

NCTPP, DADRI, STAGE-II (2X490MW)

**OF
NTPC Limited
(A Government of India Enterprise)**

TECHNICAL SPECIFICATION FOR COMPRESSED AIR SYSTEM

SPECIFICATION NO. : PE-TS-436-555-A001



**BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA (INDIA)**



2 X 490 MW NCTPPP, DADRI, STAGE-II COMPRESSED AIR SYSTEM

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SECTION-A

INTENT OF SPECIFICATION



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1.0 INTENT OF SPECIFICATION

- 1.1 The specification covers Supply part, Services part including AMC (Annual Maintenance Contract) for Three (3) years after successful handover of Compressed Air System to end customer and O&M Spares comprising of design (i.e. preparation and submission of drawing /documents including "As Built" drawings and O&M manuals), engineering, manufacture, fabrication, assembly, inspection / testing at vendor's & sub-vendor's works, painting, maintenance tools & tackles (as applicable), fill of lubricants & consumables, O&M Spares along with spares for erection, start up and commissioning as required, forwarding, proper packing, shipment and delivery at site, unloading, handling, transportation & storage at site, in-site transportation, assembly, erection & commissioning, final painting at site, minor civil work, trial run at site, AMC for three years after handover of CAS to end customer, preparation of layout drawings and carrying out Performance guarantee tests at site, training of customer/client and O&M staff and handover in flawless condition of the package to the end customer complete with all accessories for the total scope defined as per BHEL NIT & tender technical specification, amendment & agreements till placement of order for 2X 490 MW NCTPPP, DADRI, STAGE-II.
- 1.2 The contractor shall be responsible for providing all material, equipment & services, which are required to fulfil the intent of ensuring operability, maintainability, reliability and complete safety of the complete work covered under this specification, irrespective of whether it has been specifically listed herein or not. Omission of specific reference to any component / accessory necessary for proper performance of the equipment shall not relieve the contractor of the responsibility of providing such facilities to complete the supply Lube oil pumps within quoted price.
- 1.3 It is not the intent to specify herein all the details of design and manufacture. However, the equipment shall conform in all respects to highest standards of design, engineering and workmanship and shall be capable of performing the required duties in a manner acceptable to purchaser who will interpret the meaning of drawings and specifications and shall be entitled to reject any work or material which in his judgement is not in full accordance herewith.
- 1.4 The extent of supply under the contract includes all items shown in the drawings, notwithstanding the fact that such items may have been omitted from the specification or schedules. Similarly, the extent of supply also includes all items mentioned in the specification and /or schedules, notwithstanding the fact that such items may have been omitted in the drawing. Similarly, the extent of supply also includes all items required for completion of the system and not withstanding that they may have been omitted in drawings / specifications or schedules.
- 1.5 The general term and conditions, instructions to tenderers and other attachment referred to elsewhere are made part of the tender specification. The equipment materials and works covered by this specification is subject to compliance to all attachments referred to in the



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INTENT OF SPECIFICATION

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specification. The bidder shall be responsible for and governed by all requirements stipulated herein.

- 1.6 While all efforts have been made to make the specification requirement complete & unambiguous, it shall be bidders' responsibility to ask for missing information, ensure completeness of specification, to bring out any contradictory / conflicting requirement in different sections of the specification and within a section itself to the notice of BHEL and to seek any clarification on specification requirement in the format enclosed under Vol-III of the specification **within 10 days of receipt of tender documents**. In absence of any such clarifications, in case of any contradictory requirement, the more stringent requirement as per interpretation of Purchaser / Customer shall prevail and shall be complied by the bidder without any commercial implication on account of the same. Further in case of any missing information in the specification not brought out by the prospective bidders as part of pre-bid clarification, the same shall be furnished by Purchaser/ Customer as and when brought to their notice either by the bidder or by purchaser/ customer themselves. However, such requirements shall be binding on the successful bidder without any commercial & delivery implication.
- 1.7 The bidder's offer shall not carry any sections like clarification, interpretations and /or assumptions.
- 1.8 Deviations, if any, should be very clearly brought out clause by clause along with cost of withdrawal in the enclosed schedule (in Vol – III); otherwise, it will be presumed that the vendor's offer is strictly in line with NIT specification. If no cost of withdrawal is given against the deviation, it will be presumed that deviation can be withdrawn without any cost to BHEL/its customer.
- 1.9 In the event of any conflict between the requirements of two clauses of this specification documents or requirements of different codes and standards specified, Section - C shall prevail over section – D, however more stringent requirement as per the interpretation of the owner shall apply.
- 1.10 In case all above requirements are not complied with, the offer may be considered as incomplete and would become liable for rejection.
- 1.11 For definition of word like Contractor, bidder, supplier, vendor, Customer/ Purchaser / Employer, consultant, please referred relevant clause(s) of GCC.

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SECTION: B PROJECT INFORMATION WITH WIND AND SEISMIC DESIGN CRITERIA			

CLAUSE NO.	PROJECT INFORMATION																			
4.00.00	METEOROLOGICAL DATA Meteorological data of the nearest observatory Dehri station is enclosed as Annexure-II to this subsection.																			
5.00.00	CRITERIA FOR EARTHQUAKE RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT All structures and equipment shall be designed for seismic forces adopting the site specific seismic information provided in this document and using the other provisions in accordance with IS:1893 (Part 1 to Part 4). Pending finalization of Part 5 of IS:1893, provisions of part 1 shall be read along with the relevant clauses of IS:1893:1984, for embankments. A site specific seismic study has been conducted for the project site. The peak ground horizontal acceleration for the project site, the site specific acceleration spectral coefficients (in units of gravity acceleration 'g') in the horizontal direction for the various damping values and the multiplying factor (to be used over the spectral coefficients) for evaluating the design acceleration spectra are as given at Appendix-I. Vertical acceleration spectral values shall be taken as 2/3rd of the corresponding horizontal values. The site specific design acceleration spectra shall be used in place of the response acceleration spectra, given at figure-2 in IS:1893 (Part 1) and Annex B of IS:1893 (Part 4). The site specific acceleration spectra along with multiplying factors specified in Appendix-I includes the effect of the seismic environment of the site, the importance factor related to the structures and the response reduction factor. Hence, the design spectra do not require any further consideration of the zone factor (Z), the importance factor (I) and response reduction factor (R) as used in the IS:1893 (Part 1 to Part 4). Damping in Structures The damping factor (as a percentage of critical damping) to be adopted shall not be more than as indicated below for: <table><tr><td>a)</td><td>Steel structures</td><td>:</td><td>2%</td></tr><tr><td>b)</td><td>Reinforced Concrete structures</td><td>:</td><td>5%</td></tr><tr><td>c)</td><td>Reinforced Concrete Stacks</td><td>:</td><td>3%</td></tr><tr><td>d)</td><td>Steel stacks</td><td>:</td><td>2%</td></tr></table>				a)	Steel structures	:	2%	b)	Reinforced Concrete structures	:	5%	c)	Reinforced Concrete Stacks	:	3%	d)	Steel stacks	:	2%
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NCTPP,DADRI ST-II (2X490 MW) & IGSTPP,JHAJJAR(3X500MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO CS-6130/0330-109-9	SUB-SECTION-IIB PROJECT INFORMATION	PAGE 3 OF 32																

CLAUSE NO.	PROJECT INFORMATION 		
	Method of Analysis Since most structures in a power plant are irregular in shape and have irregular distribution of mass and stiffness, dynamic analysis for obtaining the design seismic forces shall be carried out using the response spectrum method. The number of vibration modes used in the analysis should be such that the sum total of modal masses of all modes considered is at least 90 percent of the total seismic mass and shall also meet requirements of IS:1893 (Part 1). Modal combination of the peak response quantities shall be performed as per Complete Quadratic Combination (CQC) method or by an acceptable alternative as per IS:1893 (Part 1). In general, seismic analysis shall be performed for the three orthogonal (two principal horizontal and one vertical) components of earthquake motion. The seismic response from the three components shall be combined as specified in IS:1893 (Part 1). The spectral acceleration coefficient shall get restricted to the peak spectral value if the fundamental natural period of the structure falls to the left of the peak in the spectral acceleration curve. For buildings, if the design base shear (V_B) obtained from modal combination is less than the base shear ($\bar{V}_B$) computed using the approximate fundamental period (T_a) given in IS:1893:Part 1 and using site specific acceleration spectra with appropriate multiplying factor, the response quantities (e.g. member forces, displacements, storey forces, storey shears and base reactions) shall be enhanced in the ratio of $\bar{V}_B / V_B$. However, no reduction is permitted if $\bar{V}_B$ is less than V_B. Design/Detailing for Ductility for Structures The site specific design acceleration spectra is a reduced spectra and has an in-built allowance for ductility. Structures shall be engineered and detailed in accordance with relevant Indian/International standards to achieve ductility.		
NCTPP,DADRI ST-II (2X490 MW) & IGSTPP,JHAJJAR(3X500MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO CS-6130/0330-109-9	SUB-SECTION-IIB PROJECT INFORMATION	PAGE 4 OF 32

CLAUSE NO.	PROJECT INFORMATION			
	APPENDIX – I			
	<u>SITE SPECIFIC SEISMIC PARAMETERS FOR DESIGN OF STRUCTURES AND EQUIPMENT</u>			
	The various site specific seismic parameters for the project site shall be as follows:			
	1)	Peak ground horizontal acceleration	:	0.24g
	2)	Multiplying factor to be applied to the site specific horizontal acceleration spectral coefficients (in units of gravity acceleration ‘g’) to obtain the design acceleration spectra		
	a)	for special moment resisting steel frames designed and detailed as per IS:800	:	0.06
	b)	For special concentrically braced steel frames designed and detailed as per IS:800	:	0.045
	c)	for special moment resisting RC frames designed and detailed as per IS:456 and IS:13920	:	0.036
	d)	for RCC chimney	:	0.12
	e)	For Liquid retaining tanks	:	0.072
Notes:	f)	for Steel chimney, Absorber tower, Vessels	:	0.09
	g)	for design of structures not covered under 2 (a) to 2 (f) above and under 3 below, in general (excluding special structure/ configuration/materials)	:	0.06
	3)	Multiplying factor to be applied to the site specific horizontal acceleration spectral coefficients (in units of gravity acceleration ‘g’) for design of equipment and structures where inelastic action is not relevant or not permitted	:	0.12
	1.g = Acceleration due to gravity			
	2.For industrial structures, analysis for verification of mechanism shall be carried out as per IS:1893 (Part 4):2015			
	The horizontal seismic acceleration spectral coefficients are furnished in subsequent pages			
	NCTPP,DADRI ST-II (2X490 MW) & IGSTPP,JHAJJAR(3X500MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE			
	TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO CS-6130/0330-109-9			
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CLAUSE NO.	PROJECT INFORMATION																																																																																																																																																			
	APPENDIX – I <u>HORIZONTAL SEISMIC ACCELERATION SPECTRAL</u> <u>COEFFICIENTS</u> (In units of 'g') <table><tr><th>Time Period</th><th colspan="3">Damping Factor (as a percentage of critical damping)</th></tr><tr><th>(Sec)</th><th>2%</th><th>3%</th><th>5%</th></tr><tr><td>0</td><td>1</td><td>1</td><td>1</td></tr><tr><td>0.03</td><td>1</td><td>1</td><td>1</td></tr><tr><td>0.05</td><td>1.605</td><td>1.531</td><td>1.413</td></tr><tr><td>0.1</td><td>3.049</td><td>2.729</td><td>2.259</td></tr><tr><td>0.12</td><td>3.61</td><td>3.178</td><td>2.556</td></tr><tr><td>0.124</td><td>3.735</td><td>3.266</td><td>2.621</td></tr><tr><td>0.127</td><td>3.735</td><td>3.332</td><td>2.744</td></tr><tr><td>0.133</td><td>3.735</td><td>3.330</td><td>2.744</td></tr><tr><td>0.2</td><td>3.735</td><td>3.330</td><td>2.744</td></tr><tr><td>0.25</td><td>3.735</td><td>3.330</td><td>2.744</td></tr><tr><td>0.3</td><td>3.735</td><td>3.330</td><td>2.744</td></tr><tr><td>0.35</td><td>3.735</td><td>3.330</td><td>2.744</td></tr><tr><td>0.4</td><td>3.735</td><td>3.330</td><td>2.744</td></tr><tr><td>0.45</td><td>3.735</td><td>3.330</td><td>2.744</td></tr><tr><td>0.5</td><td>3.735</td><td>3.330</td><td>2.744</td></tr><tr><td>0.55</td><td>3.735</td><td>3.330</td><td>2.744</td></tr><tr><td>0.6</td><td>3.735</td><td>3.330</td><td>2.744</td></tr><tr><td>0.622</td><td>3.735</td><td>3.330</td><td>2.744</td></tr><tr><td>0.634</td><td>3.666</td><td>3.330</td><td>2.744</td></tr><tr><td>0.65</td><td>3.575</td><td>3.249</td><td>2.744</td></tr><tr><td>0.667</td><td>3.487</td><td>3.166</td><td>2.744</td></tr><tr><td>0.7</td><td>3.32</td><td>3.017</td><td>2.613</td></tr><tr><td>0.75</td><td>3.099</td><td>2.816</td><td>2.439</td></tr><tr><td>0.8</td><td>2.905</td><td>2.640</td><td>2.286</td></tr><tr><td>0.85</td><td>2.734</td><td>2.485</td><td>2.152</td></tr><tr><td>0.9</td><td>2.582</td><td>2.347</td><td>2.032</td></tr><tr><td>0.95</td><td>2.446</td><td>2.223</td><td>1.925</td></tr><tr><td>1</td><td>2.324</td><td>2.112</td><td>1.829</td></tr><tr><td>1.05</td><td>2.213</td><td>2.011</td><td>1.742</td></tr><tr><td>1.1</td><td>2.113</td><td>1.920</td><td>1.663</td></tr><tr><td>1.15</td><td>2.021</td><td>1.837</td><td>1.59</td></tr><tr><td>1.2</td><td>1.937</td><td>1.760</td><td>1.524</td></tr><tr><td>1.25</td><td>1.859</td><td>1.690</td><td>1.463</td></tr><tr><td>1.3</td><td>1.788</td><td>1.625</td><td>1.407</td></tr></table>				Time Period	Damping Factor (as a percentage of critical damping)			(Sec)	2%	3%	5%	0	1	1	1	0.03	1	1	1	0.05	1.605	1.531	1.413	0.1	3.049	2.729	2.259	0.12	3.61	3.178	2.556	0.124	3.735	3.266	2.621	0.127	3.735	3.332	2.744	0.133	3.735	3.330	2.744	0.2	3.735	3.330	2.744	0.25	3.735	3.330	2.744	0.3	3.735	3.330	2.744	0.35	3.735	3.330	2.744	0.4	3.735	3.330	2.744	0.45	3.735	3.330	2.744	0.5	3.735	3.330	2.744	0.55	3.735	3.330	2.744	0.6	3.735	3.330	2.744	0.622	3.735	3.330	2.744	0.634	3.666	3.330	2.744	0.65	3.575	3.249	2.744	0.667	3.487	3.166	2.744	0.7	3.32	3.017	2.613	0.75	3.099	2.816	2.439	0.8	2.905	2.640	2.286	0.85	2.734	2.485	2.152	0.9	2.582	2.347	2.032	0.95	2.446	2.223	1.925	1	2.324	2.112	1.829	1.05	2.213	2.011	1.742	1.1	2.113	1.920	1.663	1.15	2.021	1.837	1.59	1.2	1.937	1.760	1.524	1.25	1.859	1.690	1.463	1.3	1.788	1.625	1.407
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	1.35	1.721	1.564	1.355	
	1.4	1.66	1.509	1.306	
	1.45	1.603	1.457	1.261	
	1.5	1.549	1.408	1.219	
	1.55	1.499	1.363	1.18	
	1.6	1.453	1.320	1.143	
	1.65	1.408	1.280	1.108	
	1.7	1.367	1.242	1.076	
	1.75	1.328	1.207	1.045	
	1.8	1.291	1.173	1.016	
	1.85	1.256	1.142	0.989	
	1.9	1.223	1.112	0.963	
	1.95	1.192	1.083	0.938	
	2	1.162	1.056	0.915	
	2.05	1.134	1.030	0.892	
	2.1	1.107	1.006	0.871	
	2.15	1.081	0.982	0.851	
	2.2	1.056	0.960	0.831	
	2.25	1.033	0.939	0.813	
	2.3	1.01	0.918	0.795	
	2.35	0.989	0.899	0.778	
	2.4	0.968	0.880	0.762	
	2.45	0.949	0.862	0.747	
	2.5	0.93	0.845	0.732	
	2.55	0.911	0.828	0.717	
	2.6	0.894	0.812	0.703	
	2.65	0.877	0.797	0.69	
	2.7	0.861	0.782	0.677	
	2.75	0.845	0.768	0.665	
	2.8	0.83	0.754	0.653	
	2.85	0.815	0.741	0.642	
	2.9	0.801	0.728	0.631	
	2.95	0.788	0.716	0.62	
	3	0.775	0.704	0.61	
	3.05	0.762	0.692	0.6	
	3.1	0.75	0.681	0.59	
	3.15	0.738	0.670	0.581	
	3.2	0.726	0.660	0.572	
	3.25	0.715	0.650	0.563	
	3.3	0.704	0.640	0.554	
3.35	0.694	0.630	0.546		
3.4	0.684	0.621	0.538		
3.45	0.674	0.612	0.53		
3.5	0.664	0.603	0.523		
3.55	0.655	0.595	0.515		
NCTPP,DADRI ST-II (2X490 MW) & IGSTPP,JHAJJAR(3X500MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO CS-6130/0330-109-9	SUB-SECTION-IIB PROJECT INFORMATION	PAGE 7 OF 32	

