos. (1 W+ 1 S)	Two (2x100%) nos. (1 W+ 1 S)	
(ii)	Type	--Simplex positive displacement hydraulically operated diaphragm type---		
(iii)	Whether suction strainer required	----- Yes -----		
(iv)	Material of construction			
	Liquid End (Pump Head, Valves, Valve housing, valve spring etc.)	Polypropylene	SS-316	
	Diaphragm	-----PTFE-----		
	Packing	-----PTFE-----		
	Shaft	----- Hardened steel EN 8 (BS : 970)-----		


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	Worm & worm wheel (if applicable)	-----Manganese Bronze -----	
	Connecting rod	-----Manganese Bronze -----	
	Cross head guide	-----Bronze -----	
(v)	Capacity & head	Capable of meeting regeneration one cation /Anion unit (with 20% margin); head as required (with 20% margin).	
(vi)	Accessories		
	Pressure/Pulsation Dampener	One per pump	One per pump
	External safety relief valve (in addition to inbuilt safety valve)	Two (One per pump) MOC -Polypropylene	Two (One per pump) MOC- SS-316
	MOC of safety relief valve	Poly propylene	SS-316
(vii)	Pressure gauge	----- One per pump with Teflon diaphragm seal -----	
(viii)	Maximum pump stroke speed per minute	----- 100 -----	
(ix)	Accessories required for each pump	Coupling guard, drain plug, vent valve, isolation valves, Y-type strainers, pressure gauges, pulsation dampener etc.	
(x)	Drive motor of pump	The drive motor of each pump will be Energy Efficient-1 as per IS : 12615	
d)	Density Meter	Acid	Alkali
	Number	One (1) at each mixing tee outlet	One (1) at each mixing tee outlet
	Type	Density indicator (Hydrometer type)	Density indicator (Hydrometer type)
	Indication	Local	Local
	Location	Diluted Acid line	Diluted Alkali line
e)	Flow Indicator		
	Number	One in each DM water line	One in each DM water line
	Type	Rotameter	Rotameter
f)	Flow Switch or Flow Transmitter	One in each water line, vane actuated type or DP bellows type /As per P&ID	
3.5	ACTIVATED CARBON FILTER FOR ALKALI		
(i)	Number	One (1)	
(ii)	Type	Vertical cylindrical with dished end bottom	
(iii)	Design Pressure	Design pressure shall be the maximum expected pressure to which the vessel may be subjected plus 5% extra margin. Maximum expected pressure for vessels placed in the discharge line of pumps shall be based on the shut-off head of the pumps plus static head at pump suction or 10 kg/cm2(g) whichever is maximum	
(iv)	Capacity	10 m3/hr or Not less than the design capacity of alkali transfer cum recirculation pump	
(v)	Flow Velocity	12 m/hr (max)	
(vi)	Bed depth	1200mm activated carbon + 300mm Gravel support	
(vii)	Pressure gauge	As per P&ID.	
(viii)	Number and Location	Two No. (One each at inlet and outlet of filter)	
(ix)	Seal	Teflon diaphragm	
(x)	Material of construction		
	Shell	Carbon steel plates to IS 2062 / SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70.	
	Dish ends /Head	Carbon steel plates to IS 2002 Gr. 2A / SA 515 Gr. 60 or 70 / SA 516 Gr.	


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		60 or 70.
(xi)	Inside protection	Inside lined with Natural Rubber [4.5 mm thick in (3) layers]
(xii)	Design code	ASME sec VIII div 1 ed.2010 / IS 2825 as applicable
(xiii)	Influent Distributor Material	SS 316
(xiv)	Manhole	Two (2) nos. minimum each of Davit type and 500 mm dia.
(xv)	Sight Windows	One (1) no. in backwash space
(xvi)	Hand hole	One (1) no. of 150 mm dia for removal of activated carbon
(xvii)	Accessories	Operating platforms, ladders, supports, lifting lugs (4 nos. minimum) etc.
3.6	ALKALI DILLUENT WATER HEATING TANK (HOT WATER TANK)	
(i)	Number	One (1)
(ii)	Type/Capacity	Vertical Cylindrical with dished end with Electric heater / 120% of water required for regeneration.
(iii)	Electric heater Qty.	2 nos. Electric heater (2X50%)
(iv)	Temperature of alkali to be heated	To obtain temp. from 15°C of 50°C at alkali mixing feed out let within 5 hours.
(v)	Design Pressure	Design pressure shall be the maximum expected pressure to which the vessel may be subjected plus 5% extra margin. Maximum expected pressure for vessels placed in the discharge line of pumps shall be based on the shut-off head of the pumps plus static head at pump suction or 10 kg/cm ² (g) whichever is maximum
(vi)	Material of construction	
	Shell & dished end	SS-304 adequately insulated
(vii)	Design code	ASME sec VIII div 1 ed.2010 / IS 2825 as applicable
(viii)	Temperature gauge, Temp. transmitters	To be provided by the bidder (as per P&ID)
(ix)	Burn out protection	To be provided by the bidder
(x)	Accessories	Manhole, vent, drain, sample connection, level transmitter, level gauges - 2 nos. (minimum), operating platform, ladders, lifting lugs (4 Nos. minimum) etc.
3.7	CPU REGENERATION CUM RESIN TRANSFER PUMPS	
(i)	Number	Two (2x100%) nos. (1W+1S)
(ii)	Type	Horizontal, centrifugal
(iii)	Operation	Intermittent
(iv)	Liquid to be handled	DM Water
(v)	Capacity & head	As required (with 20% margin)
(vi)	Suction condition	Flooded
(vii)	Material of construction	
	• Casing & impeller	SS 316/ ASTM A 351 CF 8M
	• Shaft	SS 410
	• Wearing rings	As per manufacturer's Standard
	• Shaft sleeve material	SS 410
(viii)	Packing seal	Mechanical type
(ix)	Mechanical Seal	To be Provided by bidder
(x)	Pump Speed	Maximum 1500 rpm
(xi)	Pressure gauge	One for each pump with Teflon diaphragm seal
(xii)	Pressure dampener	One number per pump
(xiii)	Recirculation line with motor actuated butterfly valve	Provided


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(xiv)	Accessories required for each pump	Coupling guard, drain plug, vent valve, isolation valves, Y-type strainers, pressure gauges, pulsation dampener	
(xv)	Drive motor	The drive motor of each Pump will be Energy Efficient -1as per IS 12615.	
3.8	AIR-BLOWERS FOR RESIN MIXING (REGENERATION AREA)		
(i)	Number	Two (2x100%)	
(ii)	Type	Centrifugal/Twin lobe type, oil free, positive displacement	
(iii)	Location	Indoor	
(iv)	Duty	Intermittent	
(v)	Capacity and head	As required	
(vi)	Noise Level	80 dB (A) Max. at one meter	
(vii)	Pressure gauge	One per blower	
(viii)	Material of construction	Casing – Cast Iron GR FG 260 to IS 210 Lobe – Cast Iron GR FG 260 to IS 210 Shaft – Carbon Steel to EN 8	
(ix)	Drive motor	The drive motor of each air blower will be Energy Efficient-1 as per IS 12615.	
4.0	NEUTRALISING SYSTEM		
4.1	NEUTRALIZATION PIT		
(i)	Number	One (1) no. Pit with two (2) compartments ,common for 2 x 660 MW Units	
(ii)	Type	Necessary air grid arrangement of polypropylene construction shall be provided in each compartment for effective neutralization of the waste effluent for air agitation & venturi mixing	
(iii)	Material of Construction	RCC with acid / alkali proof lining bricks	
(iv)	No. of compartments	Two compartments	
(v)	Capacity of each compartment	Adequate to hold 1.5 X quantity of waste effluent generated during single regeneration of Condensate Polisher Mixed Beds + 1.2 X DM plant waste generation during RO-DM plant for one regeneration (170 M3)	
4.2	NEUTRALIZATION PIT DISPOSAL PUMPS		
(i)	Number	Two nos. (1 working + 1 Standby)	
(ii)	Type	Horizontal, Centrifugal Single stage with priming system	
(iii)	Capacity & head	One section of the neutralization pit in 2 hours (capacity not less than 80 m3/hr) & head as per system requirement.	
(iv)	Duty	Intermittent	
(v)	Number of priming chamber & tank	Two	
(vi)	Suction condition	Suction from priming chamber / submerged (suction from pit)	
(vii)	Pump Speed	1450 rpm	
(viii)	Drive motor	Induction motor 415V, 3 phase 50Hz, TEFC	
(ix)	Suction condition	Negative, with priming chamber	
(x)	Material of Construction		
	Casing	2.5% Ni Cast Iron IS210 Gr. FG	
	Impeller	Stainless Steel CF 8M	
	Shaft	SS-304/SS-316/SS-410	
	Shaft coupling	SS-316	
	Shaft sleeve	SS-316	
4.3	CHEMICAL TANKS FOR N PIT	ALKALI MEASURING TANK	ACID MEASURING TANK
(i)	Number required	One (1)	One (1)
(ii)	Type	-----Vertical Cylindrical Atmospheric-----	



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(iii)	Useful capacity	Suitable to meet the requirement for neutralisation of excess acid/alkali present in the regeneration waste effluent from CPU & RO- DM plant + 20% margin	Suitable to meet the requirement for neutralisation of excess acid/alkali present in the regeneration waste effluent from CPU & RO- DM plant + 20% margin
(iv)	Material (Shell, Dished end & top cover)	IS 2062 Gr A/B	FRP
	Internal protection	-----Rubber lined & minimum 4.5 mm thick in three layers -----	Not Applicable
	External painting	-----Chlorinated Rubber Paint -----	Not Applicable
(v)	Level indicator	Provided	Provided
(vi)	Level transmitter per tank	One (1)	One (1)
(vii)	Stirrer per tank	Slow speed stirrer driven by motor drive and reduction gear. Speed of stirrer = 200 RPM Max.	Not Applicable
(viii)	MOC of Agitator	SS – 316	Not Applicable
(ix)	Drive motor of stirrer	Energy Efficient – 1 as per IS : 12615	Not Applicable
(x)	Dissolving Basket	Provide (50-60 mesh B.S.)	Not Applicable
(xi)	MOC of Basket	SS – 316	Not Applicable
(xii)	Accessories	Fume absorbers, carbon dioxide absorber, hand hole, vent, drain, sample connection, level transmitter, operating platform, ladders, lifting lugs (4 Nos. minimum) etc.	
5.0	PIPING & VALVES		
(i)	Resin Transfer piping (full Port Ball Valves)	ASTM A 312 Gr. TP 304 Sch 40 Minimum pipe Size : NB80 Velocity : 2-3 m/s	
(ii)	DM water line	ASTM A 312 Gr. TP 304 Sch 40	
(iii)	Piping-Service vessel Inlet	Piping-ASTM A 106 Gr C Ball Valves – SS-(CF8M) BFV – ASTM A 216 Gr. WCB- Body SS-(CF8M) - disc.	
(iv)	Piping-Service vessel Outlet	Piping – ASTMA 106 Gr. C BFV – SS-(CF8M) - Body & disc both. Ball Valves – SS-(CF8M)	
(v)	Service vessel bypass piping (Butterfly Valves)	Piping – ASTMA 106 Gr. C BFV – ASTM A 216 Gr. WCB – body CF8M -Disc	
(vi)	Service vessel rinse piping	CS to ASTM A 106 Gr. C	
(vii)	Effluent Transfer Piping	Piping, & Fittings shall be CPVC Sch. 40 only & valves shall be PN 10 rating.	
(viii)	Acid & Alkali Regeneration piping (Diaphragm Valves)	All piping, Valves & Fittings in regeneration area shall be CPVC Sch. 40 only & valves shall be PN 10 rating.	
(ix)	Acid / Alkali Transfer piping (Diaphragm Valves)	All piping, Valves & Fittings in regeneration area shall be CPVC Sch. 40 only & valves shall be PN 10 rating.	
(x)	Instrument Air piping (Full Port Ball Valves)	IS 1239 (Heavy Grade) Galvanized.	
6.0	VALVES		



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(i)	BUTTERFLY VALVES	Butterfly valves shall be of double flanged type of low leakage rate confirming to AWWA-C-504 class 300 (min.) or EN593/ BS:5155 PN 10 (min.) Condensate polishing plant outlet butterfly valves shall be of stainless steel construction, SS-316 (for body, disc and shaft). Condensate polishing plant inlet butterfly valves shall be of Carbon Steel construction (Body & Disc-CF8M/SS-316 Respectively). All the butterfly valves shall be provided with Hand wheel or lever as per the requirements. For larger sizes i.e. 150 NB and above. Valve provided with motorized or pneumatic actuator shall be provided with a hand wheel for manual operation. All the valves shall be equipped with adjustable mechanical stop-limiting devices to prevent over travel of the valve disc in the open and closed positions. The valve operators (Hand wheel or Gear reduction unit or Motor actuator etc.) shall be designed as per relevant International Standard. All the butterfly valves shall be provided with an indicator to show the position of the disc. Flanges shall conform to ANSI B 16.5 Cl.300 (min.) used for Service vessel area. Butterfly valves of the bypass line of service vessels shall be double flanged type.
(ii)	ECCENTRIC PLUG VALVE / BALL VALVE	These valves shall be used for resin transfer line. These valves shall be flanged type and of SS 316 construction.
(iii)	DIAPHRAGM VALVE	The Diaphragm shall conform to following requirement for DM water application : i) Design standard: BS: 5156 or equivalent of required rating / class. (Minimum rating of valves shall be PN 10). ii) Type : Flanged and lined body ends, sealed bonnet, weir pattern, tight shut off type iii) Material of Construction a) Body, Bonnet : Cast iron IS 210 Gr. FG 260 or equivalent or Cast steel ASTM A-216 Gr. WCB b) Body lining : Soft natural rubber(Neoprene), ebonite, Polypropylene c) Hand wheel : Cast Iron d) Compressor : Stainless Steel e) Stem and Bush : Stainless Steel For Acid and Alkali services the valve shall be CPVC PN10/Sch 40 only.
7.0	FLANGES	
(iv)	Feed water / Condensate	ASTM 105
(v)	DM water	ASTM A105 rubber lined (for NB 65 mm to 150 mm) ASTM A 182 F 304 (for NB 50 mm and below)
(vi)	Instrument Air	ASTM A 105 galvanized

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SECTION – C2

SPECIFIC TECHNICAL REQUIREMENTS FOR ELECTRICAL



**TECHNICAL SPECIFICATION FOR
CONDENSATE POLISHING UNIT
(ELECTRICAL PORTION)**

SPECIFICATION NO. PE-TS-412-155A-A001
VOLUME II B
SECTION-C
REV 01 DATE 29.04.2015
PAGE 1 OF 1

SPECIFIC TECHNICAL REQUIREMENTS: ELECTRICAL

1.0 EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER/ PURCHASER

- 1.1 Scope for supply, and erection & commissioning of various equipment forming part of electrical system for this package shall be as per Annexure-I to Section – C [Scope of Work (Electrical)].
- 1.2 Make of various equipment/ items in the scope of bidder shall be to approval of owner during detailed engineering stage without any commercial implications.
- 1.3 Bidder shall furnish all AC as well as DC loads required for the system at different voltage levels (eg. 415V AC, 240 V AC, 220 V DC etc.) of all types, such as motor feeders, supply feeders in PEM format along with the offer.
- 1.4 All electrical equipment shall be suitable for the power supplies, fault levels and climatic conditions indicated in project information enclosed with the specification.
- 1.5 All drawings, data sheets, Quality Plan, calculations, test reports, test certificates, etc. shall be submitted during detailed engineering stage as per formats enclosed. The same shall be subject to approval without any commercial implications.
- 1.6 Technical requirements shall be as per specifications listed in Clause 3.1, 3.2, 3.3, 3.4 & 3.5. In case of any discrepancy between Customer specification and BHEL standard specification, Customer specification shall prevail.

