

4 X 270MW BHADRADRI TPS AT MANUGURU

SECTION-IA

QUALITY ASURANCE AND INSPECTION REQUIREMENT



BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR PROJECT ENGINEERING MANAGEMENT
PPEI, NOIDA-INDIA

CLAUSE NO.	QUALITY ASSURANCE
1.00.00	AIR COMPRESSOR SYSTEM
1.01.00	AIR COMPRESSORS : a) All pressure parts shall be hydraulically tested at not less than 150% of design pressure prior to painting and lining, if applicable. The test pressure will be maintained for 30 minutes. b) All other parts including inter-connecting piping shall be hydraulically tested wherever possible, as per relevant codes. c) Ultrasonic testing shall be carried out on all forgings and shafts (if dia. >= 50mm) viz. Crank shaft, connecting rod, piston rod, etc. MPI/DP test will be done on machined areas of the above components. d) Pistons shall be subjected to DP testing. e) During assembly all clearances and alignments shall also be checked and recorded.
1.01.01	PERFORMANCE TEST (SHOP TEST) : a) Performance test on the compressors shall be carried out in accordance with ISO:1217/eq.. The test shall also include demonstration of loading and unloading mechanism (Capacity control) and operation of safety valves. b) Power consumption at motor input terminal at rated capacity as well as at fully unloaded condition of all the compressor shall be measured. c) Vibration and noise level measurement will be done during shop performance test. d) Test shall be carried out on all compressors with contract drive motor where power consumption for compressors has been indicated as a guaranteed parameter e) Clearance on Type test requirements from Employer's Engg. Shall be reviewed prior to final clearance.
1.02.00	INTAKE AIR FILTER & SILENCER Test for Capacity, Pressure drop and Efficiency shall be done as per manufacturer's standard.
1.03.00	AIR RECEIVER, HEAT EXCHANGERS, MOISTURE SEPERATORS, AIR DRYING PLANT: a) Each finished vessel shall be hydraulically tested to 150% of the design pressure for a duration of 30 minutes. b) NDT on weld joints shall be as per respective code requirements or the minimum as specified below: (i) 100 % DPT on root run of butt welds. (ii) 100% DPT on all finished butt welds and fillet welds

CLAUSE NO.	QUALITY ASSURANCE
	(iii) 10% RT on butt welds which shall include all T- joints. c) Tube to Tube sheet joint of the heat exchangers shall be subject to Mock-up test as per the relevant standards. e) Completely assembled ADP shall be pneumatically tested at design pressure for a duration of 5 minutes. Functional and sequential operation testing of the completely assembled ADP shall be demonstrated at shop. Other accessories shall be tested as per relevant code and sections. Dew point measurement shall be done .

MANUFACTURING QUALITY PLAN																			
ITEM : AIR COMPRESSOR SUB-SYSTEM:--			QAP NO.: 0350-108-10PE-QVM-Q-339 REV.NO.: 01 DATE: 101.03.2013 PAGE: 1 OF 4			MAIN-SUPPLIER: BHEL													
						SL. NO	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
											M	C / N				M	C	N	
1.	2.	3.	4.	5.	6.		7.	8.	9.	D*	**	10.		11.					
<u>A.</u>	<u>MATERIAL INSPECTION :</u>																		
1.	ROTOR	MECHANICAL CHEMICAL HARDNESS INTERNAL DEFECTS	MAJOR	MECHANICAL TEST ANALYSIS ULTRASO-NIC TESTING	1 / BATCH 100%	NIL	AS PER APPROVED DOCS.	AS PER REFERENCE DOCUMENT	COMPLIAN- CE CERTIFICAT- E	✓	P	V	V						
2.	COMPRESSOR CASING / ROTOR HOUSING	DIMENSIONS CHEMICAL COMPOSITION	MAJOR	DIMENSIONS CHEMICAL COMPOSITIO -N	1/ BATCH	NIL	AS PER APPROVED DOCS.	AS PER REFERENCE DOCUMENT	COMPLIAN- CE CERTIFICAT- E	✓	P	V	V						
3.	TIMING GEARS	MECHANICAL CHEMICAL HARDNESS	MAJOR	MECHANICAL L TEST ANALYSIS	1/ BATCH	NIL	AS PER APPROVED DOCS.	AS PER REFERENCE DOCUMENT	COMPLIAN- CE CERTIFICAT- E	✓	P	V	V						
4.	STEP UP GEARS	MECHANICAL CHEMICAL HARDNESS DIMENSION	MAJOR	MECHANICAL- L TEST ANALYSIS NDT MEASUREME -NT	1 / BATCH 100%	NIL	AS PER APPROVED DOCS.	AS PER REFERENCE DOCUMENT	COMPLIAN- CE CERTIFICAT- E	✓	P	V	V						

LEGEND: * RECORDS, IDENTIFIED WITH "TICK" (✓) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION. ** M: MANUFACTURER/SUB-SUPPLIER C: MAIN SUPPLIER, N: P: PERFORM W: WITNESS AND V: VERIFICATION. AS APPROPRIATE, CHP: NTPC SHALL IDENTIFIED IN COLUMN "N" AS 'W'		DOC. NO.:		REV..... CAT.....	
MANUFACTURER/ SUB-SUPPLIER	SIGNATURE				
FORMAT NO.: QS-01-QAI-P-09/F1-R1 1/1					
		REVIEWED BY	APPROVED BY	APPROVAL SEAL	
		ENG.G. DIV. /QA&I			

		MANUFACTURING QUALITY PLAN ITEM : AIR COMPRESSOR QAP NO.: 0350-180-10PE-QVM-Q-339 REV.NO.: 01 DATE: 01.03.2013 PAGE: 2 OF 4 SUB-SYSTEM:--		MAIN-SUPPLIER: BHEL	

SL. NO	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
					M	C / N			9.	D*	M	C	N	
1.	2.	3.	4.	5.	6.		7.	8.	9.	D*	**	10.		11.
5.	DRIVE SHAFT	MECHANICAL CHEMICAL HARDNESS INTERNAL DEFECTS DIMENSION	MAJOR CRITICAL MAJOR	MECHANICAL TEST ANALYSIS ULTRASONIC TESTING MEASUREME-NT	1 / BATCH 100% 100%	NIL	AS PER APPROVED DOCS.	AS PER REFERENCE DOCUMENT	COMPLIANCE CERTIFICATE	✓	P	V	V	
6.	INTERCOOLER, AFTERCOOLER & OIL COOLER	MATERIAL CHECK DIMENSION CHECK HYDROTEST	MAJOR	COMPOSITE TENSILE MEASUREME-NT LEAKAGE	1/ BATCH	NIL	AS PER APPROVED DOCS.	AS PER REFERENCE DOCUMENT	COMPLIANCE CERTIFICATE	✓	P	V	V	AFTERCOOLER WILL BE REMOVED AFTER THE PERFORMANCE TEST OF THE RELEVANT MACHINES
B.	INPROCESS INSPECTION													
1.	SAFETY VALVE	SET PRESSURE	MAJOR	MEASUREME-NT	100%	NIL	AS PER APPROVED DOCS.	AS PER REFERENCE DOCUMENT	COMPLIANCE CERTIFICATE	✓	P	V	V	

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MANUFACTURER/ SUB-SUPPLIER	MAIN-SUPPLIER	1/1			
SIGNATURE					
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FORMAT NO.: QS-01-QAI-P-09/F1-R1

ENG.G. DIV./QA&I

		MANUFACTURING QUALITY PLAN ITEM : AIR COMPRESSOR QAP NO.: 0350-180-10PE-QVM-Q-339 REV.NO.: 01 DATE: 01.03.2013 PAGE: 3 OF 4		MAIN-SUPPLIER: BHEL	

SL. NO	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
					M	C / N			9.	D*	M	C	N	
1.	2.	3.	4.	5.	6.		7.	8.	9.	D*	**	10.		11.
2.	ROTOR ELEMENT	SURFACE FURNISH COATING QUALITY DYNAMIC BALANCING	MAJOR	VISUAL MEASUREME-NT BALANCING	100%	NIL	AS PER APPROVED DOCS.	AS PER REFERENCE DOCUMENT	COMPLIAN-CE CERTIFICAT-E	✓	P	V	V	
3.	COMPRESSOR CASING / ROTOR HOUSING L.P & H.P	DIMENSIONAL CHECK TIGHTNESS	MAJOR	MEASUREME-NT HYDROTEST	100%	NIL	AS PER APPROVED DOCS.	AS PER REFERENCE DOCUMENT	COMPLIAN-CE CERTIFICAT-E	✓	P	V	V	
4.	AIREND MODULE	RUN TEST / ABNORMAL NOISE	MAJOR	RUN TEST / ABNORMAL NOISE	100%	NIL	AS PER APPROVED DOCS.	AS PER REFERENCE DOCUMENT	COMPLIAN-CE CERTIFICAT-E	✓	P	V	V	
5.	CONTROL PANEL	SIMULATION TEST CONTINUITY TEST IR / HV	MAJOR	SIMULATION TEST	100%	NIL	AS PER APPROVED DOCS.	AS PER REFERENCE DOCUMENT	COMPLIAN-CE CERTIFICAT-E	✓	P	V	V	
6.	OIL FILTER AIR FILTER INLET VALVE	VISUAL	MAJOR	APPEARANC-E	100%	NIL	AS PER APPROVED DOCS.	AS PER REFERENCE DOCUMENT	COMPLIAN-CE CERTIFICAT-E	✓	P	V	V	

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SL. NO		COMPONENT & OPERATIONS		CHARACTERISTICS		CLASS		TYPE OF CHECK		QUANTUM OF CHECK		REFERENCE DOCUMENT		ACCEPTANCE NORMS		FORMAT OF RECORD		AGENCY			REMARKS	
																		M	C	N		
MAIN-SUPPLIER: BHEL																						
ITEM : AIR COMPRESSOR				QAP NO.: 0350-180-10PE-QVM-Q-339																		
SUB-SYSTEM:--				REV.NO.: 01																		
				DATE: 01.03.2013																		
				PAGE: 4 OF 4																		

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MANUFACTURER/SUB-SUPPLIER	MAIN-SUPPLIER			
SIGNATURE		REVIEWED BY	APPROVED BY	APPROVAL SEAL