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6.00.00	3.6	0.646	0.587	0.508	
	3.65	0.637	0.579	0.501	
	3.7	0.628	0.571	0.494	
	3.75	0.62	0.563	0.488	
	3.775	0.616	0.559	0.485	
	3.8	0.612	0.556	0.481	
	3.85	0.604	0.549	0.475	
	3.9	0.596	0.542	0.469	
	3.95	0.588	0.535	0.463	
	4	0.581	0.528	0.457	
	CRITERIA FOR WIND RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT				
All structures shall be designed for wind forces in accordance with IS:875 (Part-3) and as specified in this document. See Annexure – B for site specific information. Along wind forces shall generally be computed by the Peak (i.e. 3 second gust) Wind Speed method as defined in the standard. Along wind forces on slender and wind sensitive structures and structural elements shall also be computed, for dynamic effects, using the Gust Factor or Gust Effectiveness Factor Method as defined in the standard. The structures shall be designed for the higher of the forces obtained from Gust Factor method and the Peak Wind Speed method. Analysis for dynamic effects of wind must be undertaken for any structure which has a height to minimum lateral dimension ratio greater than “5” and/or if the fundamental frequency of the structure is less than 1 Hz. Susceptibility of structures to across-wind forces, galloping, flutter, ovalling etc. should be examined and designed/detailed accordingly following the recommendations of IS:875(Part-3) and other relevant Indian standards. It should be estimated if size and relative position of other structures are likely to enhance the wind loading on the structure under consideration. Enhancement factor, if necessary, shall suitably be estimated and applied to the wind loading to account for the interference effects. Damping in Structures The damping factor (as a percentage of critical damping) to be adopted shall not be more than as indicated below for:					
NCTPP,DADRI ST-II (2X490 MW) & IGSTPP,JHAJJAR(3X500MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO CS-6130/0330-109-9		SUB-SECTION-IIB PROJECT INFORMATION	PAGE 8 OF 32

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	a) Welded steel structures : 1.0% b) Bolted steel structures : 2.0% c) Reinforced concrete structures : 1.6% d) Steel stacks : As per IS:6533 & CICIND Model Code whichever is more critical. ANNEXURE-B SITE SPECIFIC DESIGN PARAMETERS The various design parameters, as defined in IS: 875 (Part-3), to be adopted for the project site shall be as follows: a) The basic wind speed “V_b” at ten metres above the mean ground level : 47 metres/second b) The risk coefficient “K₁” : 1.07 c) Category of terrain : Category-2 1.00.00 FOUNDATION SYSTEM AND GEOTECHNICAL DATA 7.00.00 Geotechnical data and foundation system for the respective project are enclosed at Annexure-I. The corresponding bore logs are enclosed at annexure-II. 7.00.01 The available geotechnical data is of vicinity to proposed structures, therefore, bidder shall carryout his own detailed geotechnical investigation for facilities under this package and shall be as per the scheme approved by owner. The scheme for geotechnical investigation shall be as given at Clause 7.07.00 and shall be approved by owner before execution. Geotechnical investigation work shall got executed by the Contractor through the agencies as mentioned in Clause No. 7.07.03. However, no time extension shall be given on account of soil investigation carried out by the Bidder. The geotechnical investigation report shall be prepared with detailed recommendations regarding type of foundation and allowable bearing pressure for various structures/ facilities and other soil parameters. The report shall be submitted for Owner’s approval prior to commencement of design of foundation. 7.00.02 The Bidder should note that nothing extra whatsoever on account of variation between geotechnical data furnished by Owner and that found by the contractor during geotechnical investigation by him or during execution of works, shall be payable.			
NCTPP,DADRI ST-II (2X490 MW) & IGSTPP,JHAJJAR(3X500MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO CS-6130/0330-109-9	SUB-SECTION-IIB PROJECT INFORMATION	PAGE 9 OF 32

CLAUSE NO.	PROJECT INFORMATION 			
7.01.03	Tank Foundations a) The tanks shall rest on flexible tank pad foundation, resting on sand with concrete ring wall to retain sand. Base of the concrete ring wall shall not rest on the expansive soil, if any. b) Entire loose/ soft soil inside the concrete ring wall shall be removed and shall be filled with sand. Sand for filling shall be clean and well graded conforming to IS 383 with grading Zone I to III. c) Sand shall be spread in layers not exceeding 30cm compacted thickness over the area. Each layer shall be uniformly compacted by mechanical means like plate vibrators, small vibratory rollers, etc. to achieve a relative density of not less than 80%. d) Other requirements of tank foundations shall be as per IS 803 and as specified elsewhere in the specifications.			
7.02.00	Foundation System The requirements for the foundation system to be adopted are as given in subsequent Clauses. Depending upon the depth of competent strata/stratum, type of structures, functional requirement of facility, extent of cutting / filling, suitable foundation, open or pile shall be adopted with approval of owner.			
7.02.01	General Requirements a) All structures/equipment shall be supported either on suitable open foundations (isolated, combined, raft) or pile foundations depending on type of structures/facilities, sub-strata, topography etc. b) The roads, ground floor slabs, trenches, pipe pedestals, channels/drain and staircase foundation with foundation loading intensity less than 4 T / M² may be supported on open / shallow foundations resting on virgin / controlled compacted filled up soil. c) No other foundation (other than as mentioned in (b) above) shall rest on the filled up ground / soil. d) No foundation shall rest on the black cotton soil. e) Before execution of work the bidder shall ensure that there is no obstruction to underground/overground facilities like sewer lines, pipe lines etc. Any such damage and remedial/ rectification measures shall be at the contractors cost. f) Bidder shall also ensure that there is no damage to existing nearby foundations and the foundations pertaining to this package are not placed at shallower depth than the nearby foundations. If required depth of foundation			
NCTPP,DADRI ST-II (2X490 MW) & IGSTPP,JHAJJAR(3X500MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO CS-6130/0330-109-9	SUB-SECTION-IIB PROJECT INFORMATION	PAGE 10 OF 32

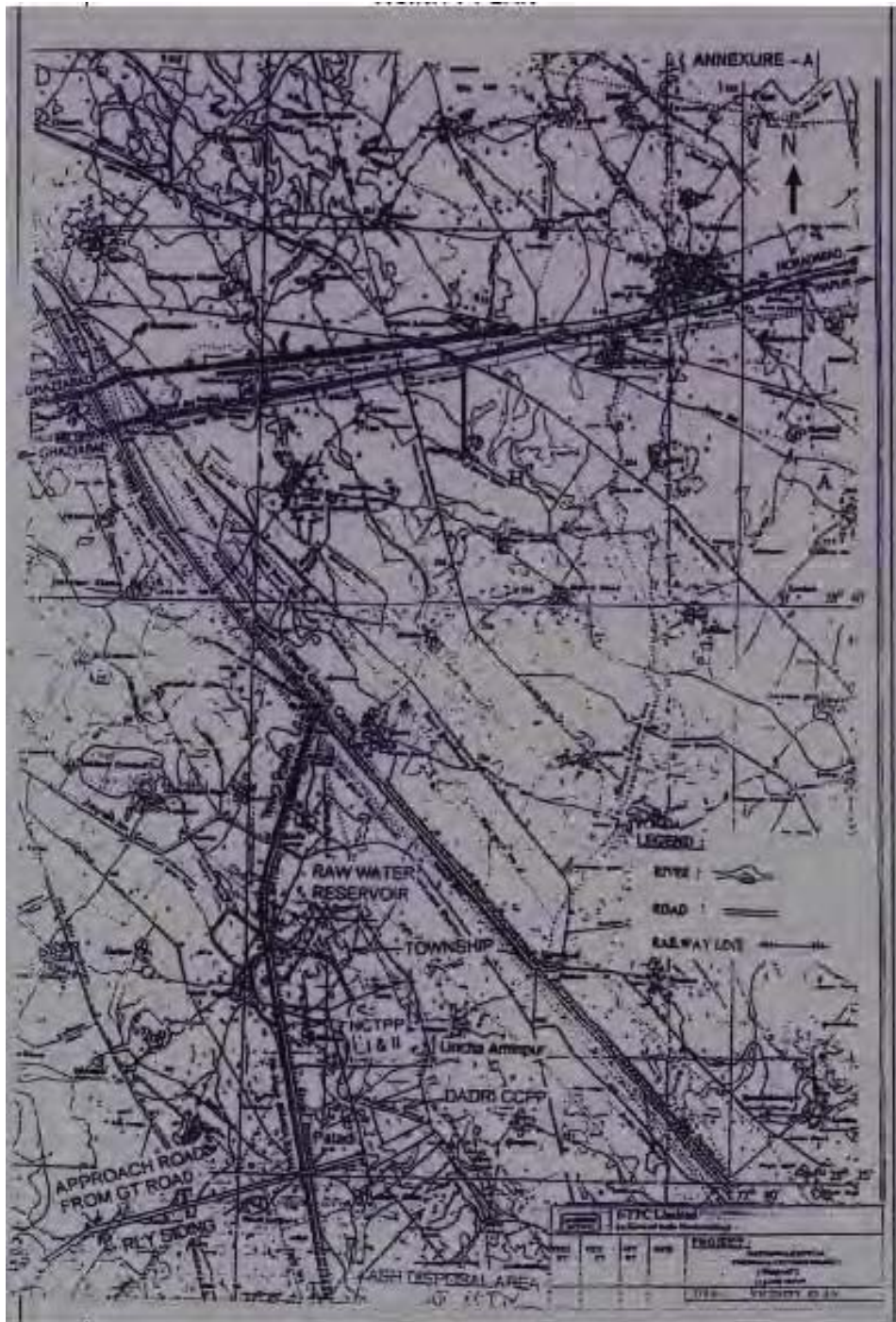
CLAUSE NO.	PROJECT INFORMATION 			
7.02.02	is deeper than the existing foundations, proper protection shall be provided to existing foundations. g) All foundations shall be designed in accordance with relevant parts of the latest revisions of Indian Standards. h) The water table for design purpose shall be considered at Finished Ground Level. i) A combination of open and pile foundations shall not be permitted under the same equipment / structure / building. j) Foundation for equipment on ground floor For equipment of static weight upto 1.5 T, the equipment may be supported on the ground floor slab by locally thickening the slab. Thickening of the ground floor slab shall be done upto an extent of about 0.6 m beyond the plan area of the equipment on all the sides. Further, the load intensity below the equipment shall be limited to 4T/m². Other requirements of floor slab and compaction below the floor slab shall be adhered, as specified elsewhere in the specifications. For equipment of static weight more than 1.5 T, the equipment foundation shall be taken to the founding level or shall be built up with PCC from the level as mentioned in the Table 1. The pedestal of equipment foundation or the foundation Block shall be isolated from the adjoining floor slab by providing bitumen impregnated fiber board of minimum 50 mm thick, conforming to IS: 1838 all around the equipment pedestal for the full depth of the floor slab.			
	Open Foundations In case open foundations are adopted, following shall be adhered to. a) The minimum width of foundation shall be 1.0 m. b) Minimum depth of foundation shall be 1.0m below Ground Level. c) It shall be ensured that all foundations of a particular structure/ buildings/ facility shall rest on one bearing stratum. d) Wherever the intended bearing sub-strata is virgin soil stratum but the actual stratum encountered during foundation excavation consists of filled up soil at founding level, under such cases either the foundation shall be lowered completely into the virgin stratum or the filled up soil upto the virgin layers shall be removed and built up through PCC (1:4:8) up to designed foundation level.			
7.02.03	Pile Foundations –			
NCTPP,DADRI ST-II (2X490 MW) & IGSTPP,JHAJJAR(3X500MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO CS-6130/0330-109-9		SUB-SECTION-IIB PROJECT INFORMATION PAGE 11 OF 32