2.0 DOCUMENTS TO BE SUBMITTED ALONG WITH BID

- 2.1 Bidder shall confirm total compliance to the electrical specification without any deviation from the technical/ quality assurance requirements stipulated. In line with this, the bidder as technical offer shall furnish two signed and stamped copies of the following:
 - a) A copy of this sheet "Electrical Equipment Specification for AC System" and sheet "Electrical Scope between BHEL and Vendor" with bidder's signature and company stamp.
 - b) List of Erection and Commissioning spares.
 - c) List of Erection & Maintenance tools & tackles.
 - d) Electrical load requirement in the load data format.
- 2.2 No technical submittal such as copies of data sheets, drawings, write-up, quality plans, type test certificates, technical literature, etc., is required during tender stage. Any such submission even if made, shall not be considered as part of offer

3.0 LIST OF ENCLOSURES

- 3.1 Electrical scope between BHEL & vendor (Annexure-I).
- 3.2 Technical specification – Customer specification - Motors
- 3.3 BHEL standard specification for LT motors : PE-SS-999-506-E101
- 3.4 Datasheets – A and C
- 3.5 Quality Plan for motors.
- 3.6 Load data format (Annexure-II).
- 3.7 Basic Technical Features for Motors (PE-DC-412-565-E003)

THIS IS A PART OF TECHNICAL SPECIFICATION NO. PE-TS-412-155A-A001
ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)

REV-0, DATE: 12.06.2015

PACKAGE: CPU

SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT

PROJECT: 2X660 MW ENNORE STPP

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1	415V MCC	BHEL	BHEL	240 V AC (supply feeder)/415 V AC (3 PHASE 4 WIRE) supply shall be provided by BHEL based on load data provided by vendor at contract stage for all equipment supplied by vendor as part of contract. Any other voltage level (AC/DC) required will be derived by the vendor.
2	Local Push Button Station (for motors)	BHEL	BHEL	Located near the motor.
3	Power cables, control cables and screened control cables for a) both end equipment in BHEL's scope b) both end equipment in vendor's scope c) one end equipment in vendor's scope	BHEL BHEL BHEL	BHEL Vendor BHEL	1. For 3.b) & c): Sizes of cables required shall be informed by vendor at contract stage (based on inputs provided by BHEL) in the form of cable listing. Finalisation of cable sizes shall be done by BHEL. Vendor shall provide lugs & glands accordingly. 2. Termination at BHEL equipment terminals by BHEL. 3. Termination at Vendor equipment terminals by Vendor.
4	Junction box for control & instrumentation cable	Vendor	Vendor	Number of Junction Boxes shall be sufficient and positioned in the field to minimize local cabling (max 10-12 mtrs) and trunk cable.
5	Any special type of cable like compensating, co-axial, prefab, MICC, optical fibre etc.	Vendor	Vendor	Refer C&I portion of specification for scope of fibre Optical cables if used between PLC/ microprocessor & DCS.
6	Cable trays, accessories & cable trays supporting system 100/ 50 mm cable trays/ Conduits/ Galvanised steel cable troughs for local cabling	BHEL Vendor	BHEL Vendor	Local cabling from nearby main route cable tray (BHEL scope) to equipment terminal (vendor's scope) shall be through 100/ 50 mm. cable trays/ conduits/ Galvanised steel cable troughs, as per approved layout drawing during contract stage.
7	Cable glands ,lugs and bimetallic strip for equipment supplied by Vendor	Vendor	Vendor	1. Double compression Ni-Cr plated brass cable glands 2. Solder less crimping type heavy duty tinned copper lugs for power and control cables.
8	Conduit and conduit accessories for cabling between equipment supplied by vendor	Vendor	Vendor	Conduits shall be medium duty, hot dip galvanised cold rolled mild steel rigid conduit as per IS: 9537.
9	Lighting	BHEL	BHEL	
10	Equipment grounding (including electronic earthing) &	BHEL	BHEL	Refer note no. 4 for electronic earthing

THIS IS A PART OF TECHNICAL SPECIFICATION NO. PE-TS-412-155A-A001
ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)

REV-0, DATE: 12.06.2015

PACKAGE: CPU

SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT

PROJECT: 2X660 MW ENNORE STPP

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
	lightning protection			
11	Below grade grounding	BHEL	BHEL	
12	LT Motors with base plate and foundation hardware	Vendor	Vendor	Makes shall be subject to customer/ BHEL approval at contract stage.
13	Mandatory spares	Vendor	-	Vendor to quote as per specification.
14	Recommended O & M spares	Vendor	-	As specified elsewhere in specification
15	Any other equipment/ material/ service required for completeness of system based on system offered by the vendor (to ensure trouble free and efficient operation of the system).	Vendor	Vendor	
16	a) Input cable schedules (Control & Screened Control Cables) b) Cable interconnection details for above c) Cable block diagram	Vendor Vendor Vendor	- - -	Cable listing for Control and Instrumentation Cable and electronic earthing cable in enclosed excel format shall be submitted by vendor during detailed engineering stage.
17	Electrical Equipment & cable tray layout drawings	Vendor	-	For ensuring cabling requirements are met, vendor shall furnish Electrical equipment layout & cable tray layout drawings (both in print form as well as in AUTOCAD) of the complete plant (including electrical area) indicating location and identification of all equipment requiring cabling, and shall incorporate cable trays routing details marked on the drawing as per PEM interface comments. Cabling arrangement of the same (wherever overhead cable trays, trenches, cable ducts, conduits etc.) shall be decided during contract stage. Electrical equipment layout & cable tray layout drawing shall be subjected to BHEL/ customer approval without any commercial implications to BHEL.
18	Electrical Equipment GA drawing	Vendor	-	For necessary interface review.

NOTES:

1. Make of all electrical equipment/ items supplied shall be reputed make & shall be subject to approval of BHEL/customer after award of contract.
2. All QPs shall be subject to approval of BHEL/customer after award of contract without any commercial implication.

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)

PACKAGE: CPU

SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT

PROJECT: 2X660 MW ENNORE STPP

3. In case the requirement of Junction Box arises on account of Power Cable size mis-match due to vendor engineering at later stage, vendor shall supply the Junction Box for suitable termination.
4. Vendor shall indicate location of Electronic Earth pit in their Civil assignment drawing.

STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)

PACKAGE: ELECTRIC HOIST FOR CPU PLANT**PROJECT :2X660 MW ENNORE STPP****SCOPE OF VENDOR: SUPPLY , ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT**

<u>S. NO</u>	<u>DETAILS</u>	<u>SCOPE SUPPLY</u>	<u>SCOPE E&C</u>	<u>REMARKS</u>
1	Isolating Switch	Vendor	Vendor	BHEL will provide one number 415 V(3ph, 4W) supply feeder only up to isolating switches for cranes. Any other voltage level (AC/DC) required will be derived by the vendor. Motor starter shall be part of crane control panel.
2	Power cables, control cables, screened control cables and any special cables (if required) between equipment supplied by vendor.	Vendor	Vendor	Cable from supply feeder to isolating switch shall be in BHEL scope.
3	Cabling material (cable trays, accessories, cable tray supporting system, conduits etc).	Vendor	Vendor	
4	Equipment Earthing	Vendor	Vendor	All equipment metallic enclosures / frames, metal structure etc. shall be grounded at two points each to the nearest grounding points / risers provided by BHEL.
5	Motors	Vendor	Vendor	
6	Cable glands and lugs for equipment supplied by vendor	Vendor	Vendor	1. Double compression Ni-Cr plated brass cable glands 2. Solder less crimping type heavy duty tinned copper lugs for power & control cables.
7	a) Input cable schedules (C & I) b) Cable interconnection details for above c) Cable block diagram	Vendor Vendor Vendor	- - -	Cable listing for Control and Instrumentation Cable in enclosed excel format shall be submitted by vendor during detailed engineering stage.
8	Equipment layout drawings	Vendor	-	
9	Electrical Equipment GA drawing	Vendor	-	For necessary interface review.

CHAPTER – 12

MOTORS

1.00.00 DESIGN CRITERIA

1.00.01 For the purpose of design of equipments /systems, an ambient temperature of 50 °C and relative humidity of 85% shall be considered. The equipment shall operate in a highly polluted environment.

1.00.02 Transient voltage dip on starting of the largest motor with DOL shall be limited to 20% of the nominal system voltage at the voltage terminals.

1.00.03 Rating

The motor rating shall be arrived at considering 15% margin over the duty point input or 10% over the maximum demand of the driven equipment, whichever is higher, considering highest system frequency.

All motors shall be continuously rated (S1 duty). However, crane motors shall be rated for S4 duty, 40% cyclic duration factor.

Whenever the basis for motor ratings are not specified in the corresponding mechanical specification sub-sections, maximum continuous motor ratings shall be at least 10% above the maximum load demand of the driven equipment under entire operating range including voltage and frequency variations.

1.00.04 Starting Voltage requirement for all motors (except mill motors):

1. 85 % of rated voltage for motors up to 1000 kW
2. 80 % of rated voltage for above 1000 kW and up to 4000 kW
3. 75 % of rated voltage for above 4000 kW

For Mill Motors:

1. 85 % of rated voltage for motors above 1000 kW
2. 90 % of rated voltage for motors up to 1000 kW

1.00.05 Canopy shall be provided for outdoor motors.

1.01.00 Contractor shall provide fully compatible electrical system, equipments, accessories and services.

1.02.00 All the equipment, material and systems shall, in general, conform to the latest edition of relevant National and international Codes & Standards, especially the Indian Statutory Regulations.

1.03.00 Voltage and frequency variations:

Frequency: (+) 3% and (-) 5%

Voltage : **i. AC**

a. $\pm 6\%$ for 11 kV/3.3 kV

b. $\pm 10\%$ for 415 V

Combined 10 % (absolute sum)

ii. DC- +10% to -15% for 220 V DC

1.04.00 All LV motors above 10 kW with S1 duty shall be compulsorily of Energy efficient level IE 2 as per IS 12615: 2011.

1.05.00 The responsibility of coordination with electrical agencies and obtaining all necessary clearances shall be of the contractor.

1.06.00 Type

AC Motors:

(a.) Squirrel cage induction motor suitable for direct-on-line starting.

(b.) Crane duty motors shall be slip ring type induction motor

DC Motors

(a.) Shunt wound.

1.07.00 Temperature Rise

Air cooled motors

70°C by resistance method

Water cooled

80° C over inlet cooling water temperature mentioned elsewhere, by resistance method.

1.08.00 Degree of Protection

Degree of protection for various enclosures shall be as follows :

i) Indoor motors — IP 54

- | | | | |
|------|---|---|-------|
| ii) | Outdoor motors | – | IP 55 |
| iii) | CW motors (in case of screen
prot. Drip proof) | – | IP 23 |
| iv) | Cable box – indoor area | – | IP 54 |
| v) | Cable box – outdoor area | – | IP 55 |

2.00.00 CODES AND STANDARDS

2.01.00 All motors shall confirm to the latest editions including all applicable amendment of relevant IS, IEC and CBIP standards/Publications. In case any other standard is followed that ensures equal or better quality, may be accepted. However the English version of the Standard adopted shall be submitted.

2.02.00 Major Standards, which shall be followed, are listed below. Any other applicable Indian standards for any component part even if not covered in the list shall also be followed

- | | | | |
|-----|---|---|--|
| 1.) | Three phase induction motors | : | IS:325, IEC:60034 |
| 2.) | Single phase AC motors | : | IS:996, IEC:60034 |
| 3.) | Crane duty motors | : | IS:3177, IEC:60034 |
| 4.) | DC motors/generators | : | IS:4722 |
| 5.) | Degree of protection by
enclosures for rotating electrical
machines | : | IS: 4691
IS: 4728
IS: 6362
IS: 2253 |
| 6.) | Noise levels for rotating
electrical machines
Mechanical Vibrations for
rotating electrical machines | : | IS: 12065
IS: 12075 |

3.00.00 OPERATIONAL REQUIREMENTS

3.01.00 Starting Time

3.01.01 For motors with starting time up to 20 secs at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 2.5 secs more than starting time .

- 3.01.02 For motors with starting time more than 20 secs and up to 45 secs at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 5 secs more than starting time.
- 3.01.03 For motors with starting time more than 45 secs at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be more than starting time by at least 10% of the starting time.
- 3.01.04 Speed switches mounted on the motor shaft shall be provided in cases where above requirements are not met.
- 3.01.05 Motors shall be capable of restarting under full load after a momentary loss of voltage with the possibility of 150 % nominal voltage during fast bus transfer.
- 3.02.00 Torque Requirements
- 3.02.01 Accelerating torque at any speed with the lowest permissible starting voltage shall be at least 10% motor full load torque.
- 3.02.02 Pull out torque at rated voltage shall not be less than 205% of full load torque. It shall be 275% for crane duty motors.