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1/1

ENG.G. DIV. /QA&I

MANUFACTURING QUALITY PLAN										
Manufacturer's Name & Address				END CUSTOMER			PROJECT			
Item: Air Dryer, Capacity 30 Nm ² /min Model : SH 160 BM (HEAT OF COMPRESSION TYPE) Sub System :				QP No.: SUM/SH-QAI/ENQ-534/12-13			R01			
				Rev : R00			05.02.2013			
				Date:03.01.2013			05.02.2013			
Page : 01 OFF 02										
Sr. No.	COMPONENT / OPERATION	CHARACTERISTICS	CL AS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY	REMARKS
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
I RAW MATERIAL										
1.1	TOWER PIPE (Plates for Shell)	Visual Dimensional Chemical Mechanical	MA MA MA MA	Visual Measurement Chemical Mechanical	100% 1/Lot	Approved/ Manufacturing Drawing/ IS 2062	Approved/ Manufacturing Drawing/ IS 2062	IR Lab TC/ * Lab TC/ *	P P P P	* MILL TC
1.2	Dished End	Visual Dimensional Chemical Mechanical DP Test on Knuckle Radius Thinning Measurement	MA MA MA MA MA	Visual Measurement Chemical Mechanical DP Test	100% 1/Lot	Approved/ Manufacturing Drawing/ IS 2062 / Rel. IS for Dished Ends/ IS 2825	Approved/ Manufacturing Drawing/ IS 2062 / Rel. IS for Dished Ends/ No significant Defects	IR Lab TC/ * Lab TC/ *	P P P P	* MILL TC
1.3	Pipe Line	Visual Dimensional Chemical Mechanical	MA MA MA MA	Visual Measurement Chemical Mechanical	100% 1/Lot	Approved/ Manufacturing Drawing/ IS 1239	Approved/ Manufacturing Drawing/ IS 1239	IR Lab TC/ * Lab TC/ *	P P P P	* MILL TC
1.4	Plates, Pipes, Tubes, Tube Sheet (as applicable) Pre Filter, After filter, inter cooler Regeneration cooler, moisture separator	Material check	MA	Chemical Mechanical	Verify	Approved Drawings/ Datasheet /	Approved Drawings/ Datasheet /	Mfg. TC	P	Refer Annexure I
1.5	Bought Out Items	Visual Verification of type, rating & manufacturing test reports	MA	Visual Dimensional	Verify	Approved Drawings/ Datasheet	Approved Drawings/ Datasheet	Mfg. TC / Calibration Report	P	Refer Annexure I
II INPROCESS INSPECTION										
2.1	Welder Qualification	WPS, PQR, & WPQ	CR	Qualification	100%	Approved WPS & ASME SEC IX	ASME SEC IX	WPS, PQR, WPQ	P	Refer note : 2
2.2	Body - Marking, Cutting, Edge preparation, Tacking Shell dish end joint setup.	Surface defects Dimensional Conformity Ovality/ Offset	MA MA	Visual Measurement	100% 100%	Manufacturing Drawing	Manufacturing Drawing	--	P P	
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Manufacturer / Sub supplier SIGNATURE				IR				DOC. NO.: REV..... CAT.....		
FORMAT NO.: QS-01-QAI-P-09/F1-R1 ENGG. DIV./QA&I				REVIEWED BY APPROVED BY APPROVAL SEAL				1/1		

Manufacturer's Name & Address		MANUFACTURING QUALITY PLAN						END CUSTOMER						
		CHARACTERISTICS		CLA	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY	REMARKS		
		3.		4.	5.	M	C/N	7.	8.	9.	10.			
										TYPE	D*	M	C	N
		2.												
Sr. No.	COMPONENT / OPERATION	Sub System :												
1.		Page : 02 OFF 02												
Item: Air Dryer, Capacity 30 Nm ³ /min Model : SH 160 BM (HEAT OF COMPRESSION TYPE)		QP No.: SUM/SH-QAP/ENQ-534/12-13												
		Rev : R00												
		Date: 03.01.2013												
		Supplier												

2.3	A. Welding shell B. Welding of Dish end to shell C. Welding of Nozzle to shell D. all fillets	DPT on Root Run of Butt Weld DPT on final weld of Butt weld & Radiography	MA MA CR	DP test DP test Radiography	100% 10% R &&	-- -- --	Manufacturing Drawing/ IS 2825 / ASME V	Mfg. Drawing/ No significant defects / ASME VIII	IR IR IR	✓ ✓ ✓	P P P	V V V	&&10% on Butt Joint on tower including 100% Cross joints for Adsorption Towers
2.4	Weld quality of Pipe Weld	DPT on Root Run of Butt Weld	MA	DPT on Final weld	100%	--	IS 2825/ ASME SEC V	Mfg. Drawing/ No significant defects / ASME VIII	IR	✓	P	V	
2.5	Heat Exchanger	Tube To Tube Sheet Expansion / Weld	MA	Penetrant test	100%	-----	ASME Sec V	No Signification defects/ASME sec VIII DIV 1	IR	✓	P	V	
2.6	Complete vessel & Heat Exchangers	Soundness of Weld	MA	Hydro test	100%		Approved Drawing/ Approved data sheet/ ASME SEC VIII DIV I	Approved Drawing/ Approved data sheet/ No leakage/ No pressure Drop	IR	✓	P	V	Hydro test pressure at 150 % of design Pressure
2.7	Pneumatic Test	Pneumatic Test for Complete Skid incl. Piping	MA	Pneumatic	100%		App. Drawing / Datasheet	App. Drawing / Datasheet	IR	✓	P	W	Pneumatic Test pressure @ 125% of Design pressure
III	FINAL INSPECTION												
3.1	Final Assembly	Final Assembly. Verification of equipment as per P&ID and GAD	MA MA	Visual Measurement	100% 100%		App. Drawing / Datasheet	App. Drawing / Datasheet	IR IR	✓ ✓	P P	W W	
3.2	Functional test	No load test/ partial load test	MA	Functional/ Operation of ADT	100%		App. Drawing / Datasheet / as per Control Writ up	App. Drawing / Datasheet / as per Control Writ up	IR	✓	P	W	Refer note 3
3.3	Insulation / cladding (as applicable)	Completeness	MA	Verification	100%		App. Drawing / Datasheet	App. Drawing / Datasheet	IR	✓	P	V	

Notes:

- All materials shall be as per approved drawing/ Data sheet.
- NTPC approved WPS will be used, qualified welders will be deployed. IF welders are already qualified by NTPC / Lloyd's/BVQI/BS/IBHEL/TUV and doing the similar jobs then same shall be verified in place of Witnessing. Record will be verified by NTPC during Inspection.
- Measurement of dew point and performance test during final inspection is demonstrative and indicative only and will be done at No-load/ partial load (available at vendor works) and will be accepted on the basis of same. Final dew point and performance parameter will be measured at site after erection.

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		F			
		REVIEWED BY	APPROVED BY	APPROVAL SEAL	
Manufacturer / Sub supplier SIGNATURE		IR			

Manufacturer's Name & Address		MANUFACTURING QUALITY PLAN					END CUSTOMER				
		Item: Air Dryer, Capacity 30 Nm ³ /min Model : SH 160 BM (HEAT OF COMPRESSION TYPE)		QP No.: SUM/SH-QAPIENQ-534/12-13		PROJECT					
		Rev : R00				CLIENT					
		Date:03.01.2013				SUPPLIER					
		Page : 03OFF 03									
Sub System :											
Sr. No.		COMPONENT / OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY	REMARKS
1.		2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
						M C/N			TYPE	D* M C N	
ANNEXURE I (FOR BOUGHT OUT ITEMS)											
SR. NO		ITEM		MAKE		REMARKS					
1.		PRESSURE		H GURU / WAAREE		VERIFICATION OF CALIBRATION REPORT, TYPE, MAKE, RANGE, ACCURACY					
2.		TEMPERATURE GAUGE		AN Instruments / H GURU/GIC/BELL CONTROLS/WAAREE		VERIFICATION OF CALIBRATION REPORT, TYPE, MAKE, RANGE, ACCURACY					
3.		CYCLE CHANGE OVER VALVE		FLOW CHEM / XOMOX		MANUFACTURER'S TEST CERTIFICATE FOR PNEUMATIC TEST OF BODY AND SEAT & MATERIAL TC					
4.		5/2 WAY SOLENOID VALVES		ROTEX / ASCO		MANUFACTURER'S INSPECTION REPORT					

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Manufacturer / Sub supplier SIGNATURE		IR		APPROVAL SEAL	
FORMAT NO.: QS-01-QAI-P-09/FI-R1		1/1		ENGG. DIV. IQA&I	

4 X 270MW BHADRADRI TPS AT MANUGURU

ANNEXURE - I (SUB- VENDOR LIST)

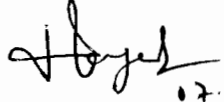


BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR PROJECT ENGINEERING MANAGEMENT
PPEI, NOIDA-INDIA



**COMPRESSED AIR SYSTEM
LIST OF MAKES OF SUB-VENDOR ITEMS**

LIST OF MAKES OF SUB-VENDOR ITEMS


07.07.15
(Harish Kumar)
PEM-MACX



SUB VENDOR LIST & INSPECTION CATEGORISATION (ANNEXURE-II)

COMPRESSED AIR SYSTEM

SL No	Item	QP / Insp.Cat	Proposed Subvendor	Place of Manufacturer	Technical Limit	Remarks
1	AIR DRYING PLANT (HOC TYPE)	I	ACIL	BELGIUM	ROTARY DRUM	Testing at Atlas Copco Works Pune
			MELLCON	Delhi	Twin Tower type	
			DELAIR	Gurgaon	Twin Tower type	
			SUMMITS	Coimbtore	Twin Tower type	
			Shalcot	Noida	Twin Tower type	
2	AIR DRYING PLANT (REFRIGERANT TYPE)	I	ACIL	BELGIUM		
			MELLCON	Delhi		
			DELAIR	Gurgaon		
			SUMMITS	Coimbtore		
			Shalcot	Noida		
			Savroe	Germany		
			MTA	Italy		
			Dominic Hunter	U.K		
3	MS/GI Pipes –ERW IS 1239 / IS 3589	III	SAIL	Rourkela		1) Quantity < 200 meters Assorted sizes)
			Jindal	Ghaziabad/Hissar	upto 350NB	2) Material will be accepted on the basis of Main contractor COC supported by manufacturer TC as per relevant Code. In addition to above main contractor will certify availability of correlated identification marks on pipe wrt Manf TC and will also certify that pipes are free from rust
			Surya Roshni	Bahadurgarh	upto 400 NB	
			Tata IS 1239 Pipes	Jamshedpur	upto 150NB	
			Maharashtra seamless IS 3589	Raigad	200 to 500 NB	
			PSL	Chennai/Vizag/Kutch/Daman	Spiral Weld SAW as per IS 3589	
			Lalit Profile	Thane	Spiral Weld SAW as per IS 3589	
			Samshi Pipes Industries	Vadodara	Spiral Weld SAW as per IS 3589	
			Mukut Pipes	Rajpura	Longitudinal SAW (Single side weld) as per IS 3589	
			Indus Tubes	G B Nagar	Upto 300 NB ERW Pipes as per IS 1239/3589	
			Mann Ind	Indore	Spiral Weld SAW as per IS 3589	
			Surendra Engg	Rajpura	Spiral Weld SAW as per IS 3589	