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	(a.) In case piles are adopted, following shall be adhered to : i) The pile foundation shall be of RCC, Cast-in-situ bored piles as per IS:2911. Pile boring shall be done using Rotary Hydraulic Rigs/conventional tripod rig. Two stage flushing of pile bore shall be ensured by airlift technique duly approved by the Employer. If required, temporary or permanent MS liner may be provided for piling. ii) The minimum diameter of pile shall be 600 mm. The allowable load capacity of the pile in different modes (vertical compression, lateral and pullout) shall be as per approved geotechnical report & as enclosed in relevant annexure: iii) Only straight shaft piles shall be used. Minimum cast length of pile above cutoff level shall be 1.0 m. iv) The contractor shall furnish design of piles (in terms of rated capacity, length, diameter, termination criteria to locate the founding level for construction of pile in terms of measurable parameter, reinforcement for job as well as test piles, pile load test arrangement, locations of initial test piles etc.) for Engineer's approval. v) The piling work shall be carried out in accordance with IS:2911 (Relevant part) and accepted construction methodology. The construction methodology shall be submitted by the Contractor for Engineer's approval. vi) Number of initial load tests to be performed for each diameter and rated capacity of pile shall be subject to minimum as under. Vertical Lateral Minimum of 2 Nos. in each mode. Uplift vii) The initial pile load test shall be conducted with test load upto three times the estimated pile capacity. In case of vertical compression test (initial test) the method of loading shall be cyclic as per IS:2911 (relevant part). viii) Load test shall be conducted at pile Cut-off Level (COL). If the water table is above the COL the test pit shall be kept dry throughout the test period by suitable de-watering methods. Alternatively the vertical load test may be conducted at a level higher than COL. In such a case, an annular space shall be created to remove the effect of skin friction above COL by providing an outer casing of suitable diameter larger than the pile diameter.			
NCTPP,DADRI ST-II (2X490 MW) & IGSTPP,JHAJJAR(3X500MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO CS-6130/0330-109-9	SUB-SECTION-IIB PROJECT INFORMATION	PAGE 12 OF 32

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	ix) Number of routine pile load tests to be performed for each diameter/allowable capacity of pile shall be as under : i) Vertical : 0.5% of the total number of piles provided. ii) Lateral : 0.5% of the total number of piles provided. x) The routine tests on piles shall be conducted upto test load of one and half times the allowable pile capacity. Piles for routine load tests shall be approved by the Employer. xi) In case, routine pile load test shows that the pile has not achieved the desired capacity or pile(s) have been rejected due to any other reason, then the Contractor shall install additional pile(s) as required and the pile cap design shall accordingly be reviewed and modified, if required. xii) Testing of piles and interpretation of pile load test results shall be carried out as per IS:2911 (Part-4). Contractor shall ensure that all the measuring equipment and instruments are properly calibrated at a reputed laboratory / institute prior to their use. Settlement / movement of the pile top shall be made by Linear Variable Differential Transducers (LVDT) having a least count of 0.01mm. xiii) The test load on initial test piles shall be applied by means of reaction from anchor piles / rock anchors alone or combination of anchor piles / rock anchors and kentledge with concrete blocks.			
NCTPP,DADRI ST-II (2X490 MW) & IGSTPP,JHAJJAR(3X500MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO CS-6130/0330-109-9	SUB-SECTION-IIB PROJECT INFORMATION	PAGE 13 OF 32	

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	xiv) Low Strain Pile Integrity test shall be conducted on all test piles and job piles. This test shall be used to identify the routine load test and not intended to replace the use of static load test. This test is limited to assess the imperfection of the pile shaft and shall be undertaken by an independent specialist agency to be approved by Engineering department of Owner. The test equipment shall be of TNO or PDI make or equivalent. The process shall confirm to ASTM. xv) Either of Static routine load test or High Strain Dynamic Load Test may be carried out for routine load testing of working piles. However, at least two numbers of static routine vertical load tests shall be carried out on pile on which high strain dynamic load test has already been carried out for establishing the correlation between the two tests. In case of discrepancy if any between dynamic and static vertical load tests, then additional static routine vertical load tests shall be conducted as decided by the Engineer and the results of static routine vertical load shall prevail. Number of routine vertical pile load tests as per clause 7.02.03 (ix) shall be total of static routine vertical load test and high strain dynamic load tests. The procedure to carry out the test shall be submitted to the Engineer. The test and equipment shall conform to ASTM D4945-00. The test shall be conducted by an experienced independent test agency approved by the owner. Field data shall be submitted to the site engineer and shall include force velocity curves, pile capacity, simulated static load test curve, net and total pile displacement, pile integrity. A (Case pile wave analysis) CAPWAP or equivalent software analysis shall be conducted on the field data for correct capacity estimation and to evaluate end bearing and skin friction components of the pile. xvi) From load considerations, single pile may be used under a column/tower. In that case, pile shall be connected with tie beams at pile cut off level in both directions. xvii) Contribution of frictional resistance of filled up soil if any, shall not be considered for computation of frictional resistance of piles. xviii) Reinforcement for job piles shall be designed as following: (a) Compression + bending piles: For these piles, the allowable safe pile capacities in compression and bending shall be considered. (b) Tension + bending piles: For these piles, the actual pile forces to be considered. However, maximum 3 types of combinations for varying percentage of tension capacity + bending case may be designed & adopted by contractor for the entire scope of work under this package.			
NCTPP,DADRI ST-II (2X490 MW) & IGSTPP,JHAJJAR(3X500MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO CS-6130/0330-109-9	SUB-SECTION-IIB PROJECT INFORMATION	PAGE 14 OF 32

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7.03.00	Special Requirements			
7.03.01	Details of treatment for foundations / underground structures required to counteract soil / water chemical environment shall be as per detailed geotechnical investigation to be carried out by contractor. Contractor shall carry out chemical analysis during detailed geotechnical investigation and required treatment shall be provided accordingly.			
7.04.00	Excavation, Filling and Dewatering			
7.04.01	For excavation works, comprehensive dewatering with well point or deep wells arrangement, if required, shall be adopted. Scheme for dewatering and design with all computations and back up data for dewatering shall be submitted for the owner's information. The water table shall be maintained at 0.5m below the founding depth.			
7.04.02	Excavation for shallow foundations shall be covered with PCC immediately after reaching the founding level. In case of any local loosening of soil or any loose pockets are encountered at founding level during excavation the same shall be removed and compensated by PCC M7.5. The final layer of about 300 mm thickness above the founding level shall be excavated by suitable means, so as to avoid disturbance to founding stratum.			
7.04.03	Backfilling around foundations, pipes, trenches, sumps, pits, plinths, etc. shall be carried out with approved material in layers not exceeding 300 mm compacted thickness (higher thickness of layers upto 500mm with heavy mechanical compacting equipment) and each layer shall be compacted to 90% of standard proctor density for cohesive soils and to 80% of relative density for non-cohesive soils			
	Rock pieces having size less than 150 mm and interstices filled with soil may be used for backfilling around foundation, plinths etc. and shall be compacted to minimum of 85% of original stack of material after filling the interstices.			
7.04.04	Founding level for trenches/channels shall be decided as per functional requirement. The bottom of excavation shall be properly compacted prior to casting of bottom slab of trenches / channels.			
7.04.05	CBR tests for pavement/road design shall be carried out by the Contractor after earth filling (if applicable) has been completed upto the formation level.			
7.04.06	The contractor shall take all necessary measures during excavation to prevent the hazards of falling or sliding of material or article from any bank or side of such excavation which is more than one and a half meter above the footing by providing adequate piling, shoring, bracing etc. against such bank or sides. Adequate and suitable warning signs shall be put up at conspicuous places at the excavation work to prevent any persons or vehicles falling into the excavation trench. No worker should be allowed to work where he may be stuck or endangered by excavation machinery or collapse of excavations or trenches.			
NCTPP,DADRI ST-II (2X490 MW) & IGSTPP,JHAJJAR(3X500MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO CS-6130/0330-109-9	SUB-SECTION-IIB PROJECT INFORMATION	PAGE 15 OF 32

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	ANNEXURE-I			
	VICINITY MAP			
				
NCTPP,DADRI ST-II (2X490 MW) & IGSTPP,JHAJJAR(3X500MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO CS-6130/0330-109-9	SUB-SECTION-IIB PROJECT INFORMATION	PAGE 31 OF 32	

METROLOGICAL DATA

[illegible]

**NCTPP,DADRI ST-II (2X490 MW) &
IGSTPP,JHAJJAR(3X500MW)
FLUE GAS DESULPHURISATION (FGD)
SYSTEM PACKAGE**

TECHNICAL SPECIFICATION
SECTION – VI, PART-A
BID DOC. NO CS-6130/0330-109-9

SUB-SECTION-IIB	
PROJECT INFORMATION	
1.	PROJECT TITLE
2.	PROJECT NUMBER
3.	PROJECT LOCATION
4.	PROJECT DESCRIPTION
5.	PROJECT STATUS
6.	PROJECT START DATE
7.	PROJECT END DATE
8.	PROJECT BUDGET
9.	PROJECT FUNDING SOURCE
10.	PROJECT CONTACT PERSON
11.	PROJECT CONTACT PHONE
12.	PROJECT CONTACT EMAIL
13.	PROJECT WEBSITE
14.	PROJECT DOCUMENTS
15.	PROJECT NOTES

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	2 X 490 MW NCTPPP, DADRI, STAGE-II COMPRESSED AIR SYSTEM	SPECIFICATION No: PE-TS-436-555-A001	
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SECTION: C TECHNICAL SPECIFICATIONS

	2 X 490 MW NCTPPP, DADRI, STAGE-II COMPRESSED AIR SYSTEM	SPECIFICATION No: PE-TS-436-555-A001	
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SECTION: C1

SPECIFIC TECHNICAL REQUIREMENT

	2 X 490 MW NCTPPP, DADRI, STAGE-II COMPRESSED AIR SYSTEM	SPECIFICATION No: PE-TS-436-555-A001	
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		SECTION : C1A	
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VOLUME - II B

SECTION: C1A
SCOPE OF SUPPLY, TERMINAL POINTS
AND EXCLUSIONS

	2 X 490 MW NCTPPP, DADRI, STAGE-II COMPRESSED AIR SYSTEM	SPECIFICATION No: PE-TS-436-555-A001	
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1. SCOPE OF SUPPLY AND SERVICES:

The scope of work under this specification shall be as below.

Items not specifically mentioned but deemed necessary by the Tenderer for making the system completely reliable and efficient shall also be considered as if included.

- 1.1.1 The specification covers Supply part, Services part including AMC (Annual Maintenance Contract) for Three (3) years after successful handover of Compressed Air System to end customer and O&M Spares comprising of design (i.e. preparation and submission of drawing /documents including "As Built" drawings and O&M manuals), engineering, manufacture, fabrication, assembly, inspection / testing at vendor's & sub-vendor's works, painting, maintenance tools & tackles (as applicable), fill of lubricants & consumables, O&M Spares along with spares for erection, start up and commissioning as required, forwarding, proper packing, shipment and delivery at site, unloading, handling, transportation & storage at site, in-site transportation, assembly, erection & commissioning, final painting at site, minor civil work, trial run at site, AMC for three years after handover of CAS to end customer preparation of layout drawings and carrying out Performance guarantee tests at site, training of customer/client and O&M staff and handover in flawless condition of the package to the end customer complete with all accessories for the total scope defined as per BHEL NIT & tender technical specification, amendment & agreements till placement of order for 2X 490 MW NCTPPP, DADRI, STAGE-II.
- 1.1.2 Two (2) Nos. Air Compressors (Oil Free Screw type) each of minimum 15 NM3/Min capacity at 8.5 Kg/cm² (g) discharge pressure, suction filter with silencer, inter cooler and after cooler with moisture separators, automatic drain traps, instruments, control system and other accessories.
- 1.1.3 Two (2) Nos. Air Drying Plants Heat of HOC - Rotary / Twin tower type of min. 15 NM3/min. capacity with all instruments, control panels and other accessories as specified.
- 1.1.4 Two (2) nos air receivers of 02 cu.m capacity located near the compressor house building.
- 1.1.5 Two (2) No. online Electronic Dew point meters.
- 1.1.6 Pipes & fittings for compressed air line, cooling water & drain line including hanger/supports, auxiliary structural members etc. inclusive of all fittings, valves, Counter flanges, bolts, nuts, gaskets etc. at all piping terminals, base plates, support plates, anchor bolts, nuts, sleeves, inserts, lifting lugs, eye bolts etc and other accessories as required - 1 Lot .
- 1.1.7 All airline valves, cooling water valves, drain valves etc.– 1 Lot.
- 1.1.8 Hoses required for O&M purpose for the compressor and air dryer – 1 Lot.
- ~~1.1.9 Additional Loose Supply – 6 nos. Ball Valves of 50 NB and 10 nos. Auto Drain Traps and strainer (end connections 25 NB) (for details of Auto Drain Trap refer attached data sheet for reference).~~
- 1.1.10 Necessary instruments for control and interlocks, instruments indicated in the P&I Diagram for the compressed air system to be considered as a minimum. Any additional instrument / valves required for successful operation of the system, to the discretion of BHEL, shall be provided to BHEL by successful bidder without any price implication.

	2 X 490 MW NCTPPP, DADRI, STAGE-II COMPRESSED AIR SYSTEM	SPECIFICATION No: PE-TS-436-555-A001	
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- 1.1.11 Instruments including all instruments necessary for performance testing of compressors as well as air drying plants & Compressed air system as a whole – 1 Lot.
- 1.1.12 Maintenance tools and tackles, start up and commissioning spares, consumables, first fill of lubricants inclusive of packing – 1 Lot
- 1.1.13 O&M Spares as specified in different section of specification inclusive of proper packing for long duration storage purpose – 1 Lot
- 1.1.14 Any other item not indicated above, but required to complete Compressed Air package as per system requirements.
- 1.1.15 Bidder to ensure availability of spares for all the supplied equipment (Air Compressor and Air dryer) at least for 15 years from the date of award of contract on successful bidder.

2. TERMINAL POINTS :

- 2.1.1 Bidder will terminate compressed air piping for IA header and SA header downstream of air receiver as per enclosed Compressor House Layout dwg.
- 2.1.2 Cooling water supply will be provided by the purchaser outside the compressor house (5m within vicinity of Compressor house) as per enclosed Compressor House Layout dwg. The return hot water shall be terminated by the contractor at the same location.
- 2.1.3 All the drains shall be terminated to plant garland drain outside compressor house by bidder.

3. EXCLUSIONS :

- 3.1.1 MCC/Switchgear for power supply to Air Compressors and other drives and panels.
- 3.1.2 Civil works like construction of compressor house, foundation of all compressor, air dryer and air receiver, pipe/cable trenches. However, civil works such as opening in wall, grouting of equipment's & structural material and inserts plates for pipes supports etc. are in the bidder's scope of supply.
- 3.1.3 Lighting and ventilation of compressor house.
- 3.1.4 Monorail hoists/Cranes as necessary for handling of equipment after erection.

4. SUB-VENDOR ITEMS

The make of Sub-vendor items shall be generally as per enclosed sub vendor list, which is subject to customer approval during detail engineering.

5. DRAWINGS AND DOCUMENTS TO BE SUBMITTED WITH THE BID

The drawings and documents to be submitted with the bid shall strictly be as mentioned under Volume III (section-1). Any documents other than those indicated in Volume III (section-1) will not be reviewed and will not form part of contract.

6. DRAWINGS/ DOCUMENTS REQUIRED DURING DETAIL ENGINEERING

	2 X 490 MW NCTPPP, DADRI, STAGE-II COMPRESSED AIR SYSTEM	SPECIFICATION No: PE-TS-436-555-A001	
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Tentative list of drawing / document required during detail engineering is attached in Volume-II (Annexure-VIII). Any other drawings and documents as required by BHEL / Customer / Consultant shall be furnished by the successful bidder during detail engineering stage for which no commercial implication shall be entertained by BHEL.