4.00.00 DESIGN AND CONSTRUCTIONAL FEATURES

- 4.00.01 Suitable single phase space heaters shall be provided on motors rated 30 kW and above to maintain windings in dry condition when motor is standstill. Separate terminal box for space heaters & RTDs shall be provided.
- 4.00.02 All motors shall be suitable for direct on line starting through any type of breaker.
- L All motors shall be either totally enclosed fan cooled (TEFC) or totally enclosed tube ventilated (TETV) or Closed air circuit air cooled (CACA) type. However, motors rated 3000KW or above can be Closed air circuit water cooled (CACW). CW motors can be screen protected drip proof (SPDP) type. Motors located in hazardous areas shall have flame proof enclosures conforming to IS: 2148 as detailed below

- (a) Fuel oil area : Group - IIB
- (b) Hydrogen generation plant Group - IIC
area :

4.00.03 Winding and Insulation

- (a) Type : Non-hygroscopic, oil resistant, flame resistant

- (b) Starting duty : Two hot starts in succession, with motor initially at normal running temperature
- (c) 11 kV / 3.3 kV AC motors : Class F: with winding temperature rise limited to class B. They shall withstand 1.2/50 micro sec switching surges of $4U+5$ KV (U=Line voltage in KV). The coil inter-turn insulation shall be suitable for 0.3/3 micro sec. surge of 32 KVp and 12 kVp for 11 kV and 3.3 kV system respectively followed by 1 min power frequency high voltage test of appropriate voltage on inter turn insulation.
- (d) 415V AC & 220V DC motors : Class 'F' with temperature rise limited to class 'B'

- 4.00.04 Motors rated above 1000 kW shall have insulated bearings to prevent flow of shaft currents.
- 4.00.05 Motors with heat exchangers shall have dial type thermometer with adjustable alarm contacts to indicate inlet and outlet primary air temperature.
- 4.00.06 Noise level and vibration shall be limited within the limits prescribed in IS: 12065 & IS: 12075 respectively. Motors shall withstand vibrations produced by driven equipment.
- 4.00.07 In MV/HV motors, 12 nos. simplex or 6 nos. duplex RTDs (two per phase), each having D.C. resistance of 100 ohms at 0°C, embedded in the stator winding at locations where highest temperatures may be expected, shall be provided. The material of the ETD's shall be platinum. Each bearing shall be provided with dial type thermometer with adjustable alarm contact and resistance type temperature detector. All HV motors shall be provided with shaft grounding rings for bearing protection and earthing shaft current.
- 4.00.08 MV/HV motors shall also be capable of satisfactory operation at full load at a supply voltage of 80% of the rated voltage and shall be capable of either two starts in quick succession with third start after 5 minutes in cold condition or two starts at 15 minutes intervals in hot condition, both cases with voltage and frequency variation within specified limits.
- 4.00.09 Locked rotor current of the MV motors shall be limited to 600% (subject to IS tolerance) of the full load current of the motors and for HV motor shall be limited to 450% (inclusive of IS tolerance) of full load current of the motor.

Locked rotor current of the LV motor shall not exceed 600% of full load current inclusive of IS tolerance.

- 4.00.10 MV Motors shall be provided with differential protection. These motors shall be provided with star connected stator windings. The 3 nos. current transformers, one for each phase shall be mounted in a separate compartment in the neutral side terminal box. The three phases shall be connected to form the star point after they pass through the CTs. These differential protection CTs shall be supplied loose by 11/ 3.3 kV switchgear manufacturer.
- 4.00.11 Motor body shall be grounded at two earthing points on opposite sides with two separate and distinct grounding pads complete with tapped holes, GI bolts and washers.
- 4.00.12 HV motors can be offered with either elastimould termination or dust tight phase separated double walled (metallic as well as insulated barrier) cable boxes. In case elastimould terminations are offered, then protective cover and trifurcating sleeves shall also be provided. Removable gland plates of thickness 3 mm (hot/cold rolled sheet steel) or 4 mm (non magnetic material for single core cables) shall be provided in case of cable boxes.
- 4.00.13 All motors shall be so designed that maximum inrush currents and locked rotor and pullout torque developed by them at extreme voltage and frequency variations do not endanger the motor and driven equipment.
- 4.00.14 The motors shall be suitable for bus transfer schemes provided on the 11 kV, 3.3 kV/415V systems without any injurious effect on its life.
- 4.00.15 All motors below 15 kW shall be provided with sealed ZZ bearings.
- 4.00.16 For motors rated 1000 KW & above, neutral current transformers of PS class shall be provided on each phase in a separate neutral terminal box.
- 4.00.17 All motors shall be provided with an emergency stop push button near the motor as per the Indian Statutory regulations.
- 4.00.18 The motor terminal box shall be suitable for withstanding the maximum system fault current for a duration of at least 0.25 seconds.
- 4.00.19 Neutral in case of HV motors shall be kept accessible.

- 4.00.20 Motors shall be designed to easy access for drilling holes through motor feed of mounting flange for installation of dowel pins after assembly of the motor and driven equipment.
- 4.00.21 Well spacious working platforms shall be provided around the motor area for carrying out maintenance & testing works. Platform shall be minimum of 300 mm below the level of motor base plate.
- 4.00.22 Flow switches shall be provided for monitoring oil flow of forced lubrication bearings, if used. Alarm switch contact rating shall be minimum 0.5 A at 220 V DC and 10 A at 230 V AC.
- 4.00.23 For bearing temperature measurement, duplex RTDs shall be provided for each bearing and shall be wired up to the terminal box..
- 4.00.24 Lube oil pressure transmitters shall be provided to DCS for remote monitoring. Lube oil pressure very low trip to HV equipment shall be 2 out of 3 logic.
- 4.00.25 Capillary type temperature gauge cum switch shall be provided for DE / NDE of HV Motors
- 4.00.26 Motors with CACA/CACW heat exchangers shall have dial type thermometer with adjustable alarm contacts to indicate the following:
- Hot and cold air temperatures of the closed air circuit for CACA motors.
 - Hot and cold, air and water temperatures for CACW motors.
- The Alarm switch contact rating shall be minimum 0.5 A at 220 V DC and 10 A at 230 V AC.
- 4.00.27 Lifting Provisions**
- Motor weighing 25 kg or more shall be provided with eye bolt or other adequate provision for shifting. Electrical hoists shall be provided for motors above 1000 kgs for maintenance of the same.
- 4.00.28 DC MOTORS
- DC motors shall be provided where specified/required. DC Motors shall be sized for operation with fixed resistance starting for reliability. DC motors shall be shunt wound type. Motors shall be capable of delivering the rated output at 220 V DC with (+) 10% and (-) 15% variations without exceeding its guaranteed temperature limits. 220 V DC

system shall be unearthed. Starting current of the DC motors shall be limited to 200% of the full load current of the motor, and is subject to IS tolerance. DC Motors shall be similar to AC Motors with respect to other features like enclosure type, cooling and class of insulation

4.00.30 Painting

Motor including fan shall be painted with corrosion proof paints of colour shade Siemens grey (RAL 7032).

4.00.31 Local Push Button Stations

The LPBS shall be installed near the motors to be controlled. Individual channel supports shall be used for each LPBS. These shall be installed as per approved erection detail drawing. LPBS for hazardous areas shall be CMRS certified and CCE approved.

All LPBS shall have necessary canopies. Wiring of LPBS shall be checked before giving control supply.

5.00.00 LIST OF TESTS TO BE CONDUCTED FOR HV, MV and LV MOTORS

5.01.00 TYPE TESTS

- (a) No load saturation and loss curves up to approximately 115% of rated voltage
- (b) Momentary overload test
- (c) Temperature rise test at rated conditions. During heat run test, bearing temp., winding temp., core temp., coolant flow and its temperature shall also be measured. In case the temperature rise test is carried at load other than rated load, specific approval for the test method and procedure is required to be obtained. Wherever ETD's are provided, the temperature shall be measured by ETD's also for the record purpose.
- (d) Surge withstand test on the sample coil after placing it in stator core at $(4U + 5 \text{ KV})$ and with at least five impulse of 1.2/50 micro sec. wave, for HV motors only, where U is the line to line voltage in kV.
- (e) Surge-withstand test with 0.3/3 micro sec. wave on each type of 3.3/11 kV motor coils with at least five such impulses, followed by one minute power frequency high voltage test on turn to turn insulation, after cutting the coil and bringing out

the turns suitably. The power frequency test voltage shall be decided during detailed engineering.

- f) Dimensions (for motors covered by IS 1231:1974 and IS 2223:1983 only)
- g) Measurement of resistance of windings of stator and wound rotor.
- h) Reduced voltage running up test at no load (for squirrel cage motors up to 37kw only)
- i) Full load test to determine efficiency, power factor and slip.
- j) Insulation resistance test
- k) Test for vibration severity of motor
- l) Test for noise levels of motor
- m) Test for degree of protection by enclosure
- n) Temperature rise test at limiting values of voltage and frequency variations
- o) Over speed test

5.02.00 ROUTINE TESTS

The following shall constitute the routine tests.

- a) Insulation resistance test
- b) Measurement of resistance of windings of stator and wound rotor.
- c) No load test
- d) Locked rotor readings of voltage, current and power input at a suitable reduced voltage
- e) Reduced voltage running up test (for squirrel cage motor)
- f) Open circuit voltage ratio of stator and rotor windings (for slip ring motors); rotor;
- g) High voltage test

6.00.00 INSPECTION AND TESTING AT SITE

6.01.01 Insulation resistance of 415V motors shall be measured between the winding of the machine and its frame by means of a 500/1000V megger. A minimum value of 1 mega ohm for 415V motors shall be considered a safe value. In case of lower I.R. Value, the insulation value shall be brought up by any of the following methods as desired by the Site Engineer:

- (a.) Blowing hot air in case of big motors.
- (b.) Putting the motor in electric oven in case of smaller motors.
- (c.) Placing heaters or lamps around and inside in case of small motors after making suitable guarding and covering arrangements so as to conserve the heat.

6.01.02 Site Test

- (a.) Measurement of vibration.
- (b.) Measurement of insulation resistance and polarization index.
- (c.) Measurement of full load current.
- (d.) Test running of the motors, checking the temperature rise and identifying the hot spot etc.

6.01.03 3.3 kV motors shall be tested for insulation by 500/1000V megger and its value should not be less than the safe minimum insulation of $\geq 20 \text{ M}\Omega$ resistance at 60 deg. C. In case the insulation is low, the following method of drying has to be adopted:

- a. By locking the motor so that it cannot rotate and then applying such a low voltage to the stator terminals that full load current flows in the stator, keeping the stator winding temperature below 90 deg. C. In this a close watch shall be kept for any possible overheating and I.R. Values vs. temperature shall be plotted and heating continued till I.R. Value becomes steady.
- b. By blasting hot air from external source, Maximum temperature of winding while drying should be 70 deg. C to 80 deg. C. (Thermometer) or 90 deg. C. to 95 deg. C. by resistance method. Heating should be done slowly till steady temperature of winding is reached after 4 to 5 hours and for large machines after 10 hours. A record has to be kept for drying process, with half an hour readings and, after steady temperature is reached, at an interval of 2 hours. In case it is essential, the drying process can be supplemented by blower.

THIS IS A PART OF TECHNICAL SPECIFICATION NO. PE-TS-412-155A-A001
CABLE SCHEDULE FORMAT

[illegible]

**TITLE**

2X 660 MW ENNORE SEZ STPP
TECHNICAL SPECIFICATION FOR
CONDENSATE POLISHING UNIT

SPECIFICATION NO : PE-TS-412-155A-A001

VOLUME: II B

REV 00

SHEET

SECTION – C3

SPECIFIC TECHNICAL REQUIREMENTS FOR CONTROL AND
INSTRUMENTATION

**A.GENERAL
&
SPECIFIC
TECHNICAL
REQUIREMENT**

	SPECIFICATION FOR CONTROL & INSTRUMENTATION FOR AUX PACKAGES	SPECIFICATION NO.:	
		VOLUME	
		SUB SECTION	
		REV. NO.	DATE :
		SHEET	OF

GENERAL REQUIREMENT

1.0 Bidder shall provide complete and independent control & instrumentation system with all accessories, auxiliaries and associated equipments for the safe, efficient and reliable operation of auxiliary systems.

2.0 The quantity of instruments for auxiliary system shall be as per tender P & ID wherever provided of the respective system as a minimum, for bidding purpose. However, Bidder shall also include in his proposal all the instruments and devices that are needed for the completeness of the plant auxiliary system/ equipment supplied by the bidder, even if the same is not specifically appearing in the P & ID. During detail engineering if any additional instruments are required for safe & reliable operation of plant, bidder shall supply the same without any price implication.

3.0 Measuring instruments/equipment and subsystems offered by the bidder shall be from reputed experienced manufacturers of specified type and range of equipment, whose guaranteed and trouble free operation has been proven. Further all the instruments shall be of proven reliability, accuracy, and acceptable international standards and shall be subject to employer's approval. All instrumentation equipment and accessories under this specification shall be furnished as per technical specification, ranges, makes/ numbers as approved by the employer' during detail engineering.

4.0 The necessary root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifold and all the other accessories required for mounting/ erection of these local instruments shall be furnished, even if not specifically asked for, on as required basis. The contacts of equipment mounted instruments; sensors, switches etc for external connection including spare contacts shall be wired out to suitably located junction boxes.

5.0 The customer specification attached as Specific Technical Requirement will supercede the Data sheets, if there is any mismatch.

	2X660 MW ENNORE STPP	
	SPECIFIC TECHNICAL REQUIREMENTS (C&I) CONDENSATE POLISHING UNIT	
Specific Technical Requirements (C&I): The control of CPU shall be through PLC based control system having Redundant Hot Stand by Processor. The operation and control philosophy of CPU has been elaborated in separate section in the specification. The control & operation of CPU service vessel area shall be done from 1 no. OWS (per unit). RPU (with Hot Redundant Processor) shall be provided near service vessel area of each TG unit. For control and operation of regeneration system, 2 No. of OWS (1 OWS & 1 OEWS) shall be provided alongwith 1 No. A4 size B/W Laser jet in regeneration area. In addition to the above, local control desk with coloured Mimic, Indicators, Ammeters, H.W. Annunciator, P.B. and indication Lamps shall also be provided. Additional laptop shall be provided with the CPU package. 1. The communication between PLC and Main plant DCS shall be OPC compliant (Data Access 2.0) TCP/IP on Fibre Optic link. The communication link between PLC and Main plant DCS shall be redundant. The necessary hardware/software including LIU (Light Interface unit) at PLC end shall be in Bidder's scope. Repeaters if required for interfacing shall also be provided by the bidder. For communication between main plant DCS and PLC, the PLC end shall be considered as server and DCS shall be considered as client. For details, please refer PLC Configuration Diagram. 2. PLC control system shall be time synchronized with the Master clock system of the main plant to ensure uniform time indication throughout the Plant. The required provision (IRIG-B) shall be made by the bidder at the PLC end to achieve the same. 3. Bidder to note that all type of hardwares & electronic modules like controllers, I/O cards, communication modules and interface modules etc. used in PLC shall be of same family and sourced/supplied from their Principal's works. 4. The software and hardware for offered PLC system shall be of latest version and shall be upgradable. Bidder to ensure the availability of spares and service support for the offered PLC system for minimum 15 years after guarantee period. 5. All motorised valves of 200NB or more than 200NB size shall be provided with integral motorized bypass valves on all process lines. 6. All electrical actuators shall be conventional type of integral starter.		