SL No	Item	QP / Insp.Cat	Proposed Subvendor	Place of Manufacturer	Technical Limit	Remarks
			Pratibha Pipes & Structure Pvt Ltd	Thane	Spiral Weld SAW as per IS 3589	
			JCO Gas Pipe	Chindwara	Spiral Weld SAW as per IS 3589	
			Nukat Tanks and Vessels	Tarapur	Longitudinal SAW (Single side weld) as per IS 3589	
			DADU Pipes	Sikandrabad	Upto 300 NB ERW Pipes as per IS 1239/3589	
			Good Luck Tubes	Sikandrabad	Upto 300 NB	
			Advance Steel Tubes	Sahibabad	Upto 300 NB	
			APL APPOLO Tubes	Sikandrabad	Upto 300 NB	
			Hi Tech Pipes	Sikandrabad	Upto 300 NB	
			Ratnamani	Kutch/Ahmedabad/Chhatral	Upto 400 NB ERW Pipes as per IS 3589 and SAW as per IS 3589	
			Welspun	Anjar/Bharuch	Upto 400 NB ERW Pipes as per IS 1239/3589 and SAW as per IS 3589	
4	Forged/Formed fittings	III	EBY	Taloja		
			Siddarth & Gautam	Faridabad		
			Pipefit	Baroda		
			MS Fittings	Kolkata		
			Tube Products	Baroda		
			Bharat Forge	Pune		
			NL Hazra	Kolkata		
5	Ball Valve	I	Precision Engg	Nasik	upto 400NB 150 class	
			Microfinish Valves Ltd	Hubli		
			Weir BDK engg Industries	NEW DELHI		
			Flow chem. Industries	Ahemdabad	upto 50 NB 800 Class: 350NB 150 class	
			Audco	Chennai		
			Akay India	Hubli	upto 50NB 800 class	
			A V Valves	Agra		
			Asian Industrial valves & Instruments Ltd.	Chennai		
			ATAM Valves	Jalandhar	(1) BALL VALVES: FCS/FSS - 1/2" to 2" #800 & CCS/CSS - 2.1/2" to 4" # 150 (2) BALL VALVES: CUN METAL VALVES SIZE 15 NB TO 80 NB - UPTO PN16.0	
			GM ENGINEERING	Rajkot		
			Hawa Valves (India) Pvt. Ltd.	Navi Mumbai	Size up to 2" & #800 with MOC as FCS & FSS and for size from 65 NB to 150 NB & #150 with MOC as CCS and CSS.	


 07.07.15
 (Harish Kumar)

SL No	Item	QP / Insp.Cat	Proposed Subvendor	Place of Manufacturer	Technical Limit	Remarks
			INTERVALVE (INDIA) LTD.	Pune	Steel ball Valves upto 50NB, #800 and 65NB to 150NB. #150	
			NILON VALVES PRIVATE LIMITED	Ahmedabad		
			LEADER VALVES LTD.	Jalandhar	CAST STEEL UPTO 200 MM, CLASS 150/300.	
			DEMBLA VALVES LTD.	Thane		
			SURYA VALVES AND INSTRUMENTS MFG CO.	Chennai	FOR CARBON STEEL/STAINLESS STEEL UPTO SIZE 200NB.	
			UNIFLOW	Chennai		
			VALTECH INDUSTRIES	Mumbai	FORGED CARBON & ALLOY STEEL BALL VALVES, SCREWED TYPE BALL VALVES RATING 800, SIZES UPTO 50 & CC& ALLOY STEEL BALL VALVES RATING 150, SIZES 65 TO 200 FLANGED TYPE.	
			VAAS AUTOMATION	NEW DELHI		
			Belgaum Aqua Valve	Belgaum		
6	CS/FS Gate/Globe/Check valves	III	Fouress	Mumbai/ Aurangabad		
			Weir BDK	NEW DELHI		
			L & T Valves	Coimbatore/ Kancheepuram		
			Leader	Jalandhar		
			KSB	Coimbatore		
			A V Valves	Agra		
			ATAM Valves	Jalandhar	(1) Carbon Steel Gate Valves & non return valves: 15 NB to 50 NB (#800) & 65 NB to 300 NB (#150) (2) Carbon Steel Globe Valves: 15 NB to 50 NB (#800) & 65 NB to 200 NB (#150)	
			Fluidline valves	Ghaziabad		
			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	
			Niton Valves	Mumbai		
			NSSL Ltd.	Nagpur		
			Steel Strong valves Ltd.	Navi Mumbai		

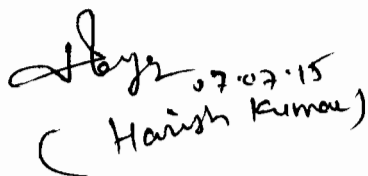

 07.07.15
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SL No	Item	QP / Insp.Cat	Proposed Subvendor	Place of Manufacturer	Technical Limit	Remarks
			VENUS PUMPS AND ENGG. WORKS	Kolkata	CC/CSS-GATE-BBT-UPTO600NB CL UPTO300,GATE-PSBT UPTO250NB CL 1500, GLV-BBT- UPTO300NB CL UPTO600, SCNRV- BBT-UPTO600NB 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/150/350/ , SCNRV/150/700, SCNRV/300/350, SCNRV/600/250.	
			V K Valves Ltd.	Jalandhar		
			KBL	Kondhapuri		
7	Butterfly Valve	II	KBL	Kondhapuri		
			Fouress	Bangalore		
			Audco	Chennai		
			Weir BDK	NEW DELHI		
			Tyco	Halol		
			Inter Valve	Pune		
			Advance Valves	Noida		
			Fluidline valves	Ghaziabad		
			Instrumentation Ltd.	Palakkad		
			R and D Multiples (Metal Cast) Pvt. Ltd.	Mumbai		
			SURYA VALVES AND INSTRUMENTS MFG CO.	Chennai	FOR CI , CCS & CSS UPTO SIZE 750 NB.	
			PENTAIR VALVES AND CONTROLS INDIA PRIVATE LIMITED	Navi Mumbai		
			UPADHAYA VALVES MANUFACTURERS PRIVATE LIMITED,	Kolkata	MOC-Cast Iron, size from 65 NB to 350 NB having rating of PN10 as per BS EN 593.	
			VENUS PUMPS AND ENGG. WORKS	Kolkata		

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07.07.15
(Harish Kumar)

SL No	Item	QP / Insp.Cat	Proposed Subvendor	Place of Manufacturer	Technical Limit	Remarks
8	Air Receiver	I	Integrated Engineers	Mumbai		
			Diamond Fabricators	Pune		
			Parkaire	Delhi		
			Temasme Vesselex	Noida		
			United Engineering Works	Nasik		
9	Safety Relief Valve	III	LEADER	JALANDHAR		
			SPIRAX MARSHALL	PUNE		
			FISCHER SANMAR	CHENNAI		
10	Pr./Vacuum/Dp Gauges	III	Auxitrol	U.K		
			Switzer (for DP gauge)	Chennai		
			Budenburg	U.K		
			A.N.Instruments	Kolkata		
			Bells Control	Kolkata		
			Manometer India	Mumbai		
			H Guru Industries	Kolkata		
			Ashcroft India	Kalol		
			General Inst.	Mumbai/Goa		
			Gluck India	Mumbai		
			BOSE PANDA INSTRUMENTS PVT.LTD.	Kolkata		
			Forbs Marshall	Hyderabad		
			Gauge Bourdon	Mumbai		
			H Guru Instruments	Bangalore		
			Baumer Technologies	Mumbai		
11	Pr./Vacuum/DP.switch	III	Barton Inst.system	USA		* If the total Quantity is <= 10, then inspection category III. However, manufacturer TC to be submitted
			Indfoss	Ghaziabad		
			SOR	USA		
			Dressor	USA		
			Delta control	UK		
			Trafag	Ranipet		
			GiC(Gauges Bourdon)	Panvel		
			ASHCROFT INDIA PVT LTD.	USA/GERMANY		
			Switzer	Chennai		
12	Temperature Gauge	III	Budenburg	U.K		
			A.N.Instruments	Kolkata		
			Bells Control	Kolkata		
			H Guru Industries	Kolkata		
			General Inst.	Mumbai/Goa		
			H Guru Instruments	Bangalore		
			Forbs Marshall	Hyderabad		
			Goa Instruments	Goa		
			Goa Thermostatics Instruments Pvt. Ltd.	Goa		
			Gauge Bourdon	Mumbai		
			Baumer Technologies	Mumbai		