7. DRAWINGS DISTRIBUTION SCHEDULE

Vendor needs to submit drawing/document during detail engineering along with editable soft copy of the same. However, exact no. of drawings / documents and submission/distribution procedure for the same shall be intimated to the successful bidder after award of contract and the same shall be complied by the successful bidder without any commercial implication.

8. DRAWINGS ENCLOSED WITH THE SPECIFICATION

Following drawings enclosed will form part of the specification.

- 1) P&I Diagram for compressed air system with air drier (Pl. refer section 8, Vol.-III).
- 2) Compressor House layout (Pl. refer section 8, Vol.-III).
- 3) Plant Layout of FGD System (Pl. refer section 8, Vol.-III)

The P&I diagrams are indicative and show the minimum requirement to be followed including minimum requirement of instruments. Any other item and instruments required (within the terminal points) to make the system complete in all respect and for satisfactory operation of the system shall also deemed to have been included by the bidder in their scope. The detailed P&I diagrams for compressed air system in line with specification requirement shall be developed by the vendor during detail engineering for customer's approval and without any commercial implication to customer. Bidder to note that the while preparing PIDs after placement of order, successful bidder shall incorporate line numbers Instrument tag nos., KKS Numbering, equipment no, Line Spec, Line MOCs, legend / symbol chart, equipment capacity, relief valve capacity and set pressure, control valve capacity, range, fail position etc. in these drawing and same are subject to the customer approval.

9. OTHER REQUIREMENTS

Detailed erection manual for each of the equipment as well as complete system supplied under this contract at least 2 months before the scheduled erection of the concerned equipment / component or along with supply of concerned equipment / component whichever is earlier.

The O&M Manual to be submitted by the successful bidder will necessarily address the following:

- a. Complete System Description along with PIDs, write up on electrical philosophy and safety/process interlocks etc.
- b. Instructions for plant operation
- c. Commissioning procedure of the system
- d. Chapter on precautions to be taken during:
 - Operation
 - Idle time
 - Long shutdown
- e. Chapter on trouble shooting during plant operation covering:

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- Safely aspects
- Do's and do not's
- Maintenance schedule
- Schedule of lubricants & consumables

f. O & M instruction for all individual equipment which shall invariably contain but not necessarily limited to the following:

- Equipment description/interdiction
- Data sheet, Equipment GA & Cross Section Drawing
- Catalogue of each equipment
- DO's & DON'T's
- Duty Conditions
- Installation & Safety Recommendation
- Start-up & shut down procedure
- Instructions for testing and adjustment of system parameters
- Disassembly & Assembly Instructions giving sequence no. of each component
- List of Replacement/ Spare parts along with their drawing and catalogues and procedure for ordering spares.
- Reason & Remedy Chart for any problem
- Maintenance Schedules- Daily, Weekly, Monthly, Half Yearly and Annual indicating clearly the spares part and man-hour requirement for each stage.
- Detailed specification/ Schedule of all the consumables including lubricant oils, greases, chemicals etc. required for the complete system
- Commission procedure for equipment.

Document approval by customer under Approval category or information category shall not absolve the vendor of their contractual obligations of completing the work as per specification requirement. Any deviation from specified requirement shall be reported by the vendor in writing and require written approval. Unless any change in specified requirement has been brought out by the vendor during detail engineering in writing while submitting the document to customer for approval, approved document (with implicit deviation) will not be cited as a reason for not following the specification requirement.

In case vendor submits revised drawing/doc after approval of the corresponding drawing/doc, any delay in approval of revised drawing shall be to vendor's account and shall not be used as a reason for extension in contract completion. However, in case changes are necessitated due to any constraints at customer end, delay in review/ approval of such revised drawing beyond one month will be to customer's account.

Bidder to note that during detail engineering, will submit the drg/doc through web based Document Management System in addition to hard copies to be submitted as per dwg/ document distribution schedule. Bidder would be provided access to the DMS for drg/doc approval and adequate training for the same. Detailed methodology would be finalized during the kick-off meeting. Bidder to ensure following at their end

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- Internet explorer version – Minimum Internet Explorer 7
- Internet speed – 2 mbps (Minimum preferred)
- Pop ups from our external DMS IP (124.124.36.198) should not be blocked
- Vendor's Internal proxy setting should not block DMS application's link (<http://124.124.36.198/wrenchwebaccess/login.aspx>)”

DMS user manuals to be used by BHEL PEM vendors for uploading, viewing, revising, commenting and tracking documents on PEM's DMS have been uploaded on PEM internet website (www.bhelpem.com) under the Vendor session.

For quick access bidder may refer the link <http://bhelpem.com/DMSManuals/DMSManuals.html>

Final Electrical Load list will be submitted by the successful bidder as per agreed drawing/ doc submission schedule and along with the bid. Thereafter any change in the electrical load list shall be entertained only subject to its feasibility, and BHEL reserves the right to debit the vendor cost of any changes necessitated in the switch gear /MCC on account of changed loads.

Wherever CIVIL works is excluded from the bidder's scope, successful bidder shall furnish civil assignment drawings. The corresponding CIVIL drawing prepared by BHEL / CIVIL agency, based on civil assignment drawing of bidder will be furnished to the successful bidder for concurrence. In case any modification is required in the civil work already carried out based on final civil inputs given by vendor, BHEL reserves the right to debit cost of such rework to vendor”.

If any deviation is there then same to be indicated separately under the heading “Schedule of Technical Deviation” enclosed as per Volume III (SECTION 4) of the Technical Specification along with Cost of Withdrawal and the same shall be made part of the price-bid to be submitted by the bidder. In case nothing is mentioned under the column Cost of withdrawal then during bid evaluation no price implication will be admissible for withdrawal of deviations. Bidders shall also note that the deviation in any other form except above is not acceptable (i.e. in data sheet or other Annexure or elsewhere in the offer) and same shall not be considered for review/evaluation purpose/comments and it would be assumed that the system/material/equipment has been offered strictly in line with specifications/requirements.

10. Bidder to note the following information :

- 10.1.1 Bidders to indicate offered model in their offer and to submit backup document (e.g. performance test, etc.) matching FAD calculation along with the catalogue of the offered model to justify selection.
- 10.1.2 Bidder to confirm that there is no deviation from the technical specification and furnish signed Compliance cum Confirmation Certificate enclosed under Volume-III of the Technical Specification.
- 10.1.3 Bidder to submit minimum 10 set of hard prints of drawing & docs. for approval. Also, 10 set of approved documents & O&M Manual to be submitted along with 5 CD's after completion of engg.

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11. ADDITIONAL POINTS TO BE NOTED BY BIDDER

- 11.1.1 Compressed Air system shall be offered as turnkey basis meeting specification requirements.
- 11.1.2 Basis of design, all calculations, equipment selection criterion, layout drawings/schemes/G.A. drg. and documents like data sheet/Technical particulars etc. are subject to Customer & BHEL approval during detail engineering stage.
- 11.1.3 All drawings and documents shall be computer based.
- 11.1.4 All commissioning spares & consumables for trouble free operation shall be provided, with minimum to what specified elsewhere in the specification.
- 11.1.5 Bidder to clearly note that the instruments, valves etc. as shown in the P&I Diagram is the bare minimum and any additional instruments/valves required to complete the system in terms of safety, trouble free operation of equipment's & system as a whole and isolation of individual equipment for maintenance, then same shall be supplied by the bidder without any commercial implication to BHEL.
- 11.1.6 Grouting of equipment's, like Air receiver, Air dryer & foundation bolts etc. are in the scope of the bidder.
- 11.1.7 Performance test for compressors shall be carried out at shops with job motor only.
- 11.1.8 All the instruments as required for performance testing shall be arranged by bidder. Instrument for testing shall be calibrated from government certified labs & this is in the bidder scope. Bidder to ensure validity of such reports before the performance tests.
- 11.1.9 Compressor and air dryer shall be designed for cooling water (passivated DM water) with inlet temp of thermal 38 deg C (max.) & mechanical 60 deg C with terminal pressure 7.0kg/sqcm (g) and the max temp of hot water from compressor shall be 6 deg. C higher cooling water inlet temp. Further the temperature of the air at the outlet of after cooler shall be limited to 7 deg.C above cooling water inlet temperature i.e. outlet air temperature from air dryer in any case shall not be more than 45 deg. C. The Compressors and dryers coolers shall be designed to withstand 10 kg/cm2 i.e., shutoff head of BHEL DM cooling water pumps. The pressure drop across the individual equipment's within the compressor shall be maintained at 6 to 8 MWC. However, the pressure drop across the complete cooling water circuit shall be 10 MWC. Successful bidder shall furnish break-up of pressure drop for individual components and compressors as a whole in the datasheet to be submitted for approval at the time of detail engineering.
- 11.1.10 Access platform required for the maintenance of instruments/valves on the towers of HOC type air drier, air receiver shall be in bidder's scope of supply.
- 11.1.11 Only KKS tagging shall be used in all document/drawings and in the field for all items/equipment/signals etc. No other tagging method is acceptable. The successful bidder shall provide detailed drawing with KKS only. Operational write up of the system should strictly contain KKS code for identification and description.

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SPECIFIC TECHNICAL REQUIREMENT



2 X 490 MW NCTPPP, DADRI, STAGE-II

COMPRESSED AIR SYSTEM

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A. GENERAL DESCRIPTION

The compressed air system is comprised of the common instrument air system and the service air system. Instrument air is required for the various pneumatically operated valves and instruments in the power plant, while service air is required for general plant services.

B. CODES AND STANDARDS

The equipment to be provided under this section shall specifically conform to the following codes, standards, specifications and regulations as applicable, including all its latest amendments subsequent to the year of publication as mentioned below:

Sl. No.	Code	Description
1	IS-2825/1969	Code for unfired pressure vessels
2	IS-4503/1967	Shell and Tube Type Heat Exchanger
3	IS-5456/1985	Code of Practice for testing of positive displacement type air compressors and exhausters
4	IS-5727/1981	Glossary of terms relating to compressors and exhausters
5	IS-1239 part-1/1990	Mild Steel tubes, tubulars and other wrought steel pipes
6	IS-1239 Part-2/1992	Mild steel tubes, tubular and other wrought steel fittings
7	IS-6206/1985	Guide for selection, installation and maintenance of air compressors/plants with operating pressure up to 10 bars
8	ANSI-B16.5(1988)	Steel Pipes Flanges and Fittings
9	IS-7938/1976	Air Receivers for Compressed Air Installations
10	IS-10431 Part-1/1983	Measurement of Air Flow of Compressor and Exhausters by nozzles
11	ASME PTC-9	Performance Test Codes for Displacement compressors, Vacuum Pumps and Blowers
12	ISO-7183 (part2)	Compressed Air Dryers - Specification and Testing, Compressed Air Dryers Performance rating.
13.	ISO-1217	Methods for acceptance tests regarding volume rate of flow and power requirements of displacement compressors.

In case of any contradiction with the aforesaid standards and the stipulations as per this Section and Attachments/Annexures of this section, the stipulations of this Section and its Annexures shall prevail.

C. SCOPE OF SUPPLY

Compressed air system includes the following:

- 2.1 Two (2) nos. (1 working + 1 standby) **multi stage oil free screw type, water cooled** air compressors shall be provided for the FGD Compressed air System requirement.
- 2.2 Two (2) nos. (1 working + 1 standby) Heat of Compression type (Twin tower type / Rotary drum type) Air Drying Plant (ADP) each suitable for connecting to individual instrument air compressor.
- 2.3 Air Receivers shall be provided as follows:

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- Two (2) nos air receiver (one each for each compressor) of 10 cu.m capacity located near the compressor house building.

2.4 All interconnecting piping including compressed air piping, cooling water piing & drain pipes, valves, fittings, supports etc. for safe and satisfactory operation of air compressors. (Refer Annexure-II).

2.5 All instruments including the electronic online dew point meter with suitable sampling connection. (Refer Annexure-II).

2.6 Compressor mounted local control panel.

D. EQUIPMENT DESIGN & TESTING CRITERIA

3.1 Air Compressor

a) The capacity of air compressor shall be **15 NM3/min** with discharge pressure of **8.5 kg/cm2 (g)**. Delivery pressure at the outlet of ADP will be 8.0 Kg/cm2 (g). Each compressor will be designed to deliver the nominal capacity at the required delivery pressure. (Refer Annexure-I).

b) The compressors and Air Drying plants shall operate under the following ambient conditions.

- i. Minimum temperature: 10 deg.C
- ii. Maximum temperature: 50 deg. C
- iii. Design condition (temperature: 45 deg. C & 75% RH Relative humidity)
- iv. Height above MSL (m): Refer Chapter "Project Information"

c) Testing of compressor will be as per ISO: 1217.

d) Air compressors will be designed for continuous operation with high efficiency to satisfy the performance requirement.

e) Satisfactory operation in parallel will be ensured without any uneven load sharing, undue vibration, noise etc.

f) Compressor noise level shall not exceed 90 dBA to a reference of 0.0002 microbar when measured at a distance of 1.5 metre above the floor.

h) The continuous motor rating (at 50 deg.C ambient) will be at least fifteen percent (15%) above the maximum load demand of the driven equipment under the entire operating range.

i) The compressors shall operate at 100% capacity with load / unload feature.

For details refer customer specification.

3.2 AIR DRYING PLANT

Air-drying plant shall be of heat of compression desiccant type (Twin tower type or rotary drum type), drying by adsorption process through a desiccant medium.

The capacity of air drying plant for instrument air compressor shall be of matching capacity to that with instrument air compressor.

Quality of outlet air from ADP shall be in accordance to ISO 8573, Class-3.

- i. Dew point at outlet of the air drying plant will be minus (-) 40^o C at atmospheric pressure.
- ii. Dust particle size in instrument air will be less than five (5) micron.
- iii. Oil content of Instrument air will be less than 0.1 mg/m3 at 20 degree C with absolute air pressure of 1 bar.

Desiccant shall be silica gel / activated alumina as per manufacturer's standard.

Hot air piping from compressor to air dryer shall be insulated.

For details refer customer specification.

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3.3 AIR RECEIVER

- a) The quantity and capacity of air receivers shall be as specified in clause no. 2.3 above.
- b) The air receivers will be vertical self-supporting cylindrical vessels with supporting legs for resting on their foundation.
- c) Operation & maintenance platform for each air receiver along with access ladders shall also be provided.
- d) A corrosion allowance of 3 mm shall be provided.
- e) The air receiver shall be hydraulically tested to a pressure of 1.5 times the design pressure.
For additional details refer customer specification.

E. LAYOUT CONSIDERATIONS

- 5.1 A separate Compressed Air System building, housing compressors with drives, air drying units, headers, piping, supports, valves etc. has been envisaged.
- 5.2 The air receivers will be located outdoors adjacent to the compressor room.

F. POWER SUPPLY ARRANGEMENT

Pl. refer electrical specification for details.

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1 GENERAL

- 1.1 The air traps and strainer shall meet the technical requirements and conform to the requirements as specified and Data sheet-A.

2 SCOPE OF SUPPLY

The air traps along with strainer shall be supplied as per Data sheet A of Section C1-B. For detail refer the same.

3 DESIGN REQUIREMENTS

All traps shall be suitable for removal of water from compressed air piping and shall be suitable for the service conditions i.e. flow, temperature and pressure under which they are required to operate. Those performing similar duties shall be interchangeable with each other unless otherwise specified.