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	SPECIFIC TECHNICAL REQUIREMENTS (C&I) CONDENSATE POLISHING UNIT	
7. Components of instruments, control devices, accessories, piping etc. which contact with steam, condensate or boiler feed water shall be manufactured from copper free materials which do not react with media at operating parameters. 8. Valve end position (Open & Close) shall be monitored for the manual critical valves, wherever provided. 9. Interface of MCC, HT SWGR, Actuators etc. with PLC based control system shall be as per Drive Control Philosophy attached in the specification. The attached philosophy is for DCS based control system. However, the same is applicable for PLC as well. 10. All the instruments/drives shall be terminated on JB's/Panels in field. JB's/Panels shall be in Bidder's scope. 11. Scope of Instrumentation cables (Screened Control Cables), Fibre Optic cable & Control cables shall be as per Electrical Cable scope matrix in Electrical portion of specification. 12. UPS for PLC & OWS shall be in bidder's scope with 2X100% configuration. UPS shall have 2X100%, Ni-Cd type battery bank with 60 min back up. 13. Bidder shall provide Customer training on the proper application and maintenance on PLC Hardware & Software at Vendor's work or at Ennore SEZ site. Duration of the training, number of persons & the topics to be covered shall be discussed & mutually agreed during contract finalization stage. 14. Following documents to be furnished by the bidder along with the bid: • Proposed PLC system configuration drawing with write-up • Duly stamped and signed copy of Quality Plan. • Product catalogues and specifications for PLC as well as HMI application. • Requirement of electronic earthing, if any, for PLC based control system. 15. Complete Industrial grade furniture required for placing OWS, swivel chairs, printers, keyboards, computers etc. shall also be furnished by bidder. The exact details shall be finalized & approved by owner/purchaser during detailed engineering. 16. Bidder to comply with codes and standards as mentioned in the specification.		

	2X660 MW ENNORE STPP	
	SPECIFIC TECHNICAL REQUIREMENTS (C&I) CONDENSATE POLISHING UNIT	
17. Bidder shall provide the necessary hardware & software required for connecting the PLC system to Bidder's remote service centre, through which the diagnostics & fault analysis of the PLC system can be carried out. The method of connection shall be as per Bidder's standard practice. However, it is preferred to have the connection through a single point in the PLC system. 18. Bidder shall provide an unlimited warranty on all equipment and software for three years after the start of the warranty period, i.e. after satisfactory completion of initial operations. This warranty shall include repair, replacement or correction of identified software or hardware discrepancies at no cost to OWNER. 19. PLC network shall have Intrusion Detection System (IDS) and Intrusion Prevention System (IPS) activity and identify suspicious patterns that may indicate a network or system attack from someone attempting to break into or compromise a system on the Station LAN Network, the recommended IDS/IPS should contain the following combined features. Any feature can be selected depending on whether it is to be configured as IPS or IDS. 20. All local gauges, transmitters and switches shall be mounted on suitable enclosures, racks subject to owner's approval. All transmitters shall be HART compatible. 21. Bidder to delegate /depute their persons/experts as per owner/consultants' requirement. 22. Bidder must offer general tools and tackles and special calibration instruments required during start-up, trial run, operation and maintenance of the system. 23. The above given scope is indicative & minimum. Any item/ equipment not indicated above however required for the completeness of the system is to be supplied by bidder without any technical, commercial and delivery implication to BHEL. 24. Bidder shall provide Cable Schedule in BHEL excel format provided in Electrical portion of the specification. Also, Cable Interconnections details for Complete System shall be in Bidder's scope.		

	2X660 MW ENNORE STPP	
	SPECIFIC TECHNICAL REQUIREMENTS (C&I) CONDENSATE POLISHING UNIT	
25. All the instruments/equipment/electrical items shall be provided & designed with maximum star rating as available in line with energy conservation policies notified by BEE, GOI at the time of supply. 26. Each communication Network shall be industrial grade and shall be provided with industrial grade managed type Ethernet switches, external surge protection system/devices and industrial firewall. Industrial grade managed type Ethernet switches shall be provided with in built diagnostic features, 20% spare parts & in built redundant power supply. 27. All approval/Inspection are to be carried out by Owner or owner appointed agency only. 28. Bidder shall offer latest system available at the time of supply / dispatch & shall also confirm that DDCMIS/PLC system/microprocessor based control system, MIS, ERP system etc. hardware / software shall be upgraded free of cost (for hardware up to commissioning of the project and software up to handing over of the project), whenever at later stage such up gradation takes place for his system offered by him or by his collaborator. 29. The make/model of various instruments/items/systems shall be subject to approval of owner/purchaser during detailed engineering stage. No commercial 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. 30. Temperature transmitters shall be provided, wherever Temperature measurement is required for monitoring purpose.		

“*” For these systems Remote I/O panels with push buttons, indication lamps and annunciation shall be provided for subsystems where manned local operation is required.

GENERAL

1. The specification hereunder provides a general guideline for Control & Instrumentations to be provided for the Plant auxiliary systems and Off Site Plants. Bidder shall provide functionally independent & geographically distributed PLC (Programmable Logic Control) based control & Instrumentation system with all control equipment, instruments, accessories, cables and erection hardware for safe, efficient and reliable operation of the plant.
2. Each of the Plant Auxiliaries & off site systems shall be provided with annunciation system. It shall be an integral part of the control system. All the field contact for this purpose shall be acquired through control system. The annunciation sequence/logic shall conform to ISA sequence ISA-2A. The window lamps for the system shall be driven through output modules of the control system.



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DESEIN

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4. The instrumentation to be provided for each of the plant auxiliary & Off Site Plant systems shall be as per the technical specification document / drawings wherever provided for the respective systems as a minimum requirement for bidding purpose. However, for completeness of each of the plant auxiliary & Off Site system and its associated equipment, Bidder shall also provide all the necessary instruments to the process requirement even if it is not specifically indicated in the given technical Specification document / drawings.
5. The instrumentation, operation and control philosophy proposed is specific to the plant design. Any improvement over the proposed typical Control & Instrumentation scheme shall be accepted so long as it does not deviate from the basic intent and general philosophy enumerated herein and elsewhere in this specification.
6. Plant auxiliaries / Off Site Plants shall be operated from their respective local control panels or Operating work stations located in the local area control rooms. Some of the auxiliaries will have operational facility from central control room as well as from local panels. All the PLC's of Ash Handling, DM-RO plant, Service water pump house, Compressor Plant, Condensate polishing unit, Fire Water Pump house etc., shall have digital data communication connectivity with DDCMIS already detailed/discussed in chapter 4. The control system for each of the Plant auxiliaries, Off Site Plant and their Man machine interface requirement and DDC MIS interfaces in the central control room shall be as follows:
 - i. Considering the high ambient noise and electromagnetic interference prevailing in power plant, it is recommended that all links between off-site controls and plant DDC MIS shall be based on Dual Optical Fiber Communication (OFC) medium. Necessary ports / converters shall be provided at both ends.
 - ii. PLC and RTU shall be designed for operating in a non air-conditioned harsh environment also. Communication media shall be optical fiber cable with MODBUS / OPC protocol between DDCMIS and PLC as per requirements. Optical cable, PLC end Modem/Converter and DDCMIS end Modem/Converter shall be supplied by bidder at both end. Optical cables shall be routed through GI conduit pipes. Communication protocol between the Modems shall be RS485/Modbus and the maximum communication time for receipt of signal at DDCMIS end should not exceed 2 seconds. The Communication links shall be as per chapter 4.



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- iii. In addition Hard wired signal interfacing shall also be provided for any signal required for interlock, control & protection. Similarly cable for hard ware signal transfer between DDCMIS and PLC/relay based control system shall be supplied, laid terminated by the bidder including preparation of cable schedule. Quantum of hard wired signals for linking each PLC based system and DDCMIS shall be decided during detailed engineering,.
- 7. Bidder will provide necessary separate industrial grade parallel redundant UPS power supply with 60 minutes battery backup for each PLC, Operating station & printer etc. Bidder shall provide necessary separate industrial grade parallel redundant 24 volts DC charger with 60 minutes battery backup for each PLC without Operating station . Bidder shall have to provide necessary cabling for redundant power supply to UPS / charger.
- 8. Whenever control system is PLC based, annunciation system shall be driven by PLC via Digital output. Mimic LED shall also be driven from PLC digital output. For other relay based control systems, solid-state annunciation system shall be provided. Mimic acrylic sheet thickness shall be min 6-7 mm.
- 9. For each PLC system, without OEWS (Operating Engineering Work Station), Laptop along with software shall be provided for engineering (Laptop shall be separate for each PLC with out OWES).
- 10. PLC system without OEWS (Operating & Engineering Work Station) shall have panel mounted push buttons, lamps, H.W. annunciation, indicators, Ammeters and MIMIC etc for operation & control purpose except specifically requirements of control desk mentioned for any package listed above.
- 11. All the PLC control system shall be of same make, model & same family and shall be supplied directly from manufacturer/vendors. PLC system supplied /engineered by system houses shall not be acceptable. It is preferred to have same family of Plant DDCMIS .
- 12. All remote I/O cards shall be with IP-65 protection class and should withstand upto 70 deg.C temperature.
- 13. All cables terminated in the terminal block, power distribution scheme instruments shall be ferruled. Ferruling shall be double cross ferruling (i.e.) source and destination addresses shall be marked on both sides of the tube ferruling.
- 14. Any Package not listed above shall be PLC (redundant hot standby controllers) controlled with one no. OWS, one no. OEWS (Operating & Engineering Work Station) and one no. A4 B/W LJP.

15. Bidder shall provide local panel for local start/ stop monitoring of auxiliaries and equipment as per requirement .The requirement shall be decided during detailed engineering. All local panel shall be NEMA 4X with canopy.
16. Bidder shall provide ammeters, voltmeters, PB indicating lamp, mimic, electrical scheme, indicators, chartless recorders and HW annunciators on the desk/ panels as requirement and shall be decided in detailed engineering.
17. PLC supplier shall prepare graphic for the complete plant with proper tag nos. for drives, binary inputs, analogue inputs, status of drives etc for the soft link for DDCMIS as per format of DDCMIS.
18. Each PLC/Microprocessor based system/electrical system shall be time synchronized with master clock system. Redundant Time synchronisation signals shall be provided for each control system, wherever redundant controllers/processors are provided.
19. Each subsystem PLC shall be provided with HW interfacing with main system PLC for signals used for command, interlocks, protections and other important process parameters.
20. Control, operation & monitoring of electrical distribution system, namely PCC, Bus coupler, Incomer, breakers etc. for respective plant BOP package shall be controlled & operated from its respective PLC operating station/ backup control desk as well as from respective switchgear unit. Control system for the same shall be implemented in the respective PLC envisaged in the local control room. Bidder shall consider all transducers for monitoring of voltage, current, Kwh, power factor at respective PLC operating station and backup control desk. All signals shall be hardwired only.
21. The technical particulars & requirements of PLC, OWS, Printers, LVS and all other related hardwares/software shall be as per Vol. V, Chapter 4.
22. The technical particulars & requirements of UPS & 24 V DC systems shall be as per Vol. V, Chapter 7.

(Refer PLC System Configuration Drawings, # 114 -01-0000, 0101, 0105, 0107, 0111, 0113, 0114 & 0116, In case any ambiguity between System Configuration Drawings & above Annexure A, Annexure A shall prevail for finalizing the PLC configuration).

7.00.00

CONDENSATE POLISHING UNIT

The Condensate polishing unit is designed for fully automatic / manual operation through the DPU of ~~Plant DDCMIS or~~ redundant PLC system housed in the respective panel. This PLC shall have interface module for redundant and bi-directional OPC connectivity with DDCMIS. Taking the equipment into service and regeneration of mixed-bed units shall be initiated manually from the OWS of control system or local panel and balance operation shall be carried out sequentially by the control system. Manual override facility is also provided for all operations.

The PLC shall be preferably from plant DDCMIS family.

The PLC system shall be provided as detailed in chapter 4 of this specification..

Open and Close limit switch feed backs of valves are to be connected to PLC for remote viewing and for interlocks and protection.

Remote and local indications of various parameters to the process requirement shall be provided. (The same can be decided during detailed engineering)

The OLCs and CLCS philosophy shall be as per the chapter 4 of this volume.

The instruments shall be offered as per the process requirement for complete auto operation.

Necessary instruments pressure gauges, Temperature gauges, DP instruments, Pressure transmitters, Radar Level transmitters, Differential pressure transmitters, Temperature Elements Various analysers, Magnetic type level indicators, shall be provided. The junction boxes and instruments / electronics housing used shall be Non – corrosive material.

Flow transmitters for each stream of CPU are to be provided for monitoring the performance and accountability

The bidder shall furnish required list and type of instruments during detail



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engineering subject to the approval of owner.

Annunciations for abnormal conditions shall be available in the Control Panel furnished by the vendor during detail engineering subject to approval of owner.

Pneumatic actuators with all accessories shall be controlled using solenoid valves, which shall be energized from OWS / Control Panel. The opening and closing of these valves is based on system requirement, which is programmed in the Control system. Feed backs to the control system regarding the valve open / close position are set through the limit switches.

CPU shall be controller & operated from ~~CCR & SWAS panel room in case of DDCMIS operation and from LCR & SWAS panel room in case of PLC operation.~~

Regenerative system shall be controller & operated from ~~SWAS panel room and from~~ local control panel with 17" LCD/TFT monitor panel mounted.

7.00.01 CONTROL AND OPERATION OF PLANT

i) GENERAL

The regeneration system shall be external. Under normal conditions, it will hold a complete charge of freshly regenerated and mixed resin, ready for use, in its storage tank. For regeneration, resin from the exhausted exchanger vessel will be transferred hydraulically to this facility. The empty exchanger vessel will then be filled up with the already regenerated resin

which was stored in the regeneration facility. This exchange vessel shall come into service soon after requisite condition is satisfied or as and when desired by the operator. In the meantime, the exhausted resin shall be cleaned, separated, regenerated, mixed and rinsed before being stored for next use.

ii) CONTROL AND OPERATION OF THE CONDENSATE POLISHING UNIT

a) The condensate polishing unit shall be controlled from the condensate polishing unit OWS or Local control panel, located near the polishing vessels. This panel shall be suitably interlocked with the regeneration system control panel.