SL No	Item	QP / Insp.Cat	Proposed Subvendor	Place of Manufacturer	Technical Limit	Remarks
			Ashcroft India	Kalol		
13	Transmitters (PT, TT, DPT, LT)	II	ABB	Faridabad	PRESSURE TRANSMITTER, DP TRANSMITTER and TEMP TRANSMITTER	* If the total Quantity is <= 10, then inspection category III. However, manufacturer TC to be submitted
			Yokogawa	Bangalore		
			Emerson	Mumbai		
			(ABB) -2600T series	Faridabad/Italy		
			Pune Techrol Pvt. Ltd.	Pune	Only for capacitance Type Level Transmitter	
			SIEMENS LIMITED	Mumbai		
			SMART INSTRUMENTS LTD, BRAZIL	Mumbai	LD-301 & T-301 TRANSMITTER FROM M/S SMART EQUIPMENTS BRAZIL.	
			SBEM PVT. LTD.	Pune	Only for capacitance Type Level Transmitter	
			TOSHNIWAL INDUSTRIES PVT. LTD.,	Ajmer		
			V. AUTOMAT & INSTRUMENTS (P) LTD.	NEW DELHI	a)DISPLACEMENT TYPE TRANSMITTERS. b)PRESSURE AND DP TRANSMITTERS	
			Honeywell Automation	NEW DELHI		
			Fuji	Japan		
			NIVO CONTROLS PVT. LTD.	Indore	For Capacitance type only	
			Moore Industries International Inc.	CALIFORNIA, USA	Indian Associate - Chemtrol	
			Endress + Hauser (India) Pvt. Ltd.,	NEW DELHI	TEMP TRANSMITTER ONLY	
14	HT Motor for Air compressor	I	CGL	Mandideep	Upto 1600 KW, 6.6 KV; Upto 1310 KW, 11 KV	
			Marathon Electric	Kolkata	Upto 6.6 KV, 750 KW	
			BHEL	Bhopal		
			SIEMENS	Germany		
			Hyosung	Korea		
			Hyundai	Korea		
15	Flow Switch	III	Switzer	Chennai		
			Levecon	Kolkata		
			DK Instruments	Kolkata		
			Delta	UK		
			ITT Barton	USA		
16	Temp Sensor	III	Pyro Electric	Mumbai		
			Detriv	Mumbai		
17	Flow Indicator	III	Sigma	Mumbai		
			Eureca	Pune		
18	Auto Drain Trap	III	Pennant	Pune		
			Forbes Marshall	Pune		
19	Dew point meter	III	GE Sensing	Ireland		



 07.07.15

 (Harish Kumar)

SL No	Item	QP / Insp.Cat	Proposed Subvendor	Place of Manufacturer	Technical Limit	Remarks
20	Flow Meter / Rota Meter	III	Michelli Instruments	UK		
			XENTAUR	USA		
			Shaw	UK		
			Trac	Hyderabad		
			Eureca	Pune	Rota Meter only	
			Flow Star Engg.	Faridabad	Rota Meter only	
			Flow Tech instruments	Vadodara	Rota Meter only	
			Instruments Engineers Pvt. Ltd.	Hyderabad	Rota Meter only	
			Scientific Devices (Bombay) Pvt. Ltd.	Mumbai	Rota Meter only	
			Emerson Process Management	singapore	Vortex Type	
			ABB Ltd.	India	Vortex Type	
			Krohne Marshall Pvt. Ltd.	India	Vortex Type	
			Endress + Hauser (I) Pvt. Ltd.	India	Vortex Type	
			Yokogawa Electric Corporation (other than high temp & h2 services)	japan	Vortex Type	
			Krohne Messtechnik GmbH & Co. Kg	Germany	Vortex Type	
21	Level Indicator/ Gauge	III	Flow Star	Faridabad		
			Scientific Devices	Mumbai		
			Gauges Bourden	Panvel		
			SBEM	Pune		
			Pune Techtrol	Pune		
			Levcon	Kolkata		
			Sigma	Mumbai		
			V-Automat	New Delhi		
22	Solenoid Valve	III	DK Instruments	Kolkata		
			HERION	GERMANY/ ITALY		
			ROTEX AUTOMATION LTD.	V V NAGAR/ BARODA		
			ASCO	CHENNAI		
			JEFFERSON	ARGENTINA		
23	Cable trays (max 300 meters)	III	AVCON	MUMBAI		
			INAR PROFILE	ANNAKAPALLI		
			ANAND UDYOG	THANE		
			MJ ENGG.	DELHI		
			INDIANA	MUMBAI		Galvanizing. At Karmatara
			TECHNO ENGG	CHANDIGARH		
			JAMUNA METAL	DELHI		


 7/7/15
 Harish Kumar

SL No	Item	QP / Insp.Cat	Proposed Subvendor	Place of Manufacturer	Technical Limit	Remarks
			INDUSTRIAL PERFORATION	KOLKATA		Galvanizing at Unistar
			VATCO	MUMBAI		Galvanizing At Sigma Mumbai
24	Cable Glands	III	SUNIL & COMPANY	KOLKATA		
			ARUP ENGG	KOLKATA		
			COMMET	MUMBAI		
			QUALITY PRECISION	KOLKATA		
25	Cable Lugs	III	DOWELLS	MUMBAI		
			CHETNA ENGG	NASIK		
			3D	VALSAD		
26	DC LEAD ACID/NI-CD BATTERY	III	AMCO SAFT INDIA LTD	BANGALORE	Ni-Cd batteries only	
			EXIDE INDUSTRIES LTD	NEW DELHI	Lead Acid batteries only.	
			HBL POWER SYSTEMS LTD	Hyderabad	NiCd and TUBULAR TYPE for Lead acid	
			HOPPECKE BATTERIEN GMBH & CO.KG,	Germany		
27	DC Battery Charger (for PLC Panel)	III	AMARA RAJA POWER SYSTEMS LIMITED	Tirupati		
			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		
28	INSTRUMENT FITTINGS	III	AURA INCORPORATED	NEW DELHI		
			Astec Valves & Fittings Pvt. Ltd.,	Mumbai		
			Arya Crafts & Engineering Pvt. Ltd.	Mumbai		
			Comfit & Valve Pvt. Ltd.	Nandasan-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		
29	SS Pipes	III	REMI	Mumbai		
			Ratmani	Ahmedabad		
			Apex Tubes	Behror		
			Choksi	Ahmedabad		
30	UPS	III	HITACHI-HIREL	Gandhinagar		
			APC	Bangalore		
			Delta	Gurgaon		
			Emerson	Mumbai		
			DB Power	Pune		
			Aplab	Mumbai		

SL No	Item	QP / Insp.Cat	Proposed Subvendor	Place of Manufacturer	Technical Limit	Remarks
31	OWS/PC	III	HP/Compaq /Dell/HCL/IBM/Lenovo			
32	Printer	III	HP/Cannon/Epson/Xerox/IBM /Lexmark			
33	PLC Based Panels	I	SIEMENS	Nasik		
			SCHNEIDER	Nasik		
			ROCKWELL	Sahibabad		
			GE Intelligent Platform	BANGALORE		
			Honeywell Automation India Limited ,	Pune		
			ABB	Bangalore		
34	Fibre Optic Cable	III	Birla Ericsson	Rewa		
			Finolex	Pune/Goa		
			Aksh Fibre	Bhiwadi		
35	Junction Box	III	AJMERA INDUSTRIAL &	Mumbai	For galvanised & FRP Junction	
			FLEXPRO ELECTRICALS	Navsari, Gujarat	Metal type Junction boxes only	
			K.S.INSTRUMENTS	Bangalore		
			SUCHITRA INDUSTRIES	Bangalore		
			Shrenik & Company,	Ahemdabad		
36	PAINTS	III	Asian Paints (I) Ltd.	Mumbai		
			Berger Paints India Ltd	Delhi		
			Goodlass Nerolac	Mumbai		
			Jenson & Nicholson (I) Ltd	Gurgaon		
			CDC carboline (I) Ltd.	Delhi		
			Shalimar Paints Ltd.	Gurgaon		
			Addison Paints Ltd	Chennai		
			Grand Polycoat	Mumbai		
			Bombay Paints	Mumbai		
			Jotun Paints	Pune		
			Hemple Paints	Singapore		

NOTES:

1) INSP CAT I : FOR THOSE ITEMS THE QUALITY PLANS ARE APPROVED BY CUSTOMER AND FINAL ACCEPTANCE WILL BE ON PHYSICAL INSPECTION WITNESS BY BHEL & CUSTOMER.

2) INSP CAT II : FOR THOSE ITEMS THE QUALITY PLANS ARE APPROVED BY CUSTOMER. HOWEVER NO PHYSICAL INSPECTION WILL BE DONE BY BHEL / CUSTOMER. THE FINAL ACCEPTANCE BY BHEL / CUSTOMER SHALL BE ON THE BASIS OF REVIEW OF DOCUMENTS AS PER QP.

3) INSP CAT III : FOR THOSE ITEMS FINAL ACCEPTANCE BY BHEL / CUSTOMER BASED ON BIDDER'S COC.

4) THE ABOVE SUB VENDOR LIST IS INDICATIVE ONLY AND IS SUBJECT TO APPROVAL/ACCEPTANCE BY CUSTOMER/BHEL . BIDDER TO PROPOSE HIS SUB VENDOR LIST WITH BACK UP DOCUMENTS (EXPERIENCE LIST, END USER CERTIFICATE AS APPLICABLE) WHICH WILL SUBJECT TO BHEL AND CUSTOMER APPROVAL DURING DETAILED ENGINEERING STAGE WITHOUT ANY TECHNICAL , COMMERCIAL AND DELIVERY IMPLICATION TO BHEL/CUSTOMER.


7/7/15
(Harish Kumar)

4 X 270MW BHADRADRI TPS AT MANUGURU

ANNEXURE - II

(DRWG/DOC DISTRIBUTION SCHEDULE)



BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR PROJECT ENGINEERING MANAGEMENT
PPEI, NOIDA-INDIA

DRAWINGS / DOCUMENTS SUBMISSION SCHEDULE

S. No	Description	TSGENCO								CONSULTANT			Equipment Vendor	Remarks
		Director Projects	Director Technical	CE/Civil Thermal Projects Hyd.	CE/ TPC-I, Hyd	CE/ O&M/ BTPS	SE/ Civil BTPS	SE/E&M / BTPS	DE Constr. BTPS	Kolkata	HYD	BTPS		
A	Letter Of Intent or Contract Documents	1	1	1	S	1	2	2	1	1	1	1	2	
B	Vendor Drawings													
1.	Preliminary	1	1	1	2	1	1	2	2	12	1	-	S	
2.	Return preliminary with comments	-	-	1	2	1	1	1	1	S	1	-	1	
3.	Final and any revision thereof													
	a. Civil	1	1	6+1T	1	1	6+1T	1	-	2+1T	1	1	S	
	b. E&M	1	1	1	6+1T	1	1	6+1T	1	2+1T	1	1	S	
C.	Design Drawings													
1.	Preliminary													
	a. Civil	1	1	2	1	1	2	1	1	4	1	1	S	
	b. E&M	1	1	1	2	1	1	2	1	4	1	1	S	
2.	Released for construction													
	a. Civil	1	1	2	1	1	6	1	1	1	1	2	S	
	b. E&M	1	1	1	1	2	1	6	1	1	1	2	S	
3.	Return marked 'As built'													
	a. Civil	-	-	1	-	-	1	-	-	1	1	S	1	
	b. E&M	-	-	-	1	-	-	1	1	1	1	S	1	
4.	As built drawings													
	a. Civil	-	-	1+1T	-	2+1T	5+1T	-	1	1+1T	-	1	S	
	b. E&M	-	-	1	2+1T	2+1T	-	5+1T	1+1T	1+1T	-	1	S	