4 CONSTRUCTION FEATURES:

- 4.1 The traps covered in the specification shall be of Ball Float Type with auto-drain arrangement conforming to supplier's own proven design and shall be with External Y-type Strainer designed suitably to prevent the internals of the trap from damage due to dirt etc.
- 4.2 The traps should be with internals easily accessible and replaceable.
- 4.3 Arrow showing inlet should be cast on the body of traps.
- 4.4 For ball float type traps, trap design should take care of removal of entrapped air for proper functioning of trap. The same can be done by providing a balancing line connection at the top of the body.
- 4.5 A metallic (stainless steel plate 2mm thick) nameplate shall be fitted on each trap. Nameplate inscription required for each trap shall be indicated at the contract stage. Inscriptions shall be engraved 1 mm deep filled with enamel paint.

5 MATERIALS

- 5.1 The materials of construction of main parts of traps shall be specified in Data sheet-A.
- 5.2 The materials of construction of the remaining parts shall be suitable for the service conditions shall be subject to approval of the purchaser.
- 5.3 Materials used in manufacture of traps shall be of tested quality.

6 TESTING AND INSPECTION

- 6.1 The items covered under this contract shall be subjected to inspection, testing and quality surveillance. The Inspection Agency shall, at all reasonable times have access to Vendor's

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works, Quality Control records and all facilities as reasonably required for carrying out the inspection and testing efficiently, and these shall be provided by the vendor free of cost.

- 6.2 The minimum NDT/testing and inspection requirements for traps shall be as per the attached Quality Plan. However, in case of order, final inspection and testing shall be carried out as per the final approved quality plan without any price implications.

~~7 EXCLUSIONS~~

~~Erection & Commissioning of equipment at site is excluded from the bidder's scope.~~

8 QUALITY ASSURANCE

- 8.1 The Quality Plan enclosed with this specification specify minimum quality control requirement. During contract stage vendor shall furnish this Quality Plan duly signed & stamped for BHEL approval. Quality plans shall be approved by BHEL and customer. All inspection and testing shall be carried out by BHEL/ BHEL representative and customer (as applicable). In case inspection is by both BHEL and their customer, then the inspection can be carried out jointly or separately, which will be informed later. In case of the foreign bidder, inspection shall be carried out by reputed third party.
- 8.2 There may be changes in quality plan depending on customer/consultant comments which will have to be accommodated by vendor at no extra cost.
- 8.3 The minimum NDT/testing and inspection requirements for air traps and strainer shall be as per the attached Quality Plan. However, in case of order, final inspection and testing shall be carried out as per the final approved quality plan without any price implications.

9 SURFACE PREPARATION AND GALVANIZING

- 9.1 The surfaces of equipment to be galvanised shall be thoroughly cleaned of all grease, oil, loose mill scale, dirt, rust and any other foreign materials as mentioned in IS:2629.
- 9.2 Traps & Strainers of Carbon steel material bodies shall be hot dip galvanised as per IS:2629 after the necessary testing has been carried out. The minimum thickness of galvanizing shall be minimum 40 microns.

10 PACKING INSTRUCTION

- Each trap shall be drained, cleaned, prepared and suitably protected in such a way so as to minimize the possibility of damage and deterioration during transit and storage.
- The trap shall be dispatched in total assembled form.
- Body ends shall be suitably sealed to protect them against damage during transit and storage.
- Trap Tag Nos. shall be incorporated in all the dispatch documents.
- Proper care shall be taken to avoid damage to the finished surface during transit.
- All the air traps shall be packed suitably in wooden cases in order to avoid damage during transit and also during storage at site in tropical climate conditions for a period of 15-18 months.

11 DOCUMENTS TO BE SUBMITTED AFTER AWARD OF CONTRACT:

13.1 TDS & QAP of Trap and Strainer

	DATA SHEET-A AIR TRAPS	SPECIFICATION NO. PE-TS-436-555-A001	
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MATERIAL OF CONSTRUCTION FOR CARBON STEEL TRAPS/ STRAINER

			PART NAME	MATERIAL REQUIRED
A	BALL FLOAT AIR TRAP (WITHOUT STRAINER) COMPLETE ASSLY.	1	Body and Cover	Cast Carbon Steel as per ASTM A216 Gr. WCB (HDG)
		2	Valve, Valve seat	AISI 420 (hardened to minimum 40 RC). Differential hardness shall be maintained between seats.
		3	Float unit assembly, Valve seat gasket, Pivot frame, Support frame and Pivot pin	AISI 304
		4	Bolts/ Nuts	ASTM A193 Gr.B7/ ASTM A194 Gr.2H
B	EXTERNAL 'Y' TYPE STRAINER COMPLETE ASSLY.	1	Body & Cap	ASTM A216 Gr. WCB (HDG)
		2	Screen	SS to AISI 304 - 20 mesh
		3	Gasket	Non - Asbestos type

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CUSTOMER SPECIFICATIONS



250 MW ROURKELA POWER PROJECT
COMPRESSED AIR SYSTEM

SPECIFICATION No: **PE-TS-427-555-A001**

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SECTION: C2-A
TECHNICAL REQUIREMENT

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES	एनटीपीसी NTPC		
3.00.00	COMPRESSED AIR SYSTEM a) Two (2) numbers (1 working+ 1 standby) oil free, rotary screw type air compressors for Instrument air and service air applications for FGD and ZLD plant (if provided) each of adequate capacity & adequate pressure, with their motor drives and other accessories as per equipment sizing criteria mentioned in Part A, Sub-section 'Salient design data' of technical specification. However, minimum capacity of each air compressor shall be 15Nm³/min at discharge pressure of 8.5 Kg/cm² (g). b) Two (2) numbers (1 working+ 1 standby) Air Drying Plants (one for each air compressor) of adequate capacity with all interconnecting piping, valves, fittings, etc. c) Two number Air Receiver each of capacity 2 m³ (normal) at the discharge of each Air compressor. d) One number Air Receiver of capacity 2m³(normal) for ZLD plant if ZLD plant is far away from compressor location. g) Monorail with Chain pulley block of minimum 2 tons or 125% of heaviest parts of equipment to be lifted whichever is more. h) Complete instruments, control system with panels as required for compressed air system. i) Complete compressed air and piping network for service air and instrument air application in FGD and ZLD system (if provided). Separate piping network for Service Air and Instrument Air shall be provided. j) Supply of Mandatory spares as specified. k) Any additional items required to make the system complete.			
4.00.00	General i. All associated Civil & structural work for air conditioning and Ventilation system and compressed air system. ii. Set of commissioning spares as may be required during erection and commissioning. iii. One (1) set Special tools and tackles required for maintenance of all the Mechanical, Electrical and C & I equipment under the scope of bidder. iv. All steel / cast iron inserts, plates, bolts, nuts, sleeves, metallic-fasteners etc. to be grouted in concrete work and used to hold/ support the equipment/piping / ducting being supplied and erected under this specifications. v. Any additional items required to make the system complete. vi. Initial charge of all lubricants and grease, etc. Further, all consumables required for PG tests shall also be in Bidder's scope of supply. Grouting, dressing and final finishing of all foundations of various equipment, etc.			
NCTPP, DADRI(2X490MW) IGSTPP JHAJJAR (3X500MW) FLUE GAS DESULPHURISATION (FGD)SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.: CS-6130/0330-109-9	SUB SECTION-III-A2 AIR CONDITIONING, VENTILATION SYSTEM & COMPRESSED AIR SYSTEM	Page 3 of 4

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES	एनटीपीसी NTPC		
	vii. Repairing and making good/ sealing of cutouts / openings in floors, roofs and walls, for executing the works under this system and making them water tight as directed by the engineer. Corrosion protection painting for all equipment / items by Bidder as detailed in relevant clauses of technical specification.			
NCTPP, DADRI(2X490MW) IGSTPP JHAJJAR (3X500MW) FLUE GAS DESULPHURISATION (FGD)SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.: CS-6130/0330-109-9	SUB SECTION-III-A2 AIR CONDITIONING, VENTILATION SYSTEM & COMPRESSED AIR SYSTEM	Page 4 of 4	

CLAUSE NO.	SALIENT DESIGN DATA			
8.00.00	Compressed Air System			
	DESIGN CRITERIA / BASIS AND PERFORMANCE GUARANTEE			
	1. All the equipment shall be designed for continuous duty and as well as for intermittent operation. Frequent start/stop of the system shall not result deterioration in performance nor damage to the equipment.			
	2. The compressors and Air Drying plants shall operate under the following ambient conditions.			
	i. Minimum temperature : 10 deg.C			
	ii. Maximum temperature : 50 deg. C			
	iii. Design condition (temperature & Relative humidity) : 45 deg.C& 75% RH			
	iv. Height above MSL (m) : Refer Chapter “Project Information”			
	3. The design ambient conditions for the motors shall be as mentioned in relevant Electrical sub-sections.			
8.01.00	Selection of Capacity of Air Compressor			
a)	Air Compressor			
	Air Compressor shall be designed to meet the Instrument air and service air requirement of all the equipment/plant/systems to be supplied by the Contractor for FGD Plant and ZLD plant (if applicable) as follows:-			
	Sl. No.	Continuous Requirement	Quantity (in NM³/min)	
	1.	Instrument air requirement for FGD plant (Continuous)	A	
	2.	Instrument air requirement for ZLD plant (Continuous)	B	
	3.	Service air requirement for FGD plant	C	
	4.	Service air requirement for ZLD plant	D	
	5.	Total Air requirement	= A+B+C+D	
	6.	Capacity of air compressor	= 2(A+B+C+D)	
	Notes: While calculating the air requirement of Bidder’s equipment\plant/systems, for continuous requirements of instrument air and service air, no diversity factor shall be considered and they are to be assumed to be of “Simultaneous Requirements”. The intermittent requirement of instrument air and service air, if any shall be converted into continuous requirement by considering frequency of such requirements or selecting an appropriate diversity factor and such diversity factor shall not be less than 0.4.			
NCTPP DADRI ST-II (2X490MW) & IGSTPP JHAJJAR (3X500MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-A BID DOCUMENT NO.: CS-6130/0330-109-9	SUB-SECTION-V SALIENT DESIGN DATA & SIZING	PAGE 11 OF 17

CLAUSE NO.	SALIENT DESIGN DATA	
	- The capacity of air drying plant shall be equal to the capacity of the individual air compressors. The Air drying plant, at its rated capacity, shall be designed to deliver continuously air at dew point of minus (-) 40 deg C at atmospheric pressure and the Quality of dry outlet air to conform to Instrument Society of American Standard S7.3 "Quality Standard for Instrument Air". - Discharge pressure available at the outlet of Air drying Plant shall be minimum 7.5 Kg/cm² (g) or more as per the requirement of Contractor. - The discharge pressure of compressor shall be minimum 8.5 Kg/cm²(g). - The heat exchangers are DMCW cooled and the maximum cooling water temperature at compressor coolers inlet to be considered same as that of PHE outlet cooled DMCW temperature. - The temperature rise of cooling water in the heat exchangers of the Compressed air system shall be limited to 5-10 deg C. - Noise level shall not exceed 90 dBA to a reference level of 0.0002 microbar when measured at a distance of 1.5 meter above the floor. Required acoustic enclosures may be provided to meet the above condition. The discharge blow-off silencer and intake silencers shall be designed to meet the above noise limitation level. - Parallel operation of compressors shall be possible without any undue vibration and noise. - The flow in compressed air piping shall be designed for the design capacity of each compressor and the flow in header and ring mains to be designed for the total capacity of working compressors. - All hot vessels/pipelines/ valves shall be insulated to restrict the outside temperature within 60 deg.C or less with mineral wool (or equivalent), GI wire netting and aluminum cladding/cover.	
9.00.00	LIMESTONE HANDLING PLANT	
9.01.00	Rated capacity of Limestone handling system from existing CHP shall be 1200 MTPH upto crushed limestone storage system. Rated capacity of all other Limestone Handling Conveyors shall be 150 MTPH (min). Rated capacity of Limestone handling system for truck unloading and reclaim conveyors from storage shed/silo to limestone mill bunkers shall be 150 MTPH (min). The rated capacity of all Gypsum handling conveyors shall be 150MTPH. Belt speed for 1200 MTPH conveyors shall not be more than 3.4 m/s, and belt speed for 150 MTPH conveyors shall not be more than 2.0 m/s.	
9.02.00	All conveyors shall be designed for 110% of rated capacity. Rated capacity (corresponding to LHP&GHP capacity) shall be guaranteed capacity for 100% duty equipment. For 50% duty equipment design capacity shall be guaranteed capacity.	
NCTPP DADRI ST-II (2X490MW) & IGSTPP JHAJJAR (3X500MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-A BID DOCUMENT NO.: CS-6130/0330-109-9	SUB-SECTION-V SALIENT DESIGN DATA & SIZING PAGE 12 OF 17

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	COMPRESSED AIR SYSTEM			
1.00.00	SYSTEM DESCRIPTION			
1.01.00	The compressed air system shall consist of Air compressors & their motor drives, Air Drying (ADPs) Plants, air receivers for each Air compressors, instrumentation and control, control panels, compressed air piping, Instrument Air Piping network, service air piping network etc.			
1.02.00	A dedicated air receiver shall be provided near ZLD Plant to meet the instrument /service air requirement of ZLD Plant if the location of ZLD Plant is far away from compressor house.			
1.03.00	Air from air compressors shall be dried in respective Air Drying Plants in compressor house and delivered to the Air receivers. From the Compressed air piping header at the downstream of Air receivers, one common header to be provided to meet the service and instrument air requirement for FGD and ZLD Plant (as provided)			
2.00.00	SCREW AIR COMPRESSORS			
	The minimum requirements of design and construction features of various components of Compressed air system (screw type air compressor, air dryer, air receiver, etc.) are described below.			
2.01.00	CODES AND STANDARDS			
2.01.01	The design, manufacture, testing and performance of the various components of the Rotary Screw type Air Compressors shall comply with the requirements of relevant codes (IS-5456, IS-10431 [part -1], ASME PTC-9, IS-6206, IS-5727 and CAGI).			
2.01.02	Other International Standards like American/BS/DIN etc. equivalent or superior to above mentioned standards are acceptable. Where IS specification is not available, the equipment shall conform to one such International Standard, which shall be indicated in the proposal.			
2.01.03	The materials of the various components shall conform to the applicable IS/BS/ASTM/DIN Standards.			
2.02.00	DESIGN AND CONSTRUCTION			
2.02.01	The compressor shall be oil free multistage, horizontal, water cooled, rotary screw type, heavy duty, rugged construction. Their speed shall be so selected as to result in low maintenance and trouble-free operation under specified conditions.			
2.02.02	The rotor and shaft shall be of single piece construction, made of forged steel (AISI C1141 or equivalent). The stator (casing) shall be of Cast-Iron (IS-210 grade) Construction with integral jacket cooling. The rotors shall be dynamically balanced to reduce vibration.			
2.02.03	The seal rings and retainers shall be of stainless steel construction and be free for radial self adjustment along the rotor shafts.			
2.02.04	Bearings shall be high precision antifriction type IS- 25 Grade 84). The axial thrust load shall be minimized by dividing the axial load of compression on the main and auxiliary bearings through suitable balancing arrangement.			
2.02.05	Lubrication system shall be as per manufacturer standard practices			
2.03.00	Gear Box			
2.03.01	Gears shall have a rating of AGMA-12 or equivalent. Speed increasing gears between the motor and compressor stages shall consist of a common helical gear driving the pinion of each stage. Helical timing gears shall be mounted on the rotor shafts to maintain accurate relative rotor position.			
NCTPP, DADRI (2X490MW) & IGSTPP, JHAJJAR (3X500MW) FLUE GAS DESULPHURISATION(FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.: CS-6130/0330-109-9	SUB SECTION-I-M3 COMPRESSED AIR SYSTEM	PAGE 1 OF 6