1. It shall be possible to select each of the CPU vessels for any of the following operations:

- Service
- Resin transfer from CPU vessel to regeneration plant
- Resin transfer from regeneration plant to CPU vessel
- Isolation from service
- Rinse recycle



- b) A mimic diagram shall be provided for the CPU scheme on the OWS and as well as front of the CPU control panel. Status of various valves shall be indicated by LED's on the mimic diagram.

iii) **CONDENSATE POLISHER CONTROL SYSTEM**

Each condensate polishing system shall be provided Same family of plant DDCMIS or programmable logic control based local panel that will clearly show the status of each service vessel. From this panel it shall be possible to initiate any of the following operating modes:

a) **RINSE RECYCLE**

The rinse recycle shall be a manually initiated in full automatic sequence. This sequence shall include the rinse down step until the unit effluent quality is acceptable for boiler feed water. The effluent quality shall be determined by conductivity monitoring of the rinse water outlet. A panel mounted cation conductivity indicator shall be interlocked to prevent advancing of the automatic sequence until the rinse down is complete.

b) **SERVICE MODE**

Service flow rate for each polishing vessel shall be monitored by panel mounted flow indicators. During periods of low condensate flow the operator may select to remove one of the vessels from service by a manually initiated automatic sequence. A differential pressure switch installed between the influent and effluent headers shall on a high signal cause an annunciator alarm.

Panel mounted cation conductivity indicators shall be provided to monitor the polishing system influent and effluent streams as well as the discharge of each service vessel.

- c) The sequence resin transfer from CPU vessel to regeneration plant and from regeneration plant to CPU vessel shall be initiated from the condensate polishing unit control panel but shall be controlled by the programmable logic controller in the regeneration control panel.

iv) **REGENERATION CONTROL SYSTEM**

- a) Manually initiated automatic sequences shall be provided for transferring resin from a vessel to the remote common facility for physical cleaning and chemical regeneration and for returning fresh resin to that vessel. Control for chemical dosing system and alkali preparation facility shall also be provided in it.
- b) Regeneration shall include hydraulic reclassification of the resins and the transfer of the resins to the respective regeneration vessels. The separated resins shall then be backwashed, cation and anion regenerated with hydrochloric acid and sodium hydroxide solutions respectively, rinsed and then followed air scrubbing



and a good backwash. The resin is then transferred back to the resin separation vessel and the resins are air mixed. The mixed resins after regeneration are given a final rinse with the discharge conductivity being monitored. If the quality is satisfactory, the mixed resin shall be transferred to the resin storage vessel otherwise regeneration sequence shall be repeated.

- c) Demineralized water shall be used throughout the regeneration process for backwashing, regenerant diluents, rinsing and resin transfer. A conical bottom hopper having a water ejector will be used for resin make-up.
- d) The complete control and operation of the regeneration plant shall be through ~~Plant DDCMIS~~ or programmable logic controller (PLC).
- e) It shall be possible to operate the regeneration plant in auto/semi-auto /manual mode.
- f) Following operations shall be possible from the regeneration control panel:
 - Complete regeneration
 - Resin transfer from CPU vessel to regeneration plant.
 - Resin transfer from regeneration plant to CPU vessel.
- g) In 'Auto' mode, once the sequence has been initiated, it shall proceed from step to step automatically.
- h) In 'Semi-auto' mode each step shall be performed only after initiation by the operator.
- i) In 'Manual' mode complete operation shall be by the operator by operation of the control switches on the panel.
- j) On Plant DDCMIS or PLC failure, it shall be possible to operate the valves by means of manual operation of solenoid valves also.
- k) It shall be possible to switch mode of operation from one to the other at any moment and the operation shall proceed on the newly selected mode from that time.
- l) The system shall incorporate the necessary safety features. During automatic sequential operation, if any pre-requisite criteria is not fulfilled or missing for a pre determined time interval, the steps should not proceed further, and Alarm shall be provided. Missing criteria, sequence which is under hold up etc. shall be displayed on the panel.
- m) A mimic diagram of the Regeneration system shall be provided on the front of the local panel. The status of various drives and valves shall be indicated by LED on the mimic diagram.
- n) Wherever standby equipments are provided, it shall be possible to select each of



the drive on 'standby' duty.

- o) The detailed logic for the sequence and for each of the drive shall be subject to the Owner's approval during detail engineering
- p) Start, progress and stop of each of the sequence shall be annunciated in all the control panels.
- q) At any time only one of the sequence shall be in progress.

v) **INTERLOCKS**

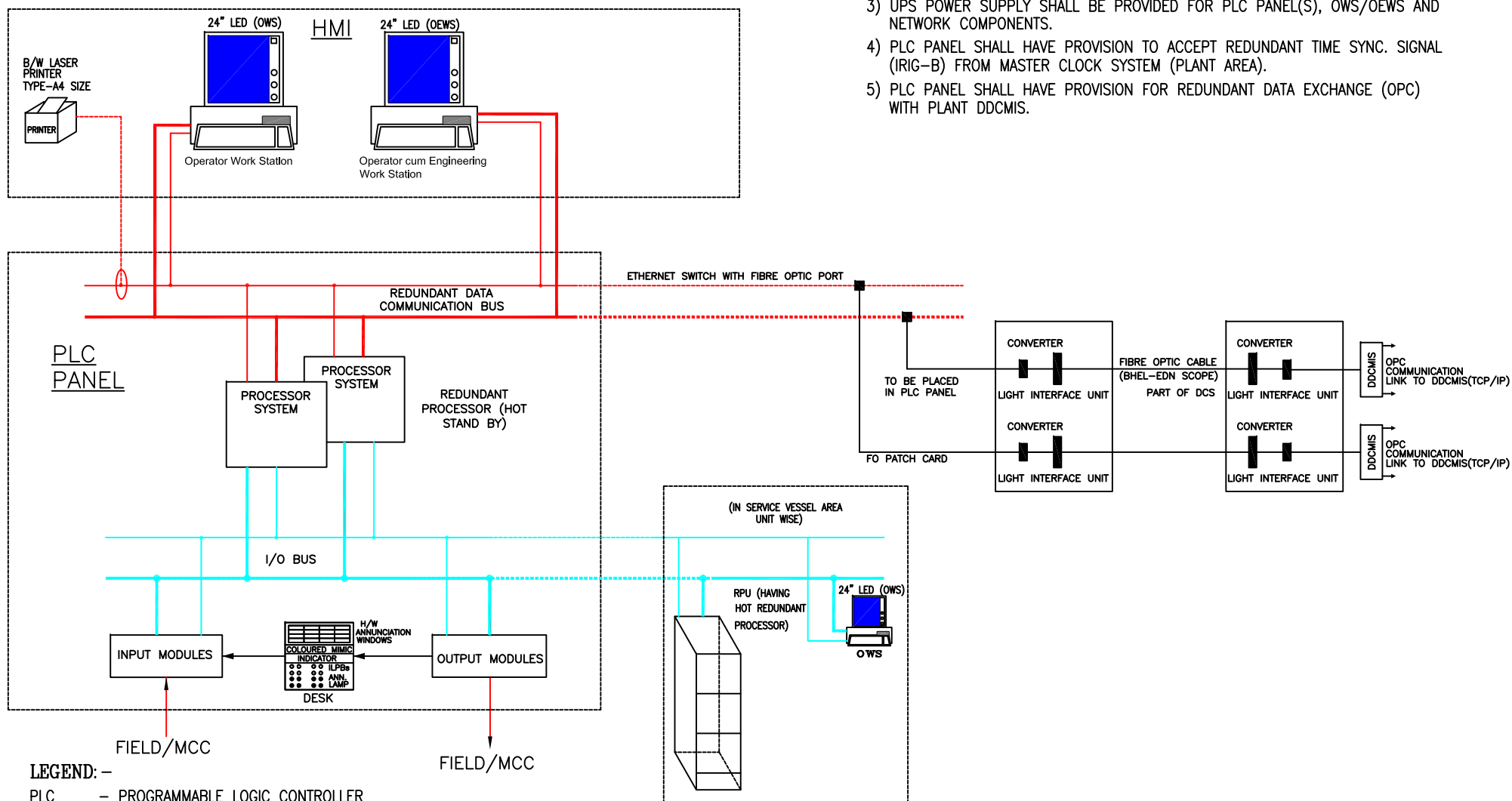
All interlocks for safe operation of the plant shall be provided. They shall specifically include the following as minimum requirement:

- a) Service vessels shall be taken back in service, only after they have been pressurized.
- b) Service vessels shall be taken up for resin transfer only after they have been completely isolated from the condensate system and depressurized.
- c) Resin shall be transferred to and from only one service vessel at a time.
- d) Resin transfer between the service and the regeneration skids shall be permitted only when the receiving vessel is initially empty.
- e) It shall be possible for the operator to extend the timing of a particular step by isolating the timer for the duration. The timer will restart once the operator puts back the system on 'auto' and the other steps will then follow as programmed.
- f) The regeneration sequence shall be prevented from advancing further in the event of tripping of a running motor or other fault condition which do not permit the various desired parameter of this step to be achieved. A manual override for this shall also be provided.
- g) The immersion heater in the hot water tank can be put on only when there is adequate water level in the tank.



NOTES:

- 1) TABLE TOP OWS/OEWS SHALL BE OF LED 24" OR AVAILABLE INDUSTRY STANDARD.
- 2) PLC SYSTEM SHALL HAVE REDUNDANCY IN PROCESSOR, COMMUNICATION SYSTEM AND POWER SUPPLY.
- 3) UPS POWER SUPPLY SHALL BE PROVIDED FOR PLC PANEL(S), OWS/OEWS AND NETWORK COMPONENTS.
- 4) PLC PANEL SHALL HAVE PROVISION TO ACCEPT REDUNDANT TIME SYNC. SIGNAL (IRIG-B) FROM MASTER CLOCK SYSTEM (PLANT AREA).
- 5) PLC PANEL SHALL HAVE PROVISION FOR REDUNDANT DATA EXCHANGE (OPC) WITH PLANT DDCMIS.



LEGEND:-

- PLC - PROGRAMMABLE LOGIC CONTROLLER
- DDCMIS - DISTRIBUTED DIGITAL CONTROL MONITORING & INFORMATION SYSTEM
- UPS - UNINTERRUPTED POWER SUPPLY
- OEWS - OPERATOR CUM ENGINEERING WORK STATION
- HMI - HUMAN MACHINE INTERFACE
- NTP - NETWORK TIME PROTOCOL
- OPC - OLE PROCESS CONTROL
- MCCB - MOULDED CASE CIRCUIT BREAKER
- MCB - MINIATURE CIRCUIT BREAKER

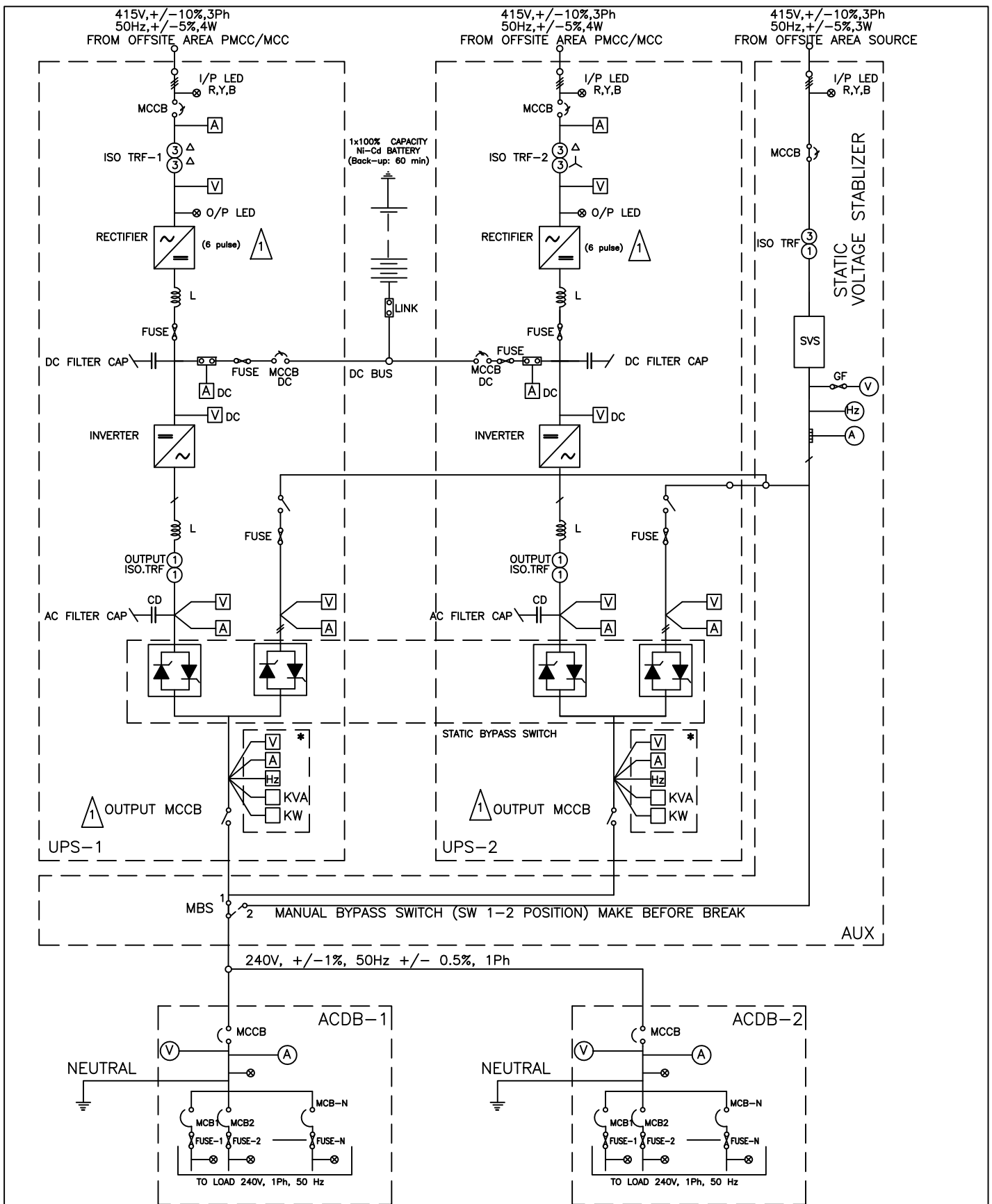


TITLE:-

PLC SYSTEM CONFIGURATION

CONDENSATE POLISHING UNIT

DRG. NO.	
REV. No.	DATE
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* V, A, Hz, KVA, KW READINGS/VALUES SHALL BE READY ON THE MIMIC DISPLAY PROVIDED ON THE UPS PANEL FRONT DOOR.