S. No	Description	TSGENCO								CONSULTANT			Equipment Vendor	Remarks
		Director Projects	Director Technical	CE/Civil Thermal Projects Hyd.	CE/ TPC-I, Hyd	CE/ O&M/ BTPS	SE/ Civil BTPS	SE/E&M / BTPS	DE Constr. BTPS	Kolkata	HYD	BTPS		
D	Progress Report Monthly													
1.	Equipment vendor	1	1	1	2	1	1	2	1	1	1	1	S	
2.	M/s DCPL, Kolkata	1	1	2	2	1	1	2	1	S	1	1	Nil	
E	Test & Inspection Reports													
1.	Equipment manufacturer													
	a. Civil	1	1	1	2	1	1	1	-	11	1	1	S	
s	b. E&M	1	1	-	2	1	-	1	1	11	1	1	S	
2.	M/s DCPL, Kolkata	1	1	-	2	1	-	1	1	S	-	1	-	
F	Instruction Manuals/Data Books													
1.	Equipment manufacturer													
	a. Civil	1	1	1+1T	1	1	6+1T	1	1	2+1T	1	1	S	
	b. E&M	1	1	-	3+1T	1	-	6+1T	2	3+1T	1	1	S	
2.	M/s DCPL, Kolkata	1	1	-	10+1T	1	-	15+1T	-	S	1	1	Nil	
G	M/s DCPL, Kolkata Criteria	1	1	1	8+1T	1	1	2	1	1	1	1	S	
H	Design Calculations	1	1	1	8+1T	1	1	2	1	1	1	1	S	
I	Final consulting Engineering Report	1	1	1	10	1	1	2	1	S	1	1	Nil	

S – Source, T – Transparency & Soft Copy on CD,

4 X 270MW BHADRADRI TPS AT MANUGURU

ANNEXURE - III

(MDL WITH SUBMISSION SCHEDULE)



BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR PROJECT ENGINEERING MANAGEMENT
PPEI, NOIDA-INDIA

MDL FOR CAS PACKAGE FOR 4X270MW BHADRADRI TPS

S. N.	DRAWING NO.	DRAWING TITLE	PURPOSE	SCHEDULED SUBMISSION, DAYS FROM LOI DATE	RESUBMISSION AFTER INCORPORATING COMMENTS (IN DAYS)
1	PE-V0-395-555-A001	QUALITY PLAN OF AIR COMPRESSOR	A-CUST	21	7
2	PE-V0-395-555-A002	QUALITY PLAN OF AIR DRYING PLANT	A-CUST	21	7
3	PE-V0-395-555-A003	QUALITY PLAN OF AIR RECEIVER	A-CUST	25	7
4	PE-V0-395-555-A006	QUALITY PLAN OF BALL VALVE	A-CUST	21	10
5	PE-V0-395-555-A007	SUB-VENDOR LIST & INSPECTION CATEGORISATION SCHEDULE	A-CUST	15	10
6	PE-V0-395-555-A101	TDS OF INSTRUMENT AIR & SERVICE AIR COMPRESSORS	A-CUST	21	10
7	PE-V0-395-555-A102	TDS OF AIR DRYING PLANT	A-CUST	21	10
8	PE-V0-395-555-A104	TDS & GA OF VALVES	I-CUST	42	10
9	PE-V0-395-555-A105	TDS OF INSTRUMENTS	I-CUST	42	10
10	PE-V0-395-555-A301	GA DRAWING OF INSTRUMENT & SERVICE AIR COMPRESSOR	I-CUST	21	10
11	PE-V0-395-555-A302	GA DRAWING OF AIR DRYER	I-CUST	21	10
12	PE-V0-395-555-A302(2 nos. sheets)	GA DRAWING OF AIR RECEIVER.	I-CUST	25	10
13	PE-V0-395-555-A401	COMPRESSOR HOUSE LAYOUT	A-CUST	30	10
14	PE-V0-395-555-A501	P & I DIAGRAM OF AIR COMPRESSOR	I-CUST	21	10
15	PE-V0-395-555-A502	P&I DIAGRAM OF AIR DRYER	I-CUST	21	10
16	PE-V0-395-555-A503	P&I DIAGRAM OF COMPRESSED AIR SYSTEM WITHIN COMPRESSOR HOUSE	A-CUST	21	10
17	PE-V0-395-555-A701	OPERATION & CONTROL PHILOSOPHY OF COMPRESSED AIR SYSTEM	A-CUST	42	10
18	PE-V0-395-555-A702	ELECTRICAL & INTERNAL WIRING DIAGRAM FOR COMPRESSOR AND AIR DRYER PANEL.	I-CUST	50	10
19	PE-V0-395-555-A751	ELECTRICAL FEEDER LIST	I-G-P	21	10
20	PE-V0-395-555-A752	CONTROL CABLE SCHEDULE	I-G-P	60	10
21	PE-V0-395-555-A753	I/O List for CAS system.	I-CUST	56	10
22	PE-V0-395-555-A901	CAS PG TEST PROCEDURE	A-CUST	75	10
23	PE-V0-395-555-A903	O&M MANUAL-COMP AIR SYSTEM	I-CUST	90	10

NOTES

- The above drawing list is tentative and shall be finalized with the successful bidder after placement of order. While some of the drawings indicated above may not be applicable, some additional drawings may also be required based on scope of work.
- Drawings shall be prepared in Auto-Cad latest edition. Required no. of hard and soft copies (editable) of the drawings shall be furnished as per requirement specified elsewhere in the specification.
- Only manual calculation with authentic supporting literature (e.g. extracts of hand Book/ standard/codes) shall be acceptable. All design calculations and drawings shall be in SI system only.
- All the drawings and documents including general arrangement drawing, data sheet, calculation etc. to be furnished to the customer during detailed engineering stage shall include / indicate the following details for clarity w.r.t. Inspection, construction, erection and maintenance etc.:-
 - All drawings and documents shall indicate the list of all reference drawings including general arrangement.
 - All drawings shall include / show plan, elevation, side view, cross - section, skin section, blow - up view; all major self-manufactured and bought out items shall be labeled and included in BOQ / BOM in tabular form.
 - Painting schedule shall also be made as a part of general arrangement drawing of each equipment / items indicating at least 3 trade names.
 - All the drawings required to be furnished to customer during detailed engineering stage shall include technical parameters, details of paints and lubrication, hardness and BOQ / BOM in tabular form indicating all major components including bought out items and their quantity, material of construction indicating its applicable code / standard, weight, make etc.
 - Drawings/ documents to be submitted for purchasers review/ approval shall be under Revision A, B, C... etc. while drawings /documents to be submitted thereafter for customer's approval after purchaser's approval shall be under R-0, 1, 2, 3etc.
 - Drawings and documents not covered above but required to check safety of machines/ system, shall be submitted during detailed engineering stage without any commercial implication.
 - All drawings shall include "B.O.M" and indicate quantity, material of construction, make along with IS/BS No., Technical parameters, dimensions, hardness, machining symbol and tolerance, requirement of radiography and hydraulic tests, painting details, elevation, side view, plan, skin section and blow-up view for clarity.

h) All drawings shall be prepared as per BHEL's title block and shall bear BHEL's drawing No.

i) Schedule of drawings submissions, comment incorporations & approval shall be as stipulated in the specifications. The successful bidder shall depute his design personnel to BHEL's/ Customer's/ Consultant's office for across the table resolution of issues and to get documents approved in the stipulated time.

j) Bidder to follow the following the drawing submission schedule:

k) 1st submission of drawings from date of LOI as per the submission schedule.

l) Every revised submission incorporating comments – within 7 days.

m) Bidder to submit revised drawings complete in all respects incorporating all comments. Any incomplete drawing submitted shall be treated as non-submission with delays attributable to bidder's account. For any clarification/ discussion required to complete the drawings, the bidder shall himself depute his personal to BHEL for across the table discussions/ finalizations/ submissions of drawings.

5. Bidder to note that during detailed engineering, drwg/doc will be submitted through web based document management system in addition to hard copies to be submitted as per drawing/document distribution schedule. Procedure for the same shall be informed after award of contract.

6. *I-G-P stands for ' internal generation purpose'.

4 X 270MW BHADRADRI TPS AT MANUGURU

ANNEXURE - IV (INPUT DRAWINGS OF TENDER)



BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR PROJECT ENGINEERING MANAGEMENT
PPEI, NOIDA-INDIA

List of Drawings, for tender estimation purpose only, enclosed with the technical specification

SNO	DESCRIPTION	DRG NO
1	PLOT PLAN	PE-DG-411-100-M001
2	PID COMPRESSOR COOLING WATER SYSTEM	PE-DG-411-179-N001
3	PID FOR COMPRESSOR HOUSE	PE-DG-411-555-A003
4.	LAYOUT FOR COMPRESSOR HOUSE BUILDING	PE-DG-411-555-A001



NOTES:—

9. GREEN BELT (CUSTOMER SCOPE) IS SHOWN INDICATIVELY.

 GREEN BELT

LANGANA STATE POWER
GENERATION CO. LTD.