CLAUSE NO.	TECHNICAL REQUIREMENTS			
3.00.00	PERFORMANCE REQUIREMENT			
3.01.00	Air Compressors (screw type) shall be designed for continuous operation with high efficiency to satisfy the performance requirement as per approved data sheet submitted by the bidder during detailed engineering.			
3.02.00	The power rating of the driver shall be selected such that a minimum margin of 10% is available over the power required to deliver rated capacity against rated pressure.			
3.03.00	As more than one compressor with drive is specified, satisfactory operation in parallel shall be ensured without any uneven load sharing, undue vibration, keeping noise level within permissible limits for a number of compressors working simultaneously in the same room.			
4.00.00	INTERCOOLER, AFTERCOOLER & OIL COOLERS (FOR SCREW)			
4.01.00	Intercoolers, After coolers and Oil coolers shall be of water cooled & shell-and-tube type with water on the tube side. Intercoolers & after coolers shall be designed in accordance with Section VIII, Division 1 of ASME Code or equivalent.			
4.02.00	Outlet temperature of air from intercooler shall be suitable to suit the equipment and outlet temperature of air from the compressor house outlet header shall be limited to 45 deg.C. However, the instruments or the pneumatic devices requires air temperature less than 45 deg.C., the same shall be achieved at the outlet header.			
4.03.00	Coolers shall be provided with removable tube bundle design in accordance with design code TEMA Class C and shall be constructed with removable shell cover.			
4.04.00	Oil Coolers shall be equipped with vent & drain connections on oil and water sides. Oil temperature control valve with manual override feature or bypass construction shall be provided to maintain constant temperature. Vent & drain connections for intercoolers and aftercoolers shall be provided.			
4.05.00	Design pressure shall be 8 Kg/cm2 (g) or based on shut-off head of cooling water pumps.			
4.06.00	The coolers shall be designed for maximum heat load and atleast 10 percent design margin shall be provided in the number of tubes.			
4.07.00	Adequately sized safety valves shall be provided for both intercoolers and after coolers.			
4.08.00	Each intercooler and aftercooler shall be provided with moisture separator units with suitable baffling. Moisture separator units shall be equipped with a level gauge glass with isolating cock.			
4.09.00	Electrically operated automatic drain trap stations with bypass and isolating valves shall be provided for moisture separators for automatically draining of condensed moisture. The drain trap may be of full bore ball valve operated by capacitance type level switch. Manual draining facility shall also be provided in the drain trap.			
4.10.00	Cooler shells, channels and covers shall be of carbon steel (SA 285 Gr C / SA 516 Gr 70 / equivalent).Tube sheet shall be of Brass or SS and the tubes shall be of Admiralty brass or Aluminium brass or Copper or SS 304.			
4.11.00	For the instrument air compressors offered with "Heat of compression" type air drying plants, the after coolers shall be provided at downstream of Air Drying Plant.			
5.00.00	AIR RECEIVERS			
5.01.00	The design pressure and temperature shall be minimum 10 Kg/cm ² (g) and 50 deg.C respectively. Receivers shall be designed in accordance with Section VIII, Division 1 of ASME Code or equivalent.			
NCTPP, DADRI (2X490MW) & IGSTPP, JHAJJAR (3X500MW) FLUE GAS DESULPHURISATION(FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.: CS-6130/0330-109-9	SUB SECTION-I-M3 COMPRESSED AIR SYSTEM	PAGE 2 OF 6

CLAUSE NO.	TECHNICAL REQUIREMENTS			
5.02.00	Air receivers are to be provided with gasketted inspection manhole of minimum 500 mm diameter with cover plate, lifting handle, davit cap etc.			
5.03.00	Receivers shall be of welded construction with minimum number of joints. Longitudinal seam in adjacent sections shall not be in same line. Welding shall be as per relevant codes. Filler material to have composition & structure as that of material welded. Welding electrodes to be approved by Employer. Electrodes to be dried before use.			
5.04.00	Relief valves shall be provided to suit compressor capacity and set pressure of the same shall be atleast 10% above working pressure. The spring in relief valve shall not reset for any pressure more than 10% above or below the design set pressure.			
5.05.00	Each receiver shall be provided with drain connection with electrically operated automatic drain trap arrangement with isolation and bypass valves.			
5.06.00	The material of construction of shell, dished ends, flanges, etc of the air receivers shall be of carbon steel as per IS:2062 or equivalent.			
6.00.00	INTAKE AIR FILTER AND SILENCER			
6.01.00	Filters with multiple elements quick removal type for easy cleaning shall be provided at suction of each air compressor and also be of heavy-duty dry type.			
6.02.00	The filters shall be complete with integral silencers. Separate silencers, if specified, shall be provided. The filtering elements shall be easily removable for cleaning.			
6.03.00	The filters shall be designed for an efficiency of not less than 99% for particles 2 microns and larger.			
7.00.00	AIR DRYING PLANTS			
7.01.00	One number Air drying plant shall be provided for each air compressor. Drying shall be by adsorption process through a desiccant medium.			
7.02.00	Air Drying (ADP) Plant may be of "Open Through type (Blower reactivated)" OR "Heat of (HOC) Compression type".			
7.03.00	Regeneration of desiccant shall be achieved by "open through" or "Heat of compression" method without any air purge loss.			
7.04.00	Hot unsaturated compressed air shall be used for regeneration of exhausted desiccant in case of "Heat of compression type ADP" and air from blower shall be used for regeneration after heating by electrical heater in case of "Open through type ADP".			
7.05.00	Each ADP shall be provided with two adsorber towers each sized for design drying cycle of minimum 8 hours. After this period, the adsorber tower which was under drying mode shall be put under regeneration/reactivation mode while the other tower will take over the drying duty. The change of drying mode to reactivation mode or vice-versa shall be automatic with provision for manual operation also. The change over from one mode to another shall be through automatic solenoid operated valves.			
7.06.00	In "Open Through" type ADP, for regeneration of desiccant, atmospheric air shall be filtered, heated through an electric heater and passed through the desiccant before exhausted to atmosphere. The reactivated desiccant shall be cooled through same atmospheric air without heater in operation. In case of HOC type drier, the reactivation shall be achieved by the heat of the compressed air itself. The hot unsaturated compressed air from the outlet of last stage of compressor shall be passed through the adsorber tower. The moist air shall be cooled in dehumidifier and passed through the second adsorber for final drying.			
NCTPP, DADRI (2X490MW) & IGSTPP, JHAJJAR (3X500MW) FLUE GAS DESULPHURISATION(FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.: CS-6130/0330-109-9	SUB SECTION-I-M3 COMPRESSED AIR SYSTEM	PAGE 3 OF 6