PROJECT:- 2 X 660 MW ENNORE SEZ STPP

TITLE:- UPS SCHEME
FOR OFFSITE

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REV. No.	01	DATE	23.05.2015
SHEET	3	OF	4

**TITLE****2X 660 MW ENNORE SEZ STPP
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SHEET

ANNEXURE I**LIST OF MAKES**



TITLE

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SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
1.	PRESSURE VESSELS	GLOBAL STRUCTURES & COMPOSITE LTD	-	
		JASMINO POLYMERTECH	TALOJA	
		SYSCON ENGINEERS	AMBERNATH	
		S.V. FABRICATORS	NAVI MUMBAI	
		SPARK FABRICATORS / STEELCON	-	
		ANUP ENGINEERING	AHMEDABAD	
		MURTHAL TANKS & VESSELS	SONEPAT	
		TITAN ENGG.	DURGAPUR	
		RISHI INDUSTRIES	BAHALGARH	
		UNIVERSAL HEAT EXCHANGERS	-	
		ATS CHEM	SALEM/HOSUR	
		CHEM PROCESS SYSTEM	SANAND	
		PROGEN	CHENNAI	
		CRYSTAL ENGINEERING	HOSUR	
		ISHAN EQUIPMENTS	VADODARA	
2.	ATMOSPHERIC/ STORAGE TANKS	GLOBAL STRUCTURES & COMPOSITE LTD	-	
		JASMINO POLYMERTECH	TALOJA	
		SYSCON ENGINEERS	AMBERNATH	
		S.V. FABRICATORS	NAVI MUMBAI	
		SPARK FABRICATORS / STEELCON	-	
		ANUP ENGINEERING	AHMEDABAD	
		MURTHAL TANKS & VESSELS	SONEPAT	
		TITAN ENGG.	DURGAPUR	
		RISHI INDUSTRIES	BAHALGARH	
		UNIVERSAL HEAT EXCHANGERS	-	
		ATS CHEM	SALEM/HOSUR	
		CHEM PROCESS SYSTEM	SANAND	
		PROGEN	CHENNAI	
		CRYSTAL ENGINEERING	HOSUR	
		ISHAN EQUIPMENTS	VADODARA	
3.	RUBBER LINING (AT SHOP)	TEMSEC	KOLKATA	
		RISHI INDUSTRIES	SONEPAT	
		CORI ENGINEERS	CHENNAI	
		POLY RUBBER	MUMBAI	
		INDUSTRIAL LINING	VADODARA	



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SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		ARUL RUBBERS	CHENNAI	
		JASMINO POLYMERTECH	TALOJA	
		WESTERN RUBBER	NAVI MUMBAI	
		ELASTOMER LINNING	AMBERNATH	
		EMKAY RUBBER	MUMBAI	
4.	AIR BLOWERS (TWIN LOBE TYPE)	SWAN PNEUMATIC	NOIDA	
		EVEREST TRANSMISSION	NEW DELHI	
		KAY INTERNATIONAL	NEW DELHI / SONEPAT	
		EVEREST BLOWER	BAHADURGARH	
		KULKARNI POWER TOOLS	KOLHAPUR/ PUNE	
5.	METERING PUMPS	VK PUMPS	NASIK	
		MILTON ROY INDIA	CHENNAI	
		SWELLORE	AHMEDABAD	
		POSITIVE METERING PUMPS	NASIK	
		METACHEM	MUMBAI	
6.	AGITATOR	REMI PEOCESS PLANT & M/C	MUMBAI	
		FIBRE & FIBRE	MUMBAI / SILVASA	
		CEECONS	CHENNAI	
		STANDARD ENGINEERS	MUMBAI	
7.	HORIZONTAL CENTRIFUGAL PUMPS	BEST AND CROMPTON ENGG LTD.	CHENNAI	
		BHARAT PUMPS & COMPRESSORS LTD	ALLAHABAD	
		FLOWMORE LTD.	GURGAON	
		FLOWSERVE INDIA CONTROLS PVT. LTD.	COIMBATORE	
		JYOTI LTD.	VADODARA	
		KIRLOSKAR BROTHERS LTD	PUNE	
		WILO MATHER & PLATT PUMPS PVT. LTD.	PUNE	
		V-FLO PUMPS & SYSTEMS CO. LTD.,	BEIJING-CHINA	
		WPIL LIMITED	KOLKATA	
8.	VERTICAL CENTRIFUGAL PUMPS	BHARAT PUMPS & COMPRESSORS LTD	ALLAHABAD	
		FLOWMORE LTD.	GURGAON	
		FLOWSERVE INDIA CONTROLS PVT. LTD.	COIMBATORE	
		JYOTI LTD.	VADODARA	
		WILO MATHER & PLATT PUMPS PVT. LTD.	PUNE	
		SULZER PUMPS INDIA LTD.	THANE	



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SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		WPIL LIMITED	KOLKATA	
9.	HORIZONTAL CENTRIFUGAL PUMPS (RUBBER LINED)	KISHORE PUMPS	PUNE	
		SU MOTORS	MUMBAI	
10.	NON METALLIC (PP/FRP) HORIZONTAL CENTRIFUGAL PUMPS	ENGINEERS COMBINE	THANE	
		ANTICORROSIVE	VALSAD	
		LEAK PROOF PUMPS PVT. LTD. (RAJEDIA)	-	
11.	MISC. PUMP VERTICAL TURBINE TYPE	KBL	PUNE	
		M&P	PUNE	
		WPIL	GHAZIABAD	
		KISHORE PUMPS	PUNE	
		FLOWMORE	SAHIBABAD	
12.	BATTERY CHARGER FOR PLC	AMARA RAJA POWER SYSTEMS LIMITED	TRIPUTI	
		CHHABI ELECTRICALS PVT.LTD.	JALGAON	
		CHLORIDE POWER SYSTEMS & SOLUTIONS LIMITED	KOLKATA	
		DUBAS ENGG PVT LTD	BANGALORE	
		HBL POWER SYSTEMS LTD	HYDERABAD	
		JEMA ENERGY	SPAIN	FOR STATIC SCR TYPE FULL WAVE FULLY CONTROL TYPE
		MASS-TECH CONTROLS PVT.LTD.	MUMBAI	
		STATCON POWER CONTROLS LTD	NOIDA	
13.	UNDER BED NOZZLE	JONSONS SCREEN	AUSTRALIA/ IRELAND	
14.	COATING & WRAPPING MATERIAL TAPE	IWL LTD.	CHENNAI	
		MP TAR PRODUCT	BHILAI	
		PORWAL INDUSTRIES	RAIPUR	
		RUSTECH	KOLKATA	
		STP	JAMSHEDPUR	
15.	HEATER	ESCORTS	FARIDABAD	
		RACOLDS	FARIDABAD	
16.	RESIN	ROHM & HASS	FRANCE / USA	
		LANXESS	GERMANY	
		PUROLITE	ROMANIA/CHINA	
17.	HIGH PRESSURE BUTTERFLY VALVE	DeZURICK (Upto 400 NB)	USA	
		TYCO VALVES (UPTO 450 NB)	USA	
		BRAY	CHINA	
18.	BALL VALVE (HIGH	VELAN	CANADA	



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SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
	PRESSURE) SIZE 100 NB	BRAY	USA	
19.	CAST IRON GATE/GLV/NRV/SRV	A.V. VALVES LTD	AGRA	
		ATAM VALVES PVT. LTD.	JALANDHAR	
		FLUIDLINE VALVES COMPANY PVT.LTD.	GHAZIABAD	
		G.M. DALUI AND SONS PVT.LTD.	HOWRAH	
		H.SARKER AND COMPANY	HOWRAH	
		LEADER VALVES LTD.	JALANDHAR	
		VENUS PUMPS AND ENGG. WORKS	KOLKATA	
20.	BALL VALVE (MANUAL /PNEUMATIC/ ELECTRIC) CLASS 150	A.V. VALVES LTD	AGRA	
		AKAY INDUSTRIES PVT.LTD.	DHARWAD	
		BELGAUM AQUA VALVES PVT. LTD.	BELGAUN	
		ASIAN INDUSTRIAL VALVES & INSTRUMENTS.	CHENNAI	
		ATAM VALVES PVT. LTD.	JALANDHAR	
		DEMBLA VALVES LTD.	THANE	
		M/S GM ENGINEERING	RAJKOT	
		HAWA VALVES (INDIA) PVT. LTD.	NAVI MUMBAI	
		INTERVALVE (INDIA) LTD.	PUNE	
		LEADER VALVES LTD.	JALANDHAR	
		MICROFINISH VALVES PVT LTD.	HUBLI	
		NILON VALVES PRIVATE LIMITED	AHMEDABAD	
		SURYA VALVES AND INSTRUMENTS MFG CO.	CHENNAI	
		UNIFLOW	CHENNAI	
		VALTECH INDUSTRIES	MUMBAI	
		VAAS AUTOMATION PVT. LTD.	NEW DELHI	
		WEIR BDK VALVES- A UNIT OF WEIR INDIA PVT. LTD.	NEW DELHI	
21.	ELECTRIC MOTOR	CROMPTON GREAVES	AHMEDNAGAR	
		LAXMI HYDRAULICS PVT. LTD	BANGALORE / HUBLI*	
		RAJINDRA ELECT INDUSTRIES	FARIDABAD* / BANGALORE	
		GE-POWER		
		BHARAT BIJLEE	MUMBAI	
		SIEMENS	MUMBAI	
		NGEF	BANGALORE	
		KIRLOSKAR ELECTRIC CO LTD.		



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SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		ASEA BROWN BOVERI		
		MARATHON	KOLKATA	
		ADVANCE VALVES PVT. LTD.	NOIDA	
		FLUIDLINE VALVES COMPANY PVT.LTD.	GHAZIABAD	
		INSTRUMENTATION LTD.	PALAKKAD	
		INTERVALVE (INDIA) LTD.	PUNE	
		R AND D MULTIPLES (METAL CAST) PVT LTD	MUMBAI	
		SURYA VALVES AND INSTRUMENTS MFG CO.	CHENNAI	
		PENTAIR VALVES AND CONTROLS INDIA PRIVATE LIMITED	NAVI MUMBAI	
		UPADHAYA VALVES MANUFACTURERS PRIVATE LIMITED,	KOLKATA	
		VENUS PUMPS AND ENGG. WORKS	KOLKATA	
		WEIR BDK VALVES- A UNIT OF WEIR INDIA PVT. LTD.	NEW DELHI	
		WEIR BDK	HUBLI	
		CRANE FLOW PROCESS	SATARA	
		PROCON	MUMBAI	
		MAJESTIC VALVES (LABLINE)	-	
		HAWA ENGINEERS	AHMEDABAD	
		ADVANCE VALVES PVT. LTD.	NOIDA	
		FLUIDLINE VALVES COMPANY PVT.LTD.	GHAZIABAD	1. DUAL PLATE CHECK VALVE CI - CLASS 150 & UP TO 600NB, 2. DUAL PLATE CHECK VALVE CCS - CLASS 150 & UP TO 500NB
		R AND D MULTIPLES (METAL CAST) PVT LTD	MUMBAI	
		VENUS PUMPS AND ENGG. WORKS	KOLKATA	CI, CCS & STAINLESS STEEL SPRING ASSISTED DUAL PLATE CHECK VALVES UPTO 700 NB AND 150 CLASS RATING.
		OTOKLIN GLOBAL BUSINESS LIMITED	MUMBAI	
		GRAND PRIX	NEW DELHI	
		JAYPEE	NEW DELHI	



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SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		GREAVES COTTON	MUMBAI	
		MULTITEX FILTRATION ENGINEERS LIMITED,	NEW DELHI / NOIDA	
		FILTRATION ENGINEERS (I) PVT. LTD	MUMBAI	
		FLUIDNYE	-	
		SUNGOV ENGINEERING PVT. LTD.	DELHI	
		GRAND PRIX	FARIDABAD	
		JAYPEE INDUSTRIES PVT. LTD.	DELHI	
		BHATIA ENGINEERING CO.	DELHI	
26.	RUBBER FLAP TYPE CHECK VALVES	ASHVIK VALVES	-	
		FLOW WAY VALVES	-	
		BDK	-	
		MAJESTIC VALVES (LABLINE INST)	-	
		ADVANCE VALVES	-	
27.	MEMBRANES	DOW		
		TORAY		
		KOCH		
		HYDRONOTICS		
		NORIT		
28.	SOLENOID VALVES	ROTEX	-	
		AVCON	-	
29.	PRESSURE GAUGE/ DIFFERENTIAL PRESSURE GAUGE	A.N. INSTRUMENTS PVT. LTD.	KOLKATA	
		ASHCROFT INDIA PVT LTD.	GUJARAT	
		BOSE PANDA INSTRUMENTS PVT.LTD.	KOLKATA	
		FORBES MARSHALL (HYD) LTD.	HYDERABAD	
		GAUGE BOURDON INDIA PVT. LTD.	MUMBAI	
		H.GURU INDUSTRIES	KOLKATA	
		H.GURU INSTRUMENTS (SOUTH INDIA) P. LTD	BANGALORE	
		BAUMER TECHNOLOGIES INDIA PVT. LTD.	MUMBAI	
30.	CHAIN PULLEY BLOCK	ARMSEL MHE PVT. LTD	BANGALORE	
		CENTURY CRANE ENGINEERS PVT. LTD.	FARIDABAD	
		HERCULES HOISTS LTD.	RAIGAD	
		LIFTING EQUIPMENTS AND ACCESSORIES	DELHI	



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CONDENSATE POLISHING UNIT**

SPECIFICATION NO.