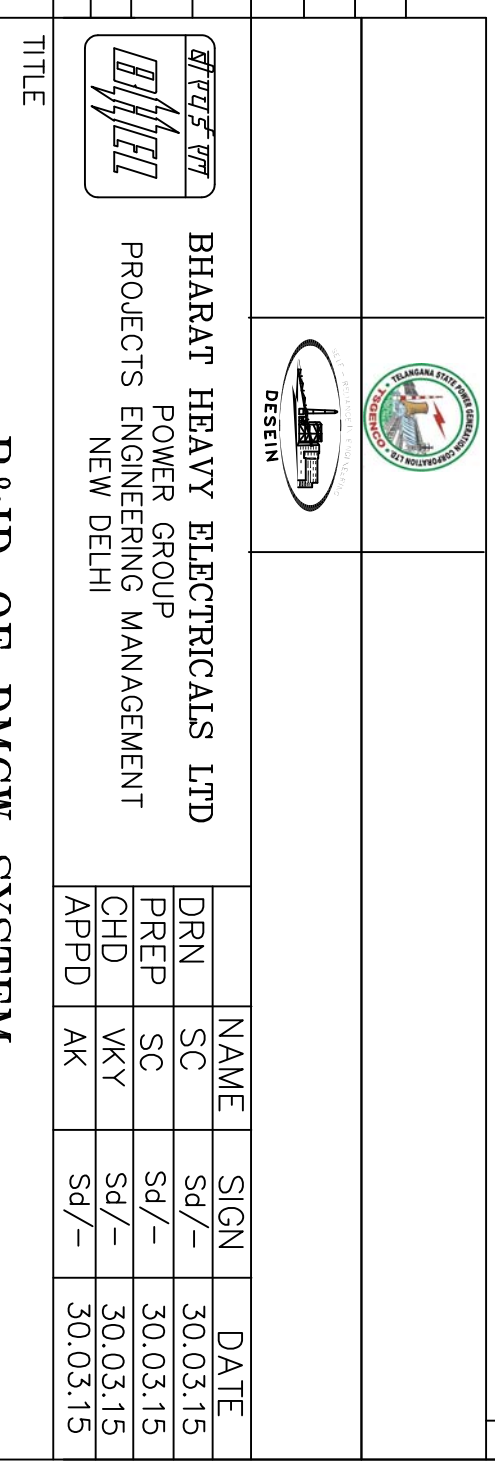
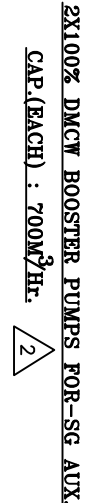


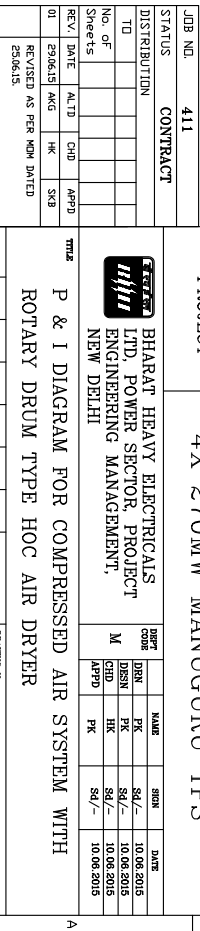
DESEIN PRIVATE LIMITED

PLOT PLAN

1. ROAD SHOW IS FOR DUMPY AND SAVE ROAD SHALL BE ATTRIBUTABLE FOR OTHER UNITS.
2. DESIGN PRESSURE = 10 KG/CMSQ
3. QUALITY OF WATER - PASSIVATED DM WATER WITH PH MAINTAINED BETWEEN 8.5 TO 9.5 PH NIGH DOSING.
4. MATERIALS OF CONSTRUCTION (PIPEWORK) :
 - A) BARRICADED SOLID MILD STEEL PER CODE
 - B) PIPING - ROAD SHALL BE CARBON STEEL, FEM CONFORMING TO IS-1229 HEAVY GRADE.
 - C) COMMON HEADERS OF PLUMBS AND HIGH PRESSURE PIPEWORK SHALL BE SS TO ASTM A 312 OR 304.
5. 50 NB DRAINS & VENTS SHALL BE PROVIDED FOR PIPE SIZES 400 NB AND ABOVE.
6. 25 NB BRANES & VENTS SHALL BE PROVIDED FOR PIPE SIZES UP TO 350 NB AS PER LOCAL REQUIREMENTS.
7. INTERCONNECTED WAGES (*) THIS SHALL BE SUPPLIED ALONGWITH THE EQUIPMENTS.
8. PAINTING/PRECAUTION MEASURES SHALL BE IN ACCORDANCE WITH THE FOLLOWING STANDARDS:
 - A) APPLICATION BY HOT EPOXY RESIN
 - B) APPLICATION OF ONE COAT OF RED LEAD PRIMER FOLLOWED BY APPROXIMATE NO. OF FINISH COATS OF SYNTHETIC PAVELL PAINT TO ACHIEVE TOTAL DFT OF 150 MICRON.
9. REFERENCE DRG./DOC. NOS.:
 - A) P&ID DRAWINGS AND DOCUMENTS.

A) DMCW SYSTEM DESIGN PHILOSOPHY - DOC. NO. PE-DC-471-1/9-N105





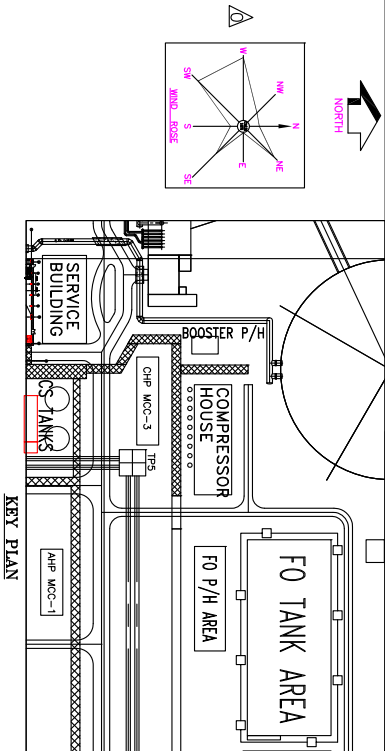
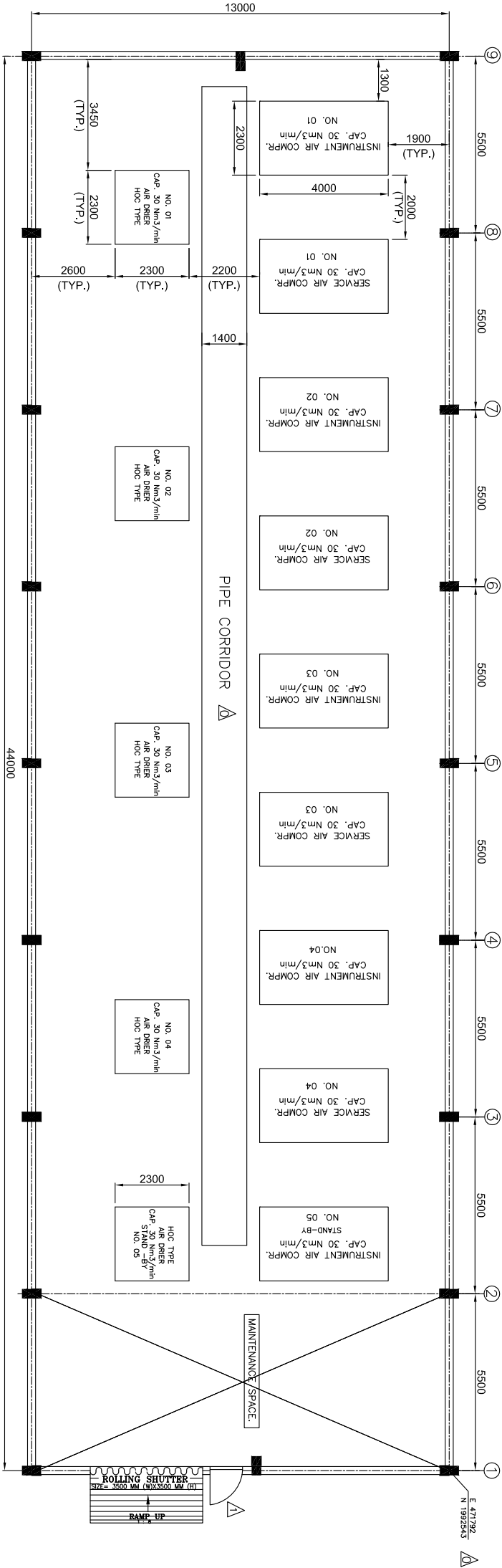
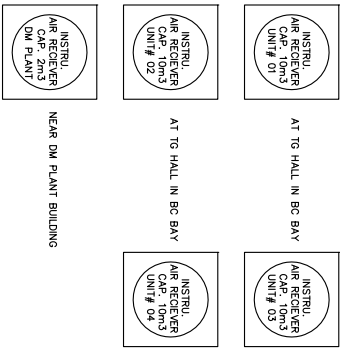
7 6 page 124 of 322

1. THE GIVEN P&I IS CONFINED TO INSTRUMENTS AND PIPING FOR COMPRESSOR HOUSE AREA ONLY.
2. ALL INTERCONNECTING COMPRESSED AIR PIPING SHALL CONFORM TO IS:1239 (HEAVY GRADE) OR IS:3589 Gr.410 AND GALVANISED AS PER IS:4736.

3. ALL COOLING WATER PIPING WILL BE CONFORMING TO IS-1239 (PART-I, HEAVY GRADE).
4. FITTINGS FOR AIR PIPING SHALL BE CONFORMING TO RELEVANT BIS STANDARD AND GRADE EQUIVALENT THAT OF PARENT PIPE GRADE.
5. COMPRESSED AIR PIPING HANDLING HOT AIR WILL BE SUITABLY INSULATED SO AS TO RESTRICT SURFACE TEMPERATURE TO 60 deg C.
6. ALL PRESSURE & TEMPERATURE GAUGE SHALL BE 150 mm DIAI. TYPE.
7. DRAIN PIPING UP TO THE NEAREST DRAINING POINT WITHIN THE AIR COMPRESSOR ROOM SHALL BE PROVIDED.
8. THIS PID HAS BEEN PREPARED CONSIDERING ROTARY TYPE AIR DRIERS FOR IA COMPRESSORS. IN CASE OF CONVENTIONAL TWIN TOWER TYPE DRIERS, THIS PID SHALL BE MODIFIED MINORLY.
9. KKS TAG, NO. PHILOSOPHY SHALL BE FOLLOWED & WILL BE INDICATED IN THE VENDOR'S P&ID's.
10. Flow meter in individual IA/SA header of each unit shall be "Metal tube rota meter type".
11. The instrumentation furnished in the PID is a minimum requirement however any instrument required for completeness of the system shall be provided by bidder without any cost implication. For redundancy criteria, Vendor to follow the clause pertaining to Redundancy Criteria mentioned in the Specific Technical Requirement."