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
7.07.00	The design reactivation cycle/period of the tower shall be less than 8 hours including cooling period for desiccant for both the types of ADP.			
7.08.00	Each ADP shall be provided with two (2) numbers of 100 percent capacity pre-filters and two (2) numbers of 100 percent capacity after-filters at the upstream & downstream of towers. The filtering media shall be of ceramic candle type elements designed to withstand atleast 50% of static pressure as differential pressure. The pre-filters shall be provided with automatic electrically operated drain trap arrangement with isolation and bypass valves.			
7.09.00	The electric heaters (if required) (2x100% capacity for each ADP) shall be provided with thermostatic control for heater and relief valve for safety and shall be flanged type to facilitate easy replacement of element.			
7.10.00	Each electric motor driven blower (2x100% capacity for each ADP) shall be provided with individual dry type filters at inlet.			
7.11.00	The adsorber tower shall be designed with sufficient cross sectional area resulting low air velocity and pressure drop. Minimum 20% of desiccant depth shall be provided as free board in adsorber vessels. Adsorber vessels to be provided with suitable number of inspection/sight windows of "Persplex" for observation of adsorbent condition. Desiccant filling and removal connections shall be provided for the adsorber vessels.			
7.12.00	The coolers/heat exchangers/ dehumidifiers of ADP shall be designed & constructed as per the requirements specified for "Intercoolers, After coolers & Oil coolers" above.			
7.13.00	All pressure vessels such as pre-filters, after-filters, adsorber vessels, heaters, heat exchangers/de-humidifiers / coolers etc associated with ADP shall be designed in accordance with Section VIII, Division 1, of ASME Code or equivalent. The pressure vessels shall be provided with air tight gasketed manholes/handholes and relief valves.			
7.14.00	Quantity of desiccant to be calculated shall take into account residual moisture content at the end of regeneration cycle.			
7.15.00	Adsorption capacity and density to be considered for silica gel shall not be more than 10% and 550 kg/m ³ respectively. In case of activated alumina the same shall be 8% (max) and 900 kg/m ³ (max.) respectively.			
7.16.00	In case of Heat of compression type, adsorbers shall be sized so that even when the compressor is operating at part load, complete regeneration shall be achieved within the cycle time and quality of air (dew point) shall be maintained throughout the design cycle period.			
7.17.00	Complete ADP equipment shall preferably be mounted on a skid.			
7.18.00	Required sample connections in piping be provided for sampling of air at desired locations.			
7.19.00	Non-lubricated two way / three way / four way valves ball valves with pneumatic actuators be provided.			
7.20.00	The material of Construction for various components of ADP shall be as as per manufacturer's proven standard.			
7.21.00	HOC dryers of single rotating drum type design using packed dessicant with in-built regeneration and adsorption compartments are also acceptable in place of specified twin-tower type dryers, if the design ensures specified performance guarantee. In case, the Contractor offers such a type, the same shall be of proven design and shall meet the conditions stipulated under "proven-ness criteria" in relevant sub-section of Part-A, of Technical Specification. The control & instrumentation requirements specified is applicable for such design also.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
8.00.00	INTERCONNECTING PIPING, FITTING AND VALVES The interconnecting piping & valves within compressor house for compressed air & cooling water etc shall be designed in line with the specification furnished in subsection titled "Low Pressure Piping" of Part-B of this Technical Specification.			
9.00.00	CONTROL PHILOSOPHY			
9.01.00	GENERAL			
9.01.01	The minimum requirements are specified herein and the same shall be elaborated by contractor. The Contractor shall include controls & instrumentation to facilitate safe, reliable and efficient operation for the system. The controls, protection, interlock and instrumentation system offered by the contractor shall be subjected to approval of the Employer during post award engineering stage.			
9.01.02	Any of the compressor and Air drying Plant may be selectable for "shutdown", "working" or "standby" duty.			
9.01.03	On tripping of working equipment, the standby equipment shall come into operation automatically in case of very low air pressure in the system.			
9.01.04	All abnormal conditions used for tripping the compressor or any other equipment shall be provided with pre-trip audio-visual indication/annunciation in the control panel.			
9.01.05	An electrically operated automatic valve shall be provided on cooling water supply line of each compressor & dryer (if applicable) which will automatically shut off the cooling water supply, in case any of the compressor/dryer is not running for more than set time duration. Suitable interlock shall also be provided for opening the valve before starting of any of the compressor.			
9.01.06	The following indications shall be made available in the control panels for repeating the same in main plant Control System / Panels. (a) Status of each compressor (b) Instrument air pressure low/high (c) Service air pressure low/high (d) Dew point of instrument air (e) Status of each ADP			
9.01.07	Lube oil pressure and temperature in the oil circuit of compressor shall be automatically controlled.			
9.01.08	Unless otherwise mentioned in the relevant electrical sub-section, automatic motor overload control system shall be included to permit continuous operation of compressors at minimum ambient air without exceeding the name plate rating of the motor.			
9.02.00	Screw Compressor			
9.02.01	Each compressor shall be in the control panel to operate either in Base duty (Auto Load-Unload) or Standby duty (Auto On-Off) mode in case of Screw and unload/modulate/energy optimization (Auto Dual Mode) in case of centrifugal			
9.02.02	In "Base duty" mode, whenever air supply from compressors exceeds the demand, control system shall operate the load-unload circuit at a predetermined set pressure, throttle the inlet valve and open the blow off valve. The compressor shall run in unloaded condition. When system pressure drops due to more demand, the load-unload circuit shall operate again to bring the compressor to 100% load after closing the blow -off valve.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
9.02.03	In "Stand-by" mode the compressor shall automatically assist base load compressors during periods of peak air demand. When air pressure in the system reaches a pre-set lower limit, compressor should start in unloaded condition and the compressor shall be fully loaded. When the pressure in the system rises to pre-set high value, the compressor shall be unloaded and shall run in idling mode for a specific period (set by a timer). The compressor may be loaded to full load in case of drop in system pressure or compressor may be stopped in case the system pressure does not drop and compressor continues to idle for more than a pre-set time.			
9.02.04	The control system shall provide warning to the operator that a hot-start condition exists for the motor driver and adequate cool-down period has not occurred after the motor was shut down.			
9.02.05	The alarms and shutdown scheme mentioned below are suggestive and shall be provided as per manufacturer's standard practice meeting the safe operational requirement of the equipment/system each compressor:-			
	(a)	"Air temperature high" at inlet to last stage	Alarm & trip	
	(b)	"Low lube oil pressure"	Alarm & trip	
	(c)	"High Lube oil supply temperature"	Alarm & trip	
	(d)	"High oil filter differential pressure"	Alarm	
	(e)	"Low lube oil level in lube oil sump"	Alarm	
	(f)	"High inlet air filter differential pressure"	Alarm & trip	
	(g)	"Low cooling water flow to air compressor"	Alarm	
9.03.00	Air Drying Plant			
9.03.01	Sequential operation of the adsorber towers & air compressors shall be controlled automatically with a provision for manual take over.			
9.03.02	Change over of tower from drying mode to regeneration mode shall happen automatically if the dew point is high at the outlet of ADP sensed by the dew point (using aluminium oxide probe) meter/sensor. Automatic operation during regeneration, starting and stopping of blowers, starting and stopping of heaters, etc shall be timer controlled. During the process, in case, operation is taken over manually from the panel through push button or selector switch, the sequential operation shall start with the manual initiation for each of the steps.			
9.02.03	The control system shall provide the (as minimum) alarms, "High Reactivation air temperature", "Low Reactivation air temperature", "Low cooling water flow", "Low air pressure at the outlet of ADP" and "High dew point at the outlet of ADP". Adequate number of temperature elements etc. shall be provided for measurement and monitoring of the same.			
9.02.04	For rotary drum type Air drying plant, control philosophy as per manufacture's standard and proven practice is also acceptable.			
10.00.00	PAINTING			
	All the equipments shall be protected against external corrosion by providing suitable painting.			
	The surface of SS, galvanized steel, Gun metal, Brass, Bronze and non-metallic components shall not be applied with any painting.			
	The steel surface to be applied with painting shall be thoroughly cleaned before applying painting by brushing, shot blasting etc as per standard procedure.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	<u>LOW PRESSURE PIPING</u>			
1.00.00	EQUIPMENT SIZING CRITERIA			
1.01.00	All the piping systems and equipment supplied under this package shall be designed to operate without replacement and with normal maintenance for a plant service life of 30 years, and shall withstand the operating parameter fluctuations and cycling which can be normally expected during this period.			
1.02.00	For all Low Pressure piping systems covered under this specification, sizing and system design shall be to the requirements of relevant codes and standard indicated. In addition to this, requirements of any statutory code as applicable shall also be taken into consideration.			
1.03.00	Inside diameters of piping shall be calculated for the flow requirements of various systems. The velocities for calculating the inside diameters shall be limited to the following:			
	a) Water Application			
	Pipe Size	Water Velocity in m/sec		
		Below 50 mm	50-150 mm	200 mm & above
	(a) Pump suction	-----	1.2-1.5	1.2-1.8
	(b) Pump discharge and recirculation	1.2-1.8	1.8-2.4	2.1-2.5
	(c) Header	-----	1.5-2.4	2.1-2.4
	Pipe line under gravity flow shall be restricted to a flow velocity of 1 m/sec generally. Channels under gravity flow shall be sized for a maximum flow velocity of 0.6 m/sec.			
	WILLIAM & HAZEN formula shall be used for calculating the friction loss in piping systems with the following "C" value:			
	(i) Carbon steel pipe	100		
	(ii) Ductile Iron.	140		
	(iii) Rubber lined steel pipe	120		
	(iv) Stainless steel pipe	100		
	For calculating the required pump head for pump selection, at least 10% margin shall be taken over the pipe friction losses and static head shall be calculated from the minimum water level of the tank/ sump/ reservoir from which the pumps draw water.			
	(b) Compressed Air Application			
	Compressed air	15.0 m/sec.(under Average Pressure & Temp. conditions)		
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CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC																																					
1.04.00	The pipes shall be sized for the worst (i.e. maximum flow, temp. and pressure values) operating conditions.																																						
1.05.00	Based on the inside dia. so established, thickness calculation shall be made as per ANSI B 31.1 OD and thickness of pipes shall than be selected as per ANSI B 36.10/IS-1239 Heavy grade/IS-3589/ASTM-A-53/API-5L/ANSI B 36.19 as the case may be.																																						
1.06.00	Corrosion allowance of 1.6 mm will be added to the calculated thickness being considered (except stainless steel piping).																																						
1.07.00	Bend thinning allowance/manufacturing allowance etc. shall be as per the requirement of the design code provision.																																						
1.08.00	High points in piping system shall be provided with vents along with valves as per the system requirement. Low points shall be provided with drains along with drain valves as per the system requirement. Drain lines shall be adequately sized so as to clear condensate in the lines. Material for drain and vent lines shall be compatible with that of the parent pipe material.																																						
1.09.00	Material of construction for pipes carrying various fluids shall be as specified elsewhere.																																						
1.10.00	Compressed air pipe work shall be adequately drained to prevent internal moisture accumulation and moisture traps shall be provided at strategic locations in the piping systems.																																						
1.11.00	Depending upon the size and system pressure, joints in compressed air pipe work shall be screwed or flanged. The flange shall be welded with the parent pipe at shop and shall be hot dip galvanized before dispatch to site. Alternatively, the flanges on GI pipes may be screwed-on flanges also.																																						
1.12.00	Threaded joints shall be provided with Teflon sealant tapes.																																						
1.13.00	Following types of valves shall be used for the system/service indicated. <table><tr><th>SYSTEM</th><th colspan="5">TYPES OF VALVES</th></tr><tr><th></th><th>Butterfly</th><th>Gate</th><th>Globe</th><th>Check</th><th>Ball</th><th>Plug</th></tr><tr><td>Water</td><td>x</td><td>x</td><td>x</td><td>x</td><td>x</td><td></td></tr><tr><td>Air</td><td></td><td>x</td><td>x</td><td>x</td><td>x</td><td></td></tr><tr><td>Drains & vents</td><td></td><td>x</td><td>x</td><td>x</td><td></td><td></td></tr></table>	SYSTEM	TYPES OF VALVES						Butterfly	Gate	Globe	Check	Ball	Plug	Water	x	x	x	x	x		Air		x	x	x	x		Drains & vents		x	x	x						
SYSTEM	TYPES OF VALVES																																						
	Butterfly	Gate	Globe	Check	Ball	Plug																																	
Water	x	x	x	x	x																																		
Air		x	x	x	x																																		
Drains & vents		x	x	x																																			
1.14.0	Recirculation pipes along with valves, breakdown orifices etc. shall be provided for important pumping systems as indicated in respective process and instrumentation diagrams (P&IDs). The recirculation pipe shall be sized for minimum 30%design flow of single pump operation or the recommended flow of the pump manufacturer whichever is higher.																																						
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
2.00.00	TECHNICAL SPECIFICATION			
2.01.00	GENERAL			
	Specific technical requirements of low-pressure piping, fittings, supports, valves, specialties and tanks etc. have been covered under this Sub-section. It includes details pertaining to design and material of construction for piping, fittings, valves, equipment, etc. cleaning/surface preparation application of primer and painting on over ground piping. It also includes detailed technical requirement of laying underground/buried piping including water proofing/anti corrosive protection. It also covers design, engineering, manufacturing, fabrication, technical details of piping, valves, specialties, piping hangers / supports, tanks etc.			
2.02.00	Pipes and fittings			
2.02.01	All low pressure piping systems shall be capable of withstanding the maximum pressure in the corresponding lines at the relevant temperatures. However, the minimum thickness as specified in the following clauses and or respective codes for pipes and fittings shall be adhered to. The bidder shall furnish the pipe sizing/ thickness calculation as per the criteria mentioned above under LP piping equipment sizing criteria of this Technical Specification.			
2.02.02	Piping and fittings coming under the purview of IBR shall be designed satisfying the requirements of IBR as a minimum.			
2.02.03	Supporting arrangement of piping systems shall be properly designed for systems where hydraulic shocks and pressure surges may arise in the system during operation. Bidder should provide necessary protective arrangement like anchor blocks/anchor bolt etc. for the safeguard of the piping systems under above mentioned conditions. The requirement will be, however, worked out by the contractor and he will submit the detailed drawings for thrust/anchor block to the Employer. External, and internal, attachments to piping shall be designed so as not to cause flattening of pipes and excessive localized bending stresses.			
2.02.04	Bends, loops, off sets, expansion or flexible joints shall be used as required in order to prevent overstressing the piping system and to provide adequate flexibility. Flexibility analysis (using software packages such as Caesar-II etc.) shall be carried out for sufficiently long piping (straight run more than 300M).			
2.02.05	Wherever Bidder's piping coming under this specification, terminates at an equipments or terminal point not included in this specification, the reaction and the thermal movement imposed by bidder's piping on equipment terminal point shall be within limits to be approved by the Employer.			
2.02.06	The hot lines shall be supported with flexible connections to permit axial and lateral movements. Flexibility analysis shall be carried out for pipelines which have considerable straight run as indicated above and necessary loops/ expansion joint etc. shall be provided as may be necessary depending on layout.			
2.02.07	Piping and fittings shall be manufactured by an approved manufacturer of repute. They should be truly cylindrical of clear internal diameter, of uniform thickness, smooth and strong, free from dents, cracks and holes and other defects.			
2.02.08	For rubber lined ERW pipes, beads shall be removed.			
2.02.09	Inspection holes shall be provided at suitable locations for pipes 800 Nb and above as required for periodic observations and inspection purposes.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC												
2.02.10	At all intersection joints, it is Contractor's responsibility to design and provide suitable reinforcements as per the applicable codes and standards.															
2.02.11	For large size pipes/ducts, at high point and bends/change of direction of flow, air release valves shall be provided as dictated by the system requirement and operation philosophy & tripping conditions of pumping system. Sizing criteria for air release valves shall be generally on the basis of valve size to pipe diameter ratio of 1:8. Requirement shall be decided as per relevant code. Transient analysis /surge analysis where ever specified and required shall be conducted in order to determine the location , number and size of the Air-Release valve on certain long distance/high volume piping systems, if applicable within the scope of work of the package.															
2.03.00	Material															
2.03.01	Alternate materials offered by Bidder against those specified. shall either be equal to or superior to those specified, The responsibility for establishing equality or superiority of the alternate materials offered rests entirely with the Bidder and any standard code required for establishing the same shall be in English language.															
2.03.02	No extra credit would be given to offers containing materials superior to those specified. Likewise no extra credit would be given to offers containing pipe thickness more than specified.															
2.03.03	All materials shall be new and procured directly from the manufacturers. Materials procured from traders or stockists are not acceptable.															
2.03.04	All materials shall be certified by proper material test certificates. All material test certificates shall carry proper heat number or other acceptable references to enable identification of the certificate that certifies the material.															
2.03.05	Material of construction for pipes carrying various fluids shall be as follows: <table><tr><th>SI No</th><th>Type of Fluid</th><th>Material</th></tr><tr><td>1.</td><td>i) Ordinary Water (Raw Water, Clarified Water, etc.) ii) Equipment cooling water including Both primary & secondary circuit (DMCW pH-corrected & ACW drain water)</td><td>IS-2062 Gr.-E-250B/ASTM A-36/ASTM A-53 type 'E'Gr.B/IS-3589 Gr. 410 /IS-1239 Heavy.</td></tr><tr><td>2.</td><td>i) Demineralised water, ii)Alkaline solution (ECW system chemical dosing)</td><td>Stainless Steel to ASTM A312, Gr. 304 welded for sizes 65 mm NB and above. Stainless steel to ASTM A312, Gr. 304 sch.40s seamless for sizes 50mm and below</td></tr><tr><td>3.</td><td>i) Drinking (potable) water ii)Compressed air (Instrument & service air)</td><td>ASTM A-53 type E Gr. B galvanized/ IS 1239 Gr heavy galvanized/IS 3589 Gr 410 galvanized. Galvanized shall be to IS- 4736 or equivalent.</td></tr></table>				SI No	Type of Fluid	Material	1.	i) Ordinary Water (Raw Water, Clarified Water, etc.) ii) Equipment cooling water including Both primary & secondary circuit (DMCW pH-corrected & ACW drain water)	IS-2062 Gr.-E-250B/ASTM A-36/ASTM A-53 type 'E'Gr.B/IS-3589 Gr. 410 /IS-1239 Heavy.	2.	i) Demineralised water, ii)Alkaline solution (ECW system chemical dosing)	Stainless Steel to ASTM A312, Gr. 304 welded for sizes 65 mm NB and above. Stainless steel to ASTM A312, Gr. 304 sch.40s seamless for sizes 50mm and below	3.	i) Drinking (potable) water ii)Compressed air (Instrument & service air)	ASTM A-53 type E Gr. B galvanized/ IS 1239 Gr heavy galvanized/IS 3589 Gr 410 galvanized. Galvanized shall be to IS- 4736 or equivalent.
SI No	Type of Fluid	Material														
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2.03.06	In water lines, pipes upto 150mm Nb shall conform to ANSI B36.10/ASTM-A-53, Type-E Gr.B /IS:1239 Gr. Heavy and minimum selected thickness shall not be less than IS:1239 Grade Heavy except for demineralised water, drinking water and condensate spill lines.															
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2.03.07	Pipes of above 150mm Nb shall be to AWWA-C200/ANSI B 36.10/ASTM A-53/IS 3589 Gr.410. Pipe to be fabricated by the bidder shall be rolled and butt welded from plates conforming to ASTM A-53 type 'E' Gr. B/IS 2062 Gr.E-250B/ASTM-A-36. However, larger pipes, i.e. 1000mm Nb and above shall be made from plates conforming to ASTM A 36/IS 2062 Gr.E-250B and shall meet the requirements of AWWA-M-11 (for deflection & buckling criteria considering water filled pipe as well as vacuum condition that may prevail during transient/surge conditions, truck-load, rail-load and weight density for compacted soil or any other load as the case may be).			
2.03.08	In demineralised water service, the pipes upto 50 Nb shall be of stainless steel ASTM A 312, Gr. 304 sch. 40 Seamless. The size for these pipes shall be to ANSI B 36.19. These shall be socket welded. The material for pipe from 65mm NB upto and including 400 NB shall be to ASTM A 312, Gr. 304 (welded). In no case the thickness of fittings shall be less than parent pipe thickness. Bidder/Contractor shall note that pipes offered as per a particular code shall conform to that code in all respects i.e. Dimension, tolerances, manufacturing methods, material, heat treatment, testing requirements, etc. unless otherwise mentioned elsewhere in the specification.			
2.03.09	Instrument air, Plant (service) air lines and Drinking water lines shall be to ASTM A 53 type E grade B/ANSI B 36. 10/IS 3589, Gr. 410 / IS: 1239 Heavy (in case thickness calculated is more than gr. Heavy, ANSI B 36.10 Schedule numbers shall be followed) and galvanized to IS 4736 or any equivalent internationally reputed standard. The material of the pipes shall be to ASTM A 53 type 'E' Gr. B / IS: 3589, Gr. 410 / IS: 1239 Gr. Heavy. The fittings shall be of either same as parent material or malleable iron to IS-1879 (galvanized).			
2.03.10	Spiral welded pipes as per API-5L/IS-3589 are also acceptable for pipe of size above 150 NB. However minimum thickness of the pipes shall be as elaborated in above clauses.			
2.03.11	Condensate lines shall be to ASTM A 106 Gr. B and dimension to ANSI B 36.10 schedule "standard" as minimum to be maintained.			
2.03.12	If carbon steel plates of thickness more than 12 mm are used for manufacture of pipes, fittings and other appurtenances, then the same shall be control-cooled or normalized as the case may be following the guidelines of the governing code.			
2.04.00	Field routed pipes:			
2.04.01	Pipe lines of NB 50 size and below are regarded as field run piping. It is Bidder's responsibility to plan suitable layouts for these system insitu. Bidder shall prepare drawings indicating the layout of field run pipe work. These drawings shall be approved by Project Manager to the installation of the field run pipe work. Based on these approved layouts the Bidder shall prepare the BOQ of field run-pipes and submit to Employer for approval.			
2.05.00	Slope/Drains and Vents			
2.05.01	Suitable slope shall be provided for all pipelines towards drain points. It is Bidder responsibility to identify the requirements of drains and vents, and supply the necessary pipe work, valves, fittings, hangers and supports etc. As per the system requirement low points in the pipelines shall be provided with suitable draining arrangement and high points shall be provided with vent connections where air or gas pockets may occur. Vent for use during hydrostatic test shall be plugged after the completion of the test. Vent shall not be less than 15mm size. Drains shall be provided at low points and at pockets in piping such that complete drainage of all systems is possible. Drain shall not be less than 15mm for line size up to 150mm, not less than 20mm up to 300mm and not less than 25mm for 350mm to 600mm pipes and not less than 50mm for 600mm and above pipes.			
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2.05.02 2.06.00 2.06.01	Air piping shall be sloped so that any part of the system can be drained through the shut-off drain valve or drain plugs. Pipe Joints In general all water lines 65mm NB and above, are to be joined generally by butt welding except the locations where valves/fittings are to be installed with flanged connections and 50mm and below by socket welding unless mentioned otherwise specifically. All air lines shall be of screwed connection and rubber lined pipes of flanged connections. Screwed Joints (a) Threading of pipes shall be carried out after bending, heat treatment etc. If not possible, threading may be done prior to these operations but proper care should be taken to protect them from damage. Threads shall be to ANSI B 2.1 (taper) NPT/IS: 554 unless specified otherwise. (b) Galvanized pipe shall generally be joined by screwing into sockets. The exposed threaded portion on the outside of the pipes shall be given a zinc silicate coating. Galvanized pipes shall not be field joined by welding for protection of Galvanising Zinc layer. Screwed ends of GI pipes shall be thoroughly cleaned and painted with a mixture of red and white lead before jointing. For galvanized pipe sizes above 150 mm NB, screw & socket jointing as per ASTM-A-865 shall be employed for both pipe-to-pipe and pipe-to-fitting jointing. For pipe to fitting connection since no direct threading can be done on the fittings (supplied as per ASTM-A-234 Gr. WPB and ANSI B-16.9) necessary straight pipe lengths acting as match pieces shall be welded to the fitting at both ends and subsequently the free ends of the straight lengths shall be threaded as per ASTM A-865 for jointing with main pipe. Once welding of fittings with match pieces and threading of free ends of match pieces are over, the entire fabricated piece shall be galvanized, or in case match pipes and fittings are already galvanized before the above mentioned fabrication then suitable application of Zinc-Silicate paste adequately at the welded surface (both in side & out side) after welding with zinc rich electrode, along with the nascent threaded metal portions at both free ends given the same application of Zinc Silicate paste. Alternatively flanged jointing may be employed for pipe sizes 100 NB and above. However, the bidder shall ensure the galvanized pipe joints do not fail during hydro test. (c) Teflon tapes shall be used to seal out screwed joints and shall be applied to the male threads only. Threaded parts shall be wiped clean of oil or grease with appropriate solvent if necessary and allowing proper time for drying before applying the sealant. Pipe ends shall be reamed and all chips shall be removed. Screwed flanges shall be attached by screwing the pipe through the flange and the pipe and flange shall be refaced accurately. (d) For pipe sizes from 350 mm NB to 550 mm NB (including 350 NB & 550 NB) the GI pipes shall be of flanged connection. However, the pipes after welding of flanges shall be completely galvanized. Any site welding done on galvanized pipes shall be done with zinc-rich special electrodes and the welded surfaces whether inside or outside shall be coated with zinc-silicate paste. Seal welding of flanges with zinc-rich electrode will be permitted only when any flange is leak-prone during hydro testing. (e) For pipe sizes 600 mm NB and above, the GI pipes shall be of welded connection (with zinc-rich special electrodes) followed by application of zinc silicate coating at welded surfaces both inside and outside the pipe, except for the last blank/blind flange, or, equipment connection where application of zinc-silicate paste after welding cannot be done due to inaccessibility of the inside welded surface and where			
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	galvanic protection has been impaired due to welding of pipe-to-pipe joint. Thus the last erection joint shall be flanged joint.			
2.06.02	Welded Joints (a) For making up welded joints (butt weld or socket weld) the welding shall be performed by manual shielded metal arc process in accordance with the requirements specified elsewhere in the spec. Any welder employed for carrying butt welding shall be qualified as per ASME section IX for the type of joints he is going to weld. Jointing by butt weld, or socket weld shall depend upon the respective piping material specifications.			
2.06.03	Flanged Joints (a) Flanged connections for pipes are to be kept to the minimum and used only for connections to vessel, equipments, flanged valves and other fittings like strainer/traps/orifices etc. for ease of connection and maintenance etc. Rubber lined pipes shall be flange joined only. (b) All flanged valves intended for installation on steel piping system, shall have their flanges drilled to ANSI B 16.5 (or equivalent) and according to the pressure class stated in their respective piping material specification. (c) Drilling on flanges of flanged valves must correspond to the drilling of flanges on the piping system on which the valves are installed.			
2.07.00	Bends/elbows/mitre bends/ Tees/ Reducers & other fittings			
2.07.01	For pipe fittings such as elbows (long radius), reducers, tees, etc. the material shall be to ASTM-A-234 Gr. WPB/ASTM-105 up to 300 NB. For pipe fittings above 300 NB, the fittings may be fabricated conforming to parent pipe material. Provision of compensation pads shall be kept as per ANSI B 31.1. The fitting shall conform to the dimensional standard of ANSI B-16.9/ 16.11.Further branching in pipes for sizes 65nb and above is also acceptable (ANSI B 31.1). However, for pipes up to 150 NB, pipe fittings may be supplied with material and dimension conforming to IS 1239 in case parent pipes also conform to IS 1239.			
2.07.02	For pipe size 350Nb and above mitre bends may be used for all pipes except rubber lined pipes. The bend radius shall be 1½ times the nominal pipe diameter. 90 deg. bends (mitre) shall be in 4 pieces (3 cuts) and 45 deg. mitre bends shall be in 3 pieces 22½ deg. Fabrication of mitre bends shall be as detailed in BS 2633/BS534.			
2.07.03	For pipes, above 1200 NB, reducer and tees shall be to dimensional standard of AWWA-C-208.			
2.07.04	Stainless steel fittings shall conform to either ASTM-A-182 Gr. 304 or ASTM-A-403 Grade WP. 304 Class-S, for sizes upto and including 50 mm NB, i.e. the fittings shall be of seamless construction. However, for stainless fittings above 50 mm NB, the same shall conform to ASTM-A-403 Gr. WP 304 Class W i.e. the fittings shall be of welded construction strictly in accordance with ASTM-A-403.			
2.07.07	In no case, the thickness of fittings shall be less than the thickness of parent pipe, irrespective of material of construction.			
2.08.00	Flanges			
2.08.01	Flanges shall be slip on type. Welding of flanges in tension is not permitted.,			
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2.08.02	All flanges and-flanged drilling shall be to ANSI B 16.5/BS EN-1092 of relevant pressure/temperature class. Flanges shall be fabricated from steel plates conforming to ASTM A 105/IS 2062 Gr. E-250B. However stainless steel flanges shall be fabricated from SS plates to ASTM-A-240, Gr. 304 or equivalent.			
2.09.00	Specific technical requirement of laying buried pipe with anti corrosive treatment			
	The pipe in general shall be laid with the top of the pipe minimum 1.0 (one) meter below finished general ground level.			
2.09.01	Trenching			
	(a) The trench shall be cut true to the line and level and shall follow the gradient of the pipeline. The width of the trench shall be sufficient to give free working space on each side of the pipe. Trenches shall conform to IS 5822 or any international standard.			
2.09.02	Preparation and cleaning of piping			
	(a) The pipeline shall be thoroughly cleaned of all rust, grease, dirt, weld scales and weld burrs etc. moisture or other foreign matter by power cleaning method such as sand or grit blasting, power tool cleaning, etc. Grease or heavy oil shall be removed by washing with a volatile solvent such as gasoline. Certain inaccessible portions of the pipeline (which otherwise not possible to be cleaned by power cleaning methods) may be scrubbed manually with a stiff wire brush and scrapped where necessary with specific permission of the Project Manager.			
	(b) On the internal surface for pipes 1000 Nb and above, a coat of primer followed by a hot coal-tar enamel or coal tar epoxy painting (cold) shall be applied.			
2.09.03	Coating and wrapping/ Anti corrosive Protection Coal tar tape			
	a. Buried piping shall be coated and wrapped, as per specification, after completion of welded and/or flanged connections, and after completion and approval of Hydro testing. Materials to be used for coating and wrapping of underground pipelines are:			
	(1) Coating primer (coal tar primer)			
	(2) Coating enamel (coal tar enamel)			
	(3) Wrapping materials.			
	All primer/coating/wrapping materials and methods of application shall conform to IS: 10221 except asphalt/bitumen material. Materials (primer/coating/wrapping) as per AWWA-C-203 are also acceptable.			
	Protective coating shall consist of coal tar primer, coal tar enamel coating, glass fiber, tissue inner wrap followed by glass fiber or coal tar impregnated Kraft outer wrap or finish coat.			
	Number of coats and wraps, minimum thickness for each layer of application shall be as per IS-10221. Number of. Coats and wraps shall be decided based on soil corrosivity/resistivity as indicated in IS-10221. Soil data-for this purpose shall be made available.			
	Total thickness of completed coating and wrapping shall not be less than 4.0 mm.			
	b. Alternatively, the anti-corrosive protection for buried pipes can consist of anti-corrosive protection Coal-tar tapes. Material and application of tapes shall conform to IS 15337 or equivalent. These-tapes shall be applied hot over the cold coal tar			
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	primer in steps of 2mm thickness so as to cover the spiral edges of the first tape by the application of second tape. The total nominal thickness of the finished protective coating shall be 4.0 mm.			
2.09.04	Trench bed preparation and back filling Prior to lowering and laying pipe in any excavated trench, the bottom of the trench may require to be back filled and compacted (or as the case may be) to provide an acceptable bed for placing the pipe. Bed preparation in general shall be as per IS: 5822.			
2.09.05	laying of galvanized steel (GI) pipes All the joints shall be screwed with socket or flanged. Screwed ends of GI pipes shall be thoroughly cleaned and painted with a mixture of red and white lead before jointing Threaded portion on either side of the socket joint shall be applied with Zinc silicate paste. All the provisions for trenching' bed preparation' laying the pipe application of primer' coating' wrapping with tapes and back filling etc. as indicated for "laying of buried piping" and " anti corrosive protection for buried piping" are applicable for buried galvanized steel (GI) pipes also.			
2.10.00	Cleaning and flushing			
2.10.01	All piping shall be cleaned by the Bidder before and after erection to remove grease, dirt, dust, scale and welding slag.			
2.10.02	Before erection all pipe work, assemblies, sub-assemblies, fittings, and components, etc. shall be thoroughly cleaned internally and externally by blast cleaning or by power driven wire brushes and followed by air-blowing . However for pipe sizes below 100nb the pipes may be cleaned internally by compressed air blowing as an alternative to internal blast cleaning. The brushes shall be of the same or similar material as the metal being cleaned. Cleaning of Galvanized pipes shall be done by air blowing only.			
2.10.03	After erection, all water lines shall be mass flushed with water. The cleaning velocities in water lines shall be 1.2-1.5 times the operating velocities in the pipelines.			
2.10.04	All compressed air pipe work shall be cleaned by blowing compressed air.			
2.11.00	Specification for hangers and supports			
2.11.01	All supports and parts shall conform to the requirement of power piping code ANSI B 31.1 or approved equivalent.			
2.11.02	The maximum spans of the supports of straight length shall not exceed the recommended values indicated in ANSI B 31.1.			
2.11.03	At all sliding surfaces of supports suitable arrangement is to be provided to minimize sliding friction.			
2.12.00	Design/Construction/Material Particulars of Gate/ Globe /Check /Butterfly / Ball / Air release /Float valves / Moisture Traps.			
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2.12.01	GENERAL (a) All valves shall have indicators or direction clearly marked on the hand-wheel so that the valves opening/closing can be readily determined. (b) Special attention shall be given to operating mechanism for large size valves with a view to obtaining quick and easy operation ensuring that a minimum of maintenance is required. (c) The valves coming in vacuum lines shall be of extended gland type and/or water sealed. (d) The actuator-operated valves shall be designed on the basis of the following: (1) The internal parts shall be suitable to support the pressure caused by the actuators; (2) The valve-actuator unit shall be suitably stiff so as not to cause vibrations, misalignments, etc. (3) All actuator-operated valves shall be provided with hand operated gearing mechanism also. (4) All actuators operated valves shall open/ close fully within time required by the process. (e) Valves coming under the purview of IBR shall meet IBR requirements. (f) All valves shall be provided with embossed name plate giving details such as tag number, type, size etc. (g) Wherever required valves shall be provided with chain operator, extension spindles and floor stands or any other arrangement approved by employer so that they can be operated with ease from the nearest operating floor. Wherever necessary for safety purpose locking device shall be provided. Further, necessary small platforms for facilitating easy valve operation shall be provided by the contractor wherever necessary in consultation with project manager within the bid price at no extra cost to employer			
2.12.02	VALVE BODY MATERIAL Valve body material for various services shall be as follows: Valve body material for water application like Secondary circuit auxiliary cooling water of ECW system, Raw water, Ash water make-up, service water, clarified water, DM cooling water (pH corrected) , drinking water etc. shall be cast iron for sizes 65NB and above; gun-metal for sizes 50 Nb and below. For compressed air application, valve body material shall be cast carbon steel or forged carbon steel for sizes 65 mm NB & above and Gun metal for sizes 50 NB and below. DM water: SS body and disc along with SS internals. However for butterfly valves, Cast Iron /Ductile Iron/SG iron/carbon steel body and disc with elastomer lining are also acceptable. Condensate: Cast Carbon Steel / Forged Carbon Steel.			
2.12.03	The design, material, construction, manufacture, inspection, testing and performance of valves shall comply with all currently applicable statutes, regulations and safety codes in the			
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2.12.04	locality where the valves will be installed. The valves shall conform to the latest editions of applicable codes and standards as mentioned elsewhere. Nothing in this specification shall be construed to relieve the Bidder of his responsibility. Valves in general shall conform to the requirements of the following standards.				
	Standards and Codes				
	AWWA-C-504	Rubber seated butterfly valves.			
	BS-5155/EN-593	Cast iron and steel body butterfly valves for general purpose.			
	IS-778	Gun-metal gate, globe and check valves for general purpose.			
	BS-5154	Copper alloy globe/globe stop and check and gate valves for general purpose.			
	IS-780	Sluice valves for water works purpose (50-300 mm size)			
	IS-2906	Sluice valves for water works purpose (350-1200 mm size)			
	IS-5150	Cast iron wedge and double disc gate for general purpose.			
	BS-5152	Specification for cast iron globe valves.			
	BS-5153	Cast iron check valves for general purpose.			
	IS-5312	Swing check type reflux (non-return) valves.			
	ANSI B 16.34	Standard for valves.			
	API-594	Standard for Dual-check valves.			
	API-600	Steel gate valves.			
	ANSI-B-16.10	Valves face to face and other relevant dimension.			
	API-598	Valves inspection test.			
	2.13.00	End Connections			
		The end connections, shall comply with the following:			
		Socket welding (SW) - ANSI B 16.11			
Butt Welding (BW) - ANSI B 16.25.					
Threaded (SC) - ANSI B 2.1					
2.13.00	Flanged (FL) - ANSI B 16.5& AWWA-C-207 (steel flanges), ANSI B 16.1 (Cast Iron flanges).				
	Gate/Globe/Check Valves				
(a) All cast iron body valves (gate, globe and non-return) shall have flanged end connections; (screwed ends for Ductile D.2NI body valves are not acceptable).					
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	(b) All steel and stainless steel body valves of sizes 65 mm and above shall have flanged or butt welding ends. Valves of sizes below 65mm shall have flanged or socket welded ends. Compatibility of welding between valve body material and connecting pipe material is a pre-requisite