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SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		TUOBRO FURGUSON (INDIA) PVT LTD	KOLKATA	UPTO 10 TONNE.
		TRACTEL TIRFOR INDIA PVT. LTD.	FARIDABAD	
		TECHNO INDUSTRIES	AHMEDABAD	
		ARMSEL MHE PVT. LTD	BANGALORE	
		ALPHA SERVICES	BHIWADI	
		CONSOLIDATED HOISTS PVT LTD	PUNE	UPTO 20 TONNES
		CENTURY CRANE ENGINEERS PVT. LTD.	FARIDABAD	
		EDDY CRANES PVT. LTD.	MUMBAI	CAPACITY UPTO 10 TONS. BOIS BHEL APP.SUB-VENDORS.
		GRIP ENGINEERS PVT. LTD.,	FARIDABAD,	
		GLOBAL TECHNOLOGIES	HYDERABAD	
		HERCULES HOISTS LTD.	RAIGAD	
		LIFTING EQUIPMENTS AND ACCESSORIES	DELHI	
		MANGLA HOISTS PVT LTD	NEW DELHI	
		MEEKA MACHINERY PVT. LTD.	AHMEDABAD	
		REVA INDUSTRIES LTD.	FARIDABAD	UPTO 25.0 T CAPACITY.
		ROCKWELL HOISTO CRANES PVT. LTD.	BAHADURGARH	
		SAFEX ENERGY PVT. LTD.	AHMEDABAD	
		TUOBRO FURGUSON (INDIA) PVT LTD	KOLKATA	UPTO 15 TONNES.
		TECHNO INDUSTRIES	AHMEDABAD	
31.	ELECTRIC HOIST	ARMSEL MHE PVT. LTD	BANGALORE	
		ALPHA SERVICES	BHIWADI	
		CONSOLIDATED HOISTS PVT LTD	PUNE	UPTO 20 TONNES
		CENTURY CRANE ENGINEERS PVT. LTD.	FARIDABAD	
		EDDY CRANES PVT. LTD.	MUMBAI	CAPACITY UPTO 10 TONS. BOIS BHEL APP.SUB-VENDORS.
		GRIP ENGINEERS PVT. LTD.,	FARIDABAD,	
		GLOBAL TECHNOLOGIES	HYDERABAD	
		HERCULES HOISTS LTD.	RAIGAD	
		LIFTING EQUIPMENTS AND ACCESSORIES	DELHI	
		MANGLA HOISTS PVT LTD	NEW DELHI	



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		MEEKA MACHINERY PVT. LTD.	AHMEDABAD	
		REVA INDUSTRIES LTD.	FARIDABAD	UPTO 25.0 T CAPACITY.
		ROCKWELL HOISTO CRANES PVT. LTD.	BAHADURGARH	
		SAFEX ENERGY PVT. LTD.	AHMEDABAD	
		TUOBRO FURGUSON (INDIA) PVT LTD	KOLKATA	UPTO 15 TONNES.
		TECHNO INDUSTRIES	AHMEDABAD	
32.	CONTROL VALVE	SPX CORPORATION, USA	AHMEDABAD	
		CONTROL COMPONENT INC.	CALIFORNIA	
		DRESSER VALVE INDIA PVT. LTD	COIMBATORE	
		DAUME REGELARMATUREN GMBH,	GERMANY	
		EMERSON PROCESS MANAGEMENT CHENNAI LIMITED	CHENNAI	
		WEIR VALVES & CONTROLS UK LTD.	U.K	
		HOLTER REGELARMATUREN GMBH & CO.KG	GERMANY	
		INSTRUMENTATION LTD.	KERALA	
		KOSO INDIA PRIVATE LIMITED,	NASHIK	
		LESLIE CONTROLS, INC	USA	
		MIL CONTROLS LTD.	KERALA	
		METSO SINGAPORE PTE. LTD.,	SINGAPORE	
		PARCOL S.P.A	ITALY	
		R.K.CONTROL INSTRUMENTS PVT. LTD.	THANE	
		RINGO VALVULAS S.L,	SPAIN	
		SHENJIANG VALVE CO. LTD.	CHINA	
		VALVITALIA S.P.A. ,	ITALY	
		WALDEMAR PRUSS ARMATURENFABRIK GMBH	GERMANY	
33.	PRESSURE/DP/VACUUM SWITCH	INDFOSS	GHAZIABAD	
		SOR	USA	
		DRESSOR	USA	
		DELTA CONTROL	UK	
		TRAFAG	RANIPET	
		GIC(GAUGES BOURDON)	PANVEL	
		ASHCROFT INDIA PVT LTD.	USA/GERMANY	
		SWITZER	CHENNAI	
34.	TEMPERATURE GAUGE	A.N. INSTRUMENTS PVT. LTD.	KOLKATA	



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		ASHCROFT INDIA PVT LTD.	GUJARAT	
		BUDENBERG GUAGE CO.LTD.	UK	
		FORBES MARSHALL (HYD) LTD.	HYDERABAD	
		GOA INSTRUMENTS INDUSTRIES PVT.LTD.	GOA	
		GOA THERMOSTATIC INSTRUMENTS PVT.LTD.		
		GAUGE BOURDON INDIA PVT. LTD.	MUMBAI	
		H.GURU INDUSTRIES	KOLKATA	
		H.GURU INSTRUMENTS (SOUTH INDIA) P. LTD	BANGALORE	
		BAUMER TECHNOLOGIES INDIA PVT. LTD.	MUMBAI	
35.	LEVEL GAUGE (F&B, TUBULAR, REFLEX)	SBEM		
		CHEMTROL		
		PUNE TECHTROL		
		SIGMA		
		V AUTOMAT		
		GENERAL INSTRUMENTS		
36.	ROTAMETER	EUREKA INDUSTRIAL EQUIPMENTS PVT.LTD.	PUNE	
		FLOW STAR ENGINEERING PVT. LTD.,	FARIDABAD	
		FLOWTECH INSTRUMENTS SERVICRS	VADODARA	
		INSTRUMENTATION ENGINEERS PVT LTD	TELANGANA	
		SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	NAVI MUMBAI	
37.	LEVEL SWITCH- CONDUCTIVITY TYPE	BLISS ANAND PVT. LTD.	GURGAON	
		FLOWTECH INSTRUMENTS SERVICRS	VADODARA	
		HI-TECH SYSTEMS & SERVICES LTD.	KOLKATA-	VENDOR SHALL SOURCE IMPORT CONTENTS OF LEVEL SWITCH (CONDUCTIVITY TYPE) FROM LEVELSTATE SYSTEMS LTD., UNITED KINGDOM.
		LEVCON INSTRUMENTS PVT. LTD.	KOLKATA	
		RAMAN INSTRUMENTS PVT.LTD.	MUMBAI	VENDOR SHALL SOURCE IMPORT CONTENTS OF



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				LEVEL SWITCH (CONDUCTIVITY TYPE) FROM MOBREY MEASUREMENT, AN OPERATING UNIT OF MORBEY LTD., SLOUGH, BERKSHIRE, UNITED KINGDOM.
		SIGMA INSTRUMENTS CO.	MUMBAI	
		SOR INC.	USA	
		SAPCON INSTRUMENT PVT LTD.	INDORE	
		V. AUTOMAT & INSTRUMENTS (P) LTD.	NEW DELHI	
38.	LEVEL SWITCH (ALL TYPES)	LEVCON		
		CHEMTROLS SAMIL (INDIA) PVT LTD.		
		SWITZER		
		WAAREE (BAUMER INSTRUMENTS)		
		V AUTOMAT		
		PUNE TECHTROL		
39.	MAGNETIC FLOW METER	ABB	-	
		WAAREE (BAUMER INSTRUMENTS)	-	
		EUREKA	-	
		EMERSON	-	
		YOKOGAWA	-	
		HACH (POTENSE)	-	
		KROHNE MARSHALL	-	
40.	FLOW ELEMENT - NOZZLE	HYDROPNEUMATICS PVT. LTD.	GOA	
		INSTRUMENTATION LTD.	PALAKKAD	
		MICRO PRECISION PRODUCTS PVT. LTD.	FARIDABAD	
		MINCO (INDIA) FLOW ELEMENTS PVT. LTD.	GOA	
		STAR-MECH CONTROLS (I) PVT.LTD.	PUNE	
		SEIKO FLOW CONTROL GMBH	AUSTRIA	
41.	FLOW ELEMENT - ORIFICE	FLOW STAR ENGINEERING PVT. LTD.,	FARIDABAD	
		HYDROPNEUMATICS PVT. LTD.	GOA	
		INSTRUMENTATION LTD.	PALAKKAD	
		INSTRUMENTATION ENGINEERS PVT LTD	HYDERABAD	



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		MICRO PRECISION PRODUCTS PVT. LTD.	FARIDABAD	
		MINCO (INDIA) PRIVATE LIMITED	GOA	
		STAR-MECH CONTROLS (I) PVT.LTD.	PUNE	
42.	FLOW TRANSMITTERS (ALL TYPES)	E & H	-	
		KHRONE MARSHALL	-	
		EMERSON	-	
		ABB	-	
		HONEYWELL	-	
		YOKOGAWA	-	
43.	LEVEL TRANSMITTERS (ALL TYPES)	EMERSON	-	
		E & H	-	
		ABB	-	
		HONEYWELL	-	
		V AUTOMAT	-	
		YOKOGAWA	-	
		SIEMENS	-	
		KROHNE MARSHALL	-	
44.	PRESSURE TRANSMITTERS (ALL TYPES)	EMERSON	USA/PAWANE	
		LAXONS AUTOMATION	DAMAN	
		YIL	BANGALORE	
		SIEMENS	THANE	
		FUJI	CHINA	
		YOKOGAWA	JAPAN	
		HONEYWELL	USA/PUNE	
45.	TEMPERATURE TRANSMITTERS	EMERSON	-	
		E & H	-	
		ABB	-	
		HONEYWELL	-	
		V AUTOMAT	-	
		YOKOGAWA	-	
		SIEMENS	-	
		FORBES MARSHALL	-	
46.	PH TRANSMITTERS	EMERSON	-	
		YOKOGAWA	-	
		HONEYWELL	-	
		ABB	-	
		HACH	-	
		FORBES MARSHALL	-	
47.	ANALYSERS (ALL	ABB	-	



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	TYPES)	EMERSON	-	
		YOKOGAWA	-	
		HONEYWELL	-	
		HACH POLYMETRON	-	
		SIEMENS	-	
		FORBES MARSHALL	-	
48.	PROGRAMMABLE LOGIC CONTROLLER	GE INTELLIGENT PLATFORMS PRIVATE LIMITED	BANGALORE	
		HONEYWELL AUTOMATION INDIA LIMITED ,	PUNE	
		ROCKWELL AUTOMATION INDIA LTD	SAHIBABAD	
		SIEMENS LIMITED	MUMBAI	
		SCHNEIDER ELECTRIC INDIA PVT.LTD.	NEW DELHI	
49.	UPS	HITACHI-HIREL	GANDHINAGAR	
		APC	BANGALORE	
		DELTA	GURGAON	
		EMERSON	MUMBAI	
		DB POWER	PUNE	
		APLAB	MUMBAI	
50.	INSTRUMENT FITTINGS	AURA INCORPORATED	NEW DELHI	
		ASTEC VALVES & FITTINGS PVT. LTD.,	MUMBAI	
		ARYA CRAFTS & ENGINEERING PVT. LTD.	MUMBAI	
		COMFIT & VALVE PVT. LTD.	GUJARAT	
		FLUIDFIT ENGINEERS PVT. LTD.	MUMBAI	
		FLUID CONTROLS PVT. LTD.	MUMBAI	
		HP VALVES & FITTINGS INDIA PVT. LTD.	CHENNAI	
		PRECISION ENGINEERING INDUSTRIES	MUMBAI	
		PANAM ENGINEERS,	MUMBAI	
		PERFECT INSTRUMENTATION CONTROL (INDIA) PVT. LTD.	MUMBAI	
		VIKAS INDUSTRIAL PRODUCTS	NOIDA	
51.	JUNCTION BOX	AJMERA INDUSTRIAL & ENGINEERING WORKS	MUMBAI	
		FLEXPRO ELECTRICALS PVT. LTD.	GUJARAT	METAL TYPE JUNCTION BOX ONLY



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		K.S.INSTRUMENTS PVT.LTD.	BANGALORE	
		SUCHITRA INDUSTRIES	BANGALORE	
		SHRENIK & COMPANY,	AHMEDABAD	
52.	CABLE GLAND	COMET	-	
		DOWELL	-	
		CHETNA	-	
53.	CABLE LUGS	ELECTRO BILLETS	-	
		COMET	-	
		DOWELL	-	
		CHETNA	-	
54.	MS PLATES	SAIL		
		ESSAR STEEL		
		TISCO		
		RINL		
		JINDAL		
		LLOYD		
		ISPAT		
		INDIAN IRON & STEEL CO. LTD		
55.	CS PIPE (ASTM A 106 GR. B)	INDIAN SEAMLESS METAL TUBES	AHMEDABAD	UPTO 150 NB
		MAHARASHTRA SEAMLESS	RAIGAD	UPTO 350 NB
56.	MS PIPES (IS: 1239 & 3589)	SAIL	ROURKELA	
		JINDAL	GHAZIBAD/HISSAR	
		SURYA ROSHNI	BAHADUR GARH	
		TATA TUBE	JAMSHEDPUR	
		PSL	CHENNAI/VIZAG/KUTCH/DAMAN	
		LALIT PROFILE	THANE	
		SAMSHI PIPES INDUSTRIES	VADODARA	
		MUKUT PIPES	RAJPURA	
		INDUS TUBES	G B NAGAR	
		MANN IND	INDORE	
		SURENDRA ENGG	RAJPURA	
		PRATIBHA PIPES & STRUCTURE PVT LTD	THANE	
		JCO GAS PIPE	CHINDWARA	
		NUKAT TANKS AND VESSELS	TARAPUR	
		DADU PIPES	SIKRANDRABAD	
		GOOD LUCK TUBES	SIKANDRABAD	



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		ADVANCE STEEL TUBES	SAHIBABAD	
		BIHAR TUBES	SIKANDRABAD	
		HI TECH PIPES	SIKANDRABAD	
		RATNAMANI	KUTCH/AHMEDABAD/CHHATRAL	
		MAHARASHTRA SEAMLESS	RAIGAD	
		WELSPUN	ANJAR/BHARUCH	
57.	SS PIPES / TUBES	APEX TUBES	BEHROR (ALWAR)	
		RATNAMANI	CHATRAL	
		REMI	TARAPUR	
		PRAKASH STEELAGE	-	
58.	POWER/CONTROL/INSTRUMENT CABLE	CORDS CABLE	BHIWADI	
		RADIANT CABLES	HYDERABAD	
		POLYCAB	DAMAN	
		KEI	BHIWADI	
		NICCO	KOLKATA	
		RAVIN CABLES	PUNE	
		INCAB	PUNE	
		HVPL	FARIDABAD	
		TORRENT CABLE	NADIAD	
		HAVELLS	ALWAR	
		PARAMOUNT	KHUSHKHERA	
		SRI RAM CABLES	BHIWADI	
		THERMOCABLES	HYDERABAD	
		TORRENT CABLE	NADIAD	
		UNIVERSAL CABLES	SATNA	
		GEMSCAB	BHIWADI	
		DELTON	FARIDABAD	
59.	SAFETY SHOWER	UNICARE	-	
		MOHAN INDUSTRIES	-	
		SUPER SAFETY SERVICES	-	
60.	FRP TANKS & FITTINGS	GLOBAL COMPOSITE	-	
		EPP	-	
		DEEPA COMPOSITE	-	
		COROSEAL INDUSTRIES	-	
		CHEMICAL PROCESS & EQUIPMENT PVT LTD	-	
		J.R FIBRE INDUSTRIES PVT LTD	-	