	B	A
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DRAWING NO. PE-DG-114-555-A001



NOTES:-

- 1) ALL DIMENSIONS ARE IN MM & LEVELS ARE IN METERS. EL.(+) 0.000 M CORRESPONDS TO FINISH FLOOR LEVEL OF MAIN PLANT.
- 2) DIMENSION FOR EQUIPMENT LOCATED IN COMPRESSOR HOUSE HAVE BEEN CONSIDERED WORST/MAXIMUM WRT ALL PROSPECTIVE BIDDERS AND WILL NOT CHANGE BUILDING DIMENSIONS AT LATER DATE.
- 3) EQUIPMENT FOUNDATION, PIPING, VALVES AND CABLE SLIT DETAILS SHALL BE INDICATED IN A SEPARATE DRAWING.

REFERENCE DRAWING :-

1) PLOT PLAN PE-DG-411-100-M001

CUSTOMER		TELANGANA STATE POWER GENERATION CO. LTD.	
CONSULTANT		DESEIN PRIVATE LTD.	
PROJECT		4X 270MW BHADRADRI TPS	
JOB NO. 411		CONTRACT	
STATUS		DISTRIBUTION	
TO		BHARAT HEAVY ELECTRICALS LTD. POWER SECTOR PROJECT	
No. of Sheets		ENGINEERING MANAGEMENT, NEW DELHI	
REV / DATE		APPROVED	
20.06.15		REVISED AS PER MOM DATED 26.06.15	
DATE		DATE	
20.06.15		20.06.2015	
DATE		DATE	
20.06.15		20.06.2015	
DATE		DATE	
20.06.15		20.06.2015	

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UNDER SLUNG EOT CRANE CAPACITY: 5.0TON

INSTRUMENT AIR COMP. STAND-BY NO. 01

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UNDER SLUNG EOT CRANE CAPACITY: 5.0TON

INSTRUMENT AIR COMP. STAND-BY NO. 01

ANNEXURE-V LIST OF MANDATORY SPARES		Doc No:	PE-PF-411-555-A001
		Rev No:	0
		Date of issue	01.04.2017
NAME OF PROJECT:		4 X 270 MW BHADRADRI TPS	
NAME OF PACKAGE:		COMPRESSED AIR SYSTEM	
TECHNICAL SPECIFICATION:		PE-TS-411-555-A001	
S. No.	DESCRIPTION	UNIT	QTY
1	Valves & Traps	Nos. (of each size, type & rating for total population)	5% or min. 1 no. (whichever is more)
2	Temperature Elements and Thermowells	Nos. (of each type, rating)	2
3	Electronic Transmitters (for pressure, DP, Flow, level, Temperature) and Electrical Transducers.	Nos. (of each type, rating)	2
4	Local gauges/switch (for Pressure, DP, Temperature, Flow, level , etc.)	Nos. (of each type, rating)	2
5	Microprocessor panel	Nos.	2
Note: Mandatory spares listed above is bare minimum requirement. In case any additional mandatory spares requirement is covered elsewhere in the tender specification apart from specified above, same shall be deemed to have been covered in bidders scope of supply.			

4 X 270MW BHADRADRI TPS AT MANUGURU

ANNEXURE - VI (PAINTING SPECIFICATION)



BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR PROJECT ENGINEERING MANAGEMENT
PPEI, NOIDA-INDIA

TECHNICAL SPECIFICATION

FOR

PROTECTIVE LINING AND PAINTING

1.00.00 INTENT OF SPECIFICATION

1.01.00 This specification addresses the requirements of all labour, material, and appliances necessary with reference to preparations for lining / painting, application as well as finishing of all lining / painting for all mechanical and electrical equipment, piping and valves, structures etc. included under the scope of this Package.

1.02.00 The Bidder shall furnish and apply all lining, primers including wash primers if required, under-coats, finish coats and colour bands as described hereinafter or necessary to complete the work in all respects.

2.00.00 CODES & STANDARDS

2.01.00 The Bidder shall follow relevant Indian and International Standards wherever applicable in cleaning of surface, selection of lining material / paints and their application. The entire work shall conform to the following standards / specifications (latest revision or as specified).

- a) SSPC SP 10 / NACE 2 / : Near White Blast Cleaning
- b) SSPC PA 2 : Measurement of dry film Coating Thickness with magnetic gauges.
- c) ASTM D 4541 : Method for pull off strength using portable Adhesion Tester.
- d) NACE RP 0274 – 2004 : High-Voltage Electrical Inspection of Pipeline Coatings
- e) NACE SP 0188 – 2006 : Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates

- f) NACE RP 0169 – 2002 : Control of External Corrosion on Underground or Submerged Metallic Piping Systems
- g) AWWA C 210 – 2007 : Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines
- h) IS 3589:2001 Annexure B : Steel Pipes for Water and Sewage Specification.
- i) AWWA C222-2000 : Polyurethane Coating for the Interior and Exterior of Steel Water Pipe and Fittings.
- j) IS 13213 : 2000 : Polyurethane Full Gloss Enamel (Two pack)

3.00.00 GENERAL REQUIREMENTS

- 3.01.00** The steel surface preparation prior to actual commencement of coating shall conform to SSPC SP 10 / NACE 2 / Sa2½ (near white metal) with sand blasting.
- 3.02.00** The contractor shall submit a detailed written description in the form of a manual covering coating equipment, procedures, materials inspection test, and repair etc. to Owner/Consultant for approval.
- 3.03.00** The contractor shall also provide copies of test reports from NABL approved laboratory (like National Test House, Kolkata) in support of the paint/primer materials to be used shall conform to the specification requirement.
- 3.04.00** The contractor shall also provide certificates from paint/primer manufacturer mentioning the batch numbers, date of manufacture and shelf life etc. of the materials to be used. In addition to that Manufacturing Quality Plan (MQP) and Field Quality Plan (FQP) shall also be submitted prior to commencement of supply of material and field application.
- 3.05.00** Paint/coating application work at site shall be done either by paint manufacturer or by their authorized applicator. The authorized applicator shall have proper training & certification from manufacturer. Applicator shall possess all the necessary specialized equipment and manpower experienced in similar job.

- 3.06.00 Applied coating shall be tested for dry film thickness, holiday (electrical inspection for continuity) and adhesion as per relevant standard such as SSPC PA 2, NACE RP 0274 and ASTM D 4541.
- 3.07.00 If necessary, the material may be heated and applied by airless spray / plural component spray system.
- 3.08.00 Manufacturer's specific recommendation, if any, shall be followed during application of lining / paints.
- 3.09.00 In areas where there is danger of spotting automobiles or other finally finished equipment or building by wind borne particles from paint spraying, a Purchaser approved method shall be adopted.
- 3.10.00 The colour scheme of the entire Plant, covered under this specification shall be approved by the Purchaser in advance before application.
- 3.11.00 All indoor and outdoor piping, insulated as well as uninsulated will have approved colour bands painted on the pipes at conspicuous places throughout the system, as approved by Purchaser.
- 3.12.00 Inside surfaces of vessels / tanks shall be protected by anticorrosive paints or rubber lining as required / specified elsewhere in the specification. External surfaces of all vessels / tanks shall be protected by anti corrosive painting.
- 3.13.00 For vessels / tanks requiring lining and epoxy painting all inside surface shall be blast cleaned using non-siliceous abrasive after usual wire brushing.
- 3.14.00 Natural rubber lining shall be provided on the inside of vessels / tanks as required / specified elsewhere in the specification, in three layers resulting in a total thickness not less than 4.5 mm.
- 3.15.00 Surface hardness of rubber lining shall be 65 +/- 5 deg. A (shore).
- 3.16.00 After the lining is completed, the vessels / tanks shall not be subjected to any prolonged exposure to direct sunlight in course of its transportation, erection etc. They shall not be stored in direct sunlight. No further lining or burning shall be carried out on the vessel, after application of the lining.

- 3.17.00 All lining projecting outside of the vessel shall be protected adequately from mechanical damages during shipment, handling storage etc.
- 3.18.00 Suitable warnings, indicating the special care that must be taken with respect to these lined vessels shall be stenciled on their outside surface with the letters at least 12 mm high.
- 3.19.00 All insulated piping shall have aluminium sheet jacketing.

4.00.00 EQUIPMENT, MATERIAL AND SERVICES TO BE FURNISHED BY THE BIDDER

- 4.01.00** After erection at site, the outside surfaces of all equipment having a shop coat shall be given further priming coat and finished coats of paint as detailed in following clauses. However, if the painting system is such that the shop coat and primer coat to be applied at site are not compatible, then shop coat has to be removed from the surface of equipment before application of primer coat with prior blasting.

All factory finished paints shall be touched up at site as required.

All uninsulated piping shall be finished with final paintings after use of proper wash primer and primer. Aluminium sheet jacketed piping need not be painted. Colour bands of Purchaser's approved shade shall however be applied on jacketed piping near walls or partitions, at all junctions, near valves and all other places as instructed by the Purchaser. All structures shall be painted with approved paint.

4.02.00 Surface Preparation

- 4.02.01 Unless mentioned otherwise, all rust and mill scale shall be removed by blasting to Sa 2-1/2 Swiss Standard before applying the primer.
- 4.02.02 Special care shall be taken to remove grease and oil by means of suitable solvents like Trichloroethylene or Carbon Tetrachloride.
- 4.02.03 The minimum degree of surface preparations for all equipment, piping, fittings, valves, structures etc. shall be "Near White" according to Steel Structure, Painting Council-SSPC-SP-10 before application of any primer/paint.

4.03.00 Painting

- 4.03.01 Specification for application of paints for external surfaces protection of vessels / tanks / equipment / piping / fittings / valves etc. to be installed indoor shall be as follows :
- a) Surface preparation shall be done either manually or by any other approved method.
 - b) Primer Coat shall consist of one coat (minimum DFT of 50 microns) of chlorinated rubber based zinc phosphate.
 - c) Intermediate Coat (or Under Coat) shall consist of one coat (minimum DFT of 50 microns) of chlorinated rubber based paint pigmented with Titanium Dioxide.
 - d) Top Coat shall consist of one coat (minimum DFT of 50 microns) of chlorinated rubber paint of approved shade and colour with glossy finish.
 - e) Total DFT of paint system shall not be less than 150 microns.
- 4.03.02 Specification for application of paints for external surfaces protection of vessels / tanks / equipment / piping / fittings / valves etc to be installed **outdoor** shall be as follows :
- a) Surface preparation shall be done by means of sand blasting, which shall conform to Sa 2-1/2 Swiss Standard.
 - b) Primer Coat shall consist of one coat (minimum DFT of 100 microns) of epoxy resin based zinc phosphate primer.
 - c) Intermediate Coat (or Under Coat) shall consist of one coat (minimum DFT of 100 microns) epoxy resin based paint pigmented with Titanium Dioxide.
 - d) Top Coat shall consist of one coat (minimum DFT of 75 microns) of epoxy paint of approved shade and colour with glossy finish. Additional one coat (minimum DFT of 25 microns) of Finish Coat of polyurethane shall be provided.
 - e) Total DFT of paint system shall not be less than 300 microns.
- 4.03.03 Specification for application of paints for external surfaces protection of steel pipes and fittings which are **buried underground / laid inside a huge pipe & or submerged Under Water and laid under Pipe Trenches** (in road/rail/pipe or trench crossings) shall be as follows :

The no. of coats and DFT specified above is minimum. However to achieve above specified DFT, no of coats can be increased as per paint manufacture's recommendation.

External surface of the pipe, fittings, specialties etc. handling raw water/clarified water/filter water shall be painted with one coat of two part chemically cured polyurethane primer of min 50 micron dry film thickness followed by three or maximum four coats of two part solvent less polyurethane to build up coating of dry film thickness of 2000 micron including primer coat.

- 4.03.04 Specification for application of paints for **internal surface protection of large diameter pipes** (sizes above 600 mm NB and above) if any, shall be as follows :
- a) All Internal surfaces of steel pipes, fittings, specialties etc. buried underground or located within pipe trenches shall be given epoxy coating to protect them from (except for drinking water service, where the compatible painting shall be so selected to meet relevant quality standards) corrosion.
 - b) Internal surface of the pipe should be coated with one coat of two part epoxy primer with not less than 50 micron DFT (dry film thickness) followed by two part polyamide cured solvent less epoxy.
 - c) The minimum dry film thickness (DFT) of internal lining shall be 600 micron.
- 4.03.05 Specification for application of paints for protection of **internal surfaces of DM Water Storage Tank(s)** shall be as follows :
- a) Primer - One coat of epoxy primer containing high level of Zinc Phosphate anticorrosive pigment. Total Dry Film Thickness (DFT) of primer shall not be less than 125 microns.
 - b) Finish Paint - Three (3) coats Polyamine HB Epoxy Paint. Total Dry Film Thickness (DFT) of finish paint shall not be less than 125 microns per coat.
 - c) Total thickness of primer and paint should not be less than 500 microns.
- 4.03.06 All motors, local push button stations, cable racks, structures used for supports etc. are to be painted with acid proof paint.
- 4.03.07 The following surfaces shall not be painted - stainless steel, galvanized steel, aluminum, copper, brass, bronze and other nonferrous materials.
- 4.03.08 No painting or filler shall be applied until all repairs, hydrostatic tests and final shop inspection are completed.

The no. of coats and DFT specified above is minimum. However to achieve above specified DFT, no of coats can be increased as per paint manufacture's recommendation.

4.03.09 All machined surfaces shall have two (2) coats of water repellant grease after thorough cleaning.

5.00.00 COATING PROCEDURE AND APPLICATION

5.01.00 Surface Preparation :

Pipe shall be blast cleaned by sand. The cleanliness achieved prior to application shall be in accordance with the requirement of SSPC SP 10 / NACE 2 / Sa2½ of ISO 8501 (near white metal)

- a) The blast pattern or profile depth shall be 40 to 100 micron and shall be measured by dial micrometer.
- b) Before sand blasting is started or during blasting or coating, temperature of the pipe surface should be more than 3°C above dew point temperature. Blast cleaned surface should be primed within 4 hours and shall be protected from rainfall or surface moisture and shall not be allowed to flash rust. If the rust occurs, the surface again to be prepared by sand blasting or wire brushing.

5.02.00 Application of Epoxy Coating

- a) Coating shall be applied when
 - i) When the pipe surface temperature shall be atleast 3°C above dew point temperature.
 - ii) The temperature of mixed coating material and the pipe at the time of application shall not be lower than 10°C or greater than 50°C.
- b) Material preparation shall be in accordance with manufacturer's recommendations.
- c) Application of epoxy coating system :

The epoxy coating system shall be applied as per recommendation of the manufacturer and shall be applied by airless spray / plural component spray machine. For more than one coat, the second shall be applied with the time limits as recommended by the manufacturer.

5.03.00 Application of PU Coating

- a) PU coating shall be applied when the pipe surface temperature atleast 3°C above dew point temperature (when R.H is more than 85%).
- b) Material preparation and application shall be done as per manufacturer recommendation.

6.00.00 TEST REQUIREMENTS :

6.01.00 Measurement of dry film thickness

Measurement of dry film thickness of coating : Coating thickness shall be in the range of $\pm 20\%$ and as per SSPC PA 2.

6.01.01 Apparatus / Instrument:-

The instrument used for dry film thickness may be Type 1 pull of gauges or Type 2 electronic gauges.

6.01.02 Procedures:-

- a) Number of measurements:
For 100 square feet (9.29 square meters), five (5) spots per test area (each spot is 3.8 cm) in diameter. Three gauge readings per spot (average becomes the spot measurement).
- b) If the structure is less than 300 square feet, each 100 square feet should be measured.
- c) If the structure is between 300 and 1000 sq ft, select 3 random 100 square feet test areas and measure.
- d) For structure exceeding 1000 square feet, select 3 random 100 square feet testing areas for the first 1000 sq ft and select 1 random 100 square feet testing area for each additional 1000 square feet
- e) Coating thickness Tolerance: Individual reading taken to get a representative measurement for the spot are unrestricted (usually low or high readings are discarded). Spot measurements (the average of 3 gauge readings) must be within 80% of the minimum thickness and 120% of the maximum thickness.
Area measurement must be within specified range.

6.02.00 Electrical Inspection (Holiday) Test

- 6.02.01 All the coated / lined pipes shall be tested with an approved high voltage holiday detector preferably equipped with an audio visual signaling device to indicate any faults, holes, breaks or conductive particles in the protective coating.
- 6.02.02 The applied output voltage of holiday detector shall have a spark discharge of thickness equal to at least twice the thickness of the coating to assure adequate inspection voltage and compensate for any variation in coating thickness. The electrode shall be passed over the coated surface at approximately half the spark discharge distance from the coated surface only one time at the rate of approximately 10 to 20m/min. The edge effect shall be ignored. Excessive voltage shall be avoided as it tends to induce holiday in the coated surface thereby giving erroneous readings.
- 6.02.03 While selecting test voltages, consideration should be given to the tolerance on coating thickness and voltage should be selected on the basis of maximum coating thickness likely to be encountered during testing of a particular pipe.
- The testing voltage shall be calculated by using following formula. (as per NACE 0274 : 2004)
- Testing Voltage $V = 7900 \sqrt{T} \pm 10$ percent where T is the average coating thickness in mm.
- 6.02.04 Any audio visual sound or spark leads to indicate pinhole, break or conductive particle.
- 6.03.00 Adhesion Pull off Test :**
- After holiday the coated surface is subjected to adhesion pull off test as per ASTM D 4541.
- 6.03.01 Apparatus / Instrument: Adhesion tester consists of three basic components:
- A hand wheel, a black column containing a dragging indicator pin and scale in the middle and a base containing three legs and a pulling "Jaw" at the bottom and also dollies.
- 6.03.02 Prepare the test surface :
- Once test area is selected, test area shall be free of grease, oil, dirt, water. The area should be flat surfaces and large enough to accommodate the specified number of replicate test.
- 6.03.03 Prepare Dolly (Test Pull Stub) :

The dolly is a round, two sided aluminium fixture. Both sides of the dolly looks same, however, one side sloped on top surface while flat on bottom surface. As the surface of the dolly is polished aluminium, roughen the same using a coarse sand paper.

6.03.04 Select an adhesive:

Use araldite, a 100% solid epoxy adhesive. This adhesive requires at least 24 hours at room temperature to cure.

6.03.05 Attach the dolly to the surface.

- a) Using a wooden stick, apply an even layer of adhesive to the entire contact surface area of the dolly.
- b) Carefully remove the excessive adhesive by using a cotton swab. Allow the adhesive to fully cure before performing the adhesion test.
- c) Attach the dolly to the coated surface and gently push downward to displace any excessive adhesive.
- d) Push the dolly inward against the surface, then apply tape across the head of the dolly.

6.03.06 Adhesion Test Procedure

- a) Attach the adhesion tester to the dolly by rotating the hand wheel counter clockwise to lower the jaw of the device.
- b) Slide the jaw completely under the head of the dolly. Position the three legs of the instruments so that they are sitting flat on the coated surface.
- c) Slide the dragging indicator pin on the black column to zero by pushing it downward.
- d) Firmly hold the base of the instrument in one hand and rotate the handwheel clockwise to raise the jaw of the device that is attached to the head of the dolly. The dragging indicator pin will move upward on the black column as the force is increased and will hold the reading. Apply the tension using a moderate speed. Continue to increase the tension on the head of the dolly until (a) the minimum PSI/MPa/Kg/cm² required by project specification is exceeded and the test is discontinued, (b) the maximum PSI/MPa/Kg/cm² of adhesion tester has been achieved and dolly is still attached, (c) The force applied by the adhesion tester causes the dolly to dislodge.

e) Read the scale and record the adhesion value.

6.04.00 Coating Repair

Defective Coating shall be repaired in accordance with the following subsections.

6.04.01 Surface Preparation:

Accessible areas of pipe requiring coating repairs shall be cleaned to remove debris and damaged coating using surface grinders or other means. The adjacent coating shall be feathered by sanding, grinding or other method. Accumulated debris shall be removed by blowing with contaminant free air or wiping with clean rags.

6.04.02 Areas not accessible for coating repair such as interior surfaces of small diameter pipe shall be reprocessed and recoated.

6.04.03 Coating Application :

The coating system shall be applied to the prepared areas in accordance with procedure.

6.04.04 Repair Inspection :

Repaired portion shall be electrically inspected using a holiday detector.

6.05.00 Welded Field Joints

6.05.01 Preparation :

The weld joints shall be cleaned so as to be free from mud, oil, grease, welding flux, weld spatter and other foreign contaminants. The cleaned metal surfaces of the weld joint shall then be blasted or abraded using rotary abrading pads. The adjacent liquid Epoxy / PU coating shall be feathered by abrading the coating surface for a distance of 25 mm.

6.05.02 Electrical Inspection :

After curing the coating system applied to the welding joints shall be holiday tested. Any holidays indicated by the detector shall be marked with chalk to identify the area of repair.