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		POLYPLAST	-	
61.	EJECTOR	ESSEM TECHNOLOGIES	-	
		RATNA PRASAD	-	
62.	LOCAL CONTROL PANEL	INDUSTRIAL SWITCHGEAR & CONTROL	-	
		POSITRONICS	-	
		DELTA CONTROL	-	
		L & T	-	
		GE POWER	-	
		PYROTECH	-	
		C&S	-	
63.	TANK (FRP)	INDUSTRIAL SERVICE	KOLKATA	
		SUNRISE	BARODA	
		GANDHI & ASSOCIATES	AHMEDABAD	
		MODERN EQUIPMENTS	CHENNAI	
		EAGLE PLAST	PUNE	
		OMEGA PLAST	MUMBAI	
64.	STROKE CONTROLLER	V K PUMPS	NASIK	
		METACHEM	MUMBAI	
		SWELORE	AHMEDABAD	
		MILTON ROY INDIA	CHENNAI	
65.	SAFETY VALVES/RELIEF VALVES	METACHEM	MUMBAI	
		KEYSTONE	BARODA	
		V K PUMPS	NASIK	
		MILTON ROY	CHENNAI	
66.	DUPLEX STRAINER	JAYPEE INDUSTRIES PVT. LTD.	NEW DELHI	
		MULTITEX FILTRATION ENGINEERS LIMITED,	NEW DELHI	
		OTOKLIN GLOBAL BUSINESS LIMITED	MUMBAI	
		SUNGOV ENGINEERING PVT. LTD.	CHENNAI	
67.	ORIFICE PLATE	MICRO PRECISION	FARIDABAD	
		INSTRUMENTAION LTD	PALGHAT	
		CARLO DYNAMICS	HYDERABAD	
68.	STEEL GATE/GLOBE/NR VALVES	A.V. VALVES LTD	AGRA	
		ATAM VALVES PVT. LTD.	JALANDHAR	(1) CARBON STEEL GATE VALVES & NON RETURN VALVES: 15 NB TO 50 NB (#800) & 65 NB TO 300 NB (#150) (2) CARBON



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				STEEL GLOBE VALVES: 15 NB TO 50 NB (#800) & 65 NB TO 200 NB (#150)
		FLUIDLINE VALVES COMPANY PVT.LTD.	KAUSHAMBI	
		M/S GM ENGINEERING	RAJKOT	
		INTERVALVE (INDIA) LTD.	PUNE	A) STEEL GATE VALVES: UPTO 50NB, #800 AND 65NB TO 150NB, #150 B) STEEL GLOBE VALVES: UPTO 50NB, #800 AND 65NB TO 100NB, #150 C)SUPPLIER NOT REGISTERED FOR NR VALVES
		LEADER VALVES LTD.	JALANDHAR	
		NITON VALVE INDUSTRIES PVT LTD	MUMBAI	
		NSSL LIMITED.	NAGPUR	
		STEEL STRONG VALVES (I) PVT.LTD.,	NAVI MUMBAI	LIMITED TO RANGES & CLASSES AS AVAILABE IN VD FILE.
		VENUS PUMPS AND ENGG. WORKS	KOLKATA	CC/CSS-GATE-BBT- UPTO600NB CL UPTO300,GATE-PSBT UPTO250NB CL 1500,GLV-BBT- UPTO300NB CL UPTO600,SCNRV-BBT- UPTO600NB CL UPTO150,SCNRV-BBT- UPTO300NB CL 300,SCNRV-PSBT- UPTO150NB CL UPTO900
		VALTECH INDUSTRIES	MUMBAI	CAST CARBON & ALLOY STEEL - VALVE/RATING/SIZE- GV/150/900,GV/300/400, GV/600/300 , GV/GLV/NRV/900/250 , GLV/300/300,GLV/150/35 0/ , SCNRV/150/700, SCNRV/300/350, SCNRV/600/250.



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		V.K. VALVES PVT. LTD.,	JALANDHAR	
		WEIR BDK VALVES- A UNIT OF WEIR INDIA PVT. LTD.	NEW DELHI	
69.	SLUICE GATE	H SARKAR	KOLKATA	
		JASH ENGINEERING	-	
		YASHWANT INDUSTRIES	-	
70.	3 WAY VALVE	HI TECH	AHMEDABAD	
		ADVANCE VALVES PVT.LTD	NOIDA	
		BDK	HUBLI	
		FOURESS ENGG.INDIA LTD.	MUMBAI	
		FLUIDLINEVALVES COMPANY PRIVATE LTD.,	MUMBAI	
		INSTRUMENTATION LTD.	PALAKAD	
		KIRLOSKAR BROTHERS LTD.	PUNE	
		VENUS PUMP & ENGG. WORKS	KOLKATA	
		SURYA VALVES AND INSTRUMENTS MANUFACTURING COMPANY	CHENNAI	
		STAFFORD CONTROLS LIMITED	PUNE	
		MICON VALVES (INDIA) PVT.LTD	MUMBAI	
71.	PLUG VALVE(MANUAL)	BDK	HUBLI	
		HAWA ENGINEERS / MARCK & CARE	-	
		MICON VALVES	-	
		MICON VALVES (INDIA) PVT.LTD	MUMBAI	
72.	FITTINGS (CS/SS)	M.S. FITTINGS	KOLKATA	
		METAL LLOYDS	MUMBAI	
		TRUE FORGE	FARIDABAD	
		TUBE PRODUCTS	BARODA	
		NL HAZRA	KOLKATA	
		GUJRAT INFRA PIPES	BARODA	
		EDWARDS	USA	
		PIPEFIT ENGINEERS	BARODA	
		SIDDARTH & GAUTAM	FARIDABAD	
		EBY	MUMBAI	
73.	FLANGES (SS/CS)	PRADEEP METALS LTD	MUMBAI	
		TUBE PRODUCT INCOROPORATION	BARODA	



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		MS FITTINGS	KOLKATA	
		HAWA ENGINEERING	-	
		ALIANCE PIPE & PLANGES	KOLKATA	
		JAI AMBE	MUMBAI	
74.	PIPE & FILLTING (PP,HDPE,PVC & CPVC)	GEROGE FISHCHER	DELHI	
		ASTROL PLYTECHINC LTD	AHMEDABAD	
		JAIN IRRIGATION	-	
		ORIPLAST	-	
75.	VALVES (GATE/GLOBE/NRV/BALL)- (PP,HDPE,PVC & CPVC)	GEROGE FISHCHER IPING SYSTEMS PVT LTD	DELHI	
		ASTROL PLYTECHINC LTD	AHMEDABAD	
		JAIN IRRIGATION	-	
		ORIPLAST	-	
76.	AIR FILTER REGULATOR	SHAVO NORGEN	-	
		PLACKA INSTRUMENTS	-	
77.	FILTER MEDIA	GLOBAL ABSORBENT	KOLKATA	
		BHARAT MINERALS		
78.	DC LEAD ACID / NI-CD BATTERIES	AMCO SAFT INDIA LTD	BANGALORE	NI-CD BATTERIES ONLY
		EXIDE INDUSTRIES LTD	NEW DELHI	LEAD ACID BATTERIES ONLY.
		HBL POWER SYSTEMS LTD	HYDERABAD	NI/CD AND TUBULAR TYPE FOR LEAD ACID
		HOPPECKE BATTERIEN GMBH & CO.KG,	GERMANY	
79.	DC LEAD ACID BATTERIES	EXIDE INDUSTRIES LTD	NEW DELHI	
		HBL POWER SYSTEMS LTD	HYDERABAD	TUBULAR TYPE
		HOPPECKE BATTERIEN GMBH & CO.KG,	GERMANY	
80.	DC NI CD BATTERIES	AMCO SAFT INDIA LTD	BANGALORE	
		HBL POWER SYSTEMS LTD	HYDERABAD	
		HOPPECKE BATTERIEN GMBH & CO.KG,	GERMANY	
81.	SIGHT FLOW INDICATORS	B.K.EQUIPMENTS PVT.LTD.	CHENNAI	
		BLISS ANAND PVT. LTD.	GURGAON	
		FLOWTECH INSTRUMENTS SERVICRS	VADODARA	
		INSTRUMENTATION ENGINEERS PVT LTD	TELANGANA	
		SIGMA INSTRUMENTS CO.	MUMBAI	
		SCIENTIFIC DEVICES (BOMBAY)	NAVI MUMBAI	


TITLE

**2X 660 MW ENNORE SEZ STPP
TECHNICAL SPECIFICATION FOR
CONDENSATE POLISHING UNIT**

SPECIFICATION NO.

PE-TS-412-155A-A001

VOLUME: II B

REV 00

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		PVT LTD, TELACE EQUIPMENT PVT.LTD.	CHENNAI	
82.	PAINT	ASIAN PAINTS (I) LTD.		
		BERGER PAINTS INDIA LTD		
		GOODLASS NEROLAC		
		JENSON & NICHOLSON (I) LTD		
		CDC CARBOLINE (I) LTD.		
		SHALIMAR PAINTS LTD.		
		ADDISON PAINTS LTD		
		GRAND POLYCOAT		
		BOMBAY PAINTS		
		HEMPLE PAINTS (SINGAPORE)		
		JOTUN PAINTS		
83.	PNEUMATIC ACTUATOR	PROCON ENGINEERS	-	
		TYCO	-	
		CRANE PROCESS	-	
		BDK	-	
		INTERVALVE	-	
		BRAY CONTROL	-	
84.	MOTORISED ACTUATOR	ROTARK	-	
		AUMA	-	
		LIMITORK	-	

NOTE:

1. The sub vendor list enclosed ANNEXURE-I is indicative only and is subject to approval / acceptance by customer (TANGEDCO). Bidder to propose his sub vendor list with back up documents (experience list, end user certificate as applicable) etc. The same shall subject to BHEL and Customer approval during detailed engineering stage without any technical, commercial & delivery implications to BHEL /TANGEDCO.
2. Any other sub-vendor not listed in above list shall be subject to BHEL / customer approval during detailed engineering stage without any commercial and delivery implication to BHEL.
3. The inspection category will be intimated after award of contract by BHEL/customer. However the same will be adhered by the bidder without any commercial and delivery implication to BHEL/ customer.

**TITLE**

**2X 660 MW ENNORE SEZ STPP
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SHEET

ANNEXURE II**MANDATORY SPARE LIST**


TITLE

**2X 660 MW ENNORE SEZ STPP
TECHNICAL SPECIFICATION FOR
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SHEET

MANDATORY SPARES LIST FOR CONDENSATE POLISHING UNIT

Sr. no.	Description of Item	Unit	Quantity
	MECHANICAL		
1.0	SERVICE & REGENERATION VESSELS (FOR EACH TYPE & SIZE)		
i)	Diffuser, Distributors & Nozzle	%	10
ii)	Perforated Laterals & Under Drain Collectors	%	10
iii)	Gaskets	Set	2
iv)	Nut & Bolts	Set	1
2.0	Valves	%	20 % of each type & size
3.0	Pumps & Blowers along with Drive Motors		1 no. each type & size
4.0	Ejector & Dosing Pump		1 no. each type & size
5.0	Resin Trap		1 no. each type & size

	ELECTRICAL		
6.0	415 V Motors		
i)	Terminal plates	Nos.	10 Nos. each for small motors upto 30 KW & 4 Nos. each for more than 30 KW
ii)	Heaters	Set	2 sets
iii)	Greasing arrangements	Set	4 sets each type of motor
iv)	Motor of each type and rating	%	10% of the installed quantity or minimum 1 number whichever be higher.
v)	Bearings (DE and NDE) for each type and rating of motor	Set	4 sets

Note: Bidder to please refer the notes of section C1A of this technical specification regarding spares.

THIS IS A PART OF TECHNICAL SPECIFICATION NO. PE-TS-412-155A-A001
**MANDATORY SPARES LIST FOR CONDENSATE POLISHING UNIT
CONTROL & INSTRUMENTATION**

2x660 MW ENNORE SEZ PROJECT OF TANGEDCO					
MANDATORY SPARES					
III.	CONTROL & INSTRUMENTATION PACKAGES				
TANGEDCO				Total Ex-Works price	*Remarks
SI no	Name of spares	Unit	Qty	in INR	
1.0.0		INSTRUMENTATION			
(I)	Each type of lamps, PBs, ILPBs, fuse, MCB, MCCB used in the equipment/system.	Nos.	20 % of Installed of each type.		
1.00.01	Measuring Instruments				
1.00.01.01	Indicators, Recorders, Electrical Metering and Skid Mounted Instruments				
(i)	Indicators, recorders and meters offered from each model for the project. These instruments shall be supplied with three sets of blank scales.	Nos.	10 % of Installed of each type/Model or a minimum of one number for each model and type, whichever is more		
(ii)	For skid mounted instruments	Nos.	10% of total number of instruments for each Type and model or a minimum of one number for each model and type, whichever is more		
1.00.01.02	Temperature Elements and Thermowells				

1. C&I Mandatory spares are indicated in above list. These spares shall be considered as per the applicable items in main supply of CPU system package.

2. The spares shall be considered as unit wise except for any item/equipment supplied as common for both units.

TANGEDCO				Total Ex-Works price	*Remarks
SI no	Name of spares	Unit	Qty	in INR	
(i)	Thermocouple/RTD elements	Nos.	10% spare for each type and length of element furnished with thermocouple/RTD assemblies, or a minimum of one number of each type & length, whichever is more.		
(ii)	Thermowells	Nos.	10% for each type of temperature sensors or a minimum of one for each type, whichever is more		
1.00.01.03	Temperature, Transmitters and Electronic Transmitters (For Pressure, DP, Temp, Flow, Level), Temperature, Pressure, Flow & Level Switch, safety switches, Gauges, meters, Transducer or any other instrument etc.	Nos.	10% of total number of Instruments/transducers offered for each model and type for the project or a minimum of one number, whichever is more.		
1.00.01.04	Flue Gas Analyzers & CEMS (Spareparts shall be furnished in accordance with manufacturer's recommendations for five years continuous operation or minimum quantities indicated as below (whichever is more))				

1. C&I Mandatory spares are indicated in above list. These spares shall be considered as per the applicable items in main supply of CPU package.

2. The spares shall be considered as unit wise except for any item/equipment supplied as common for both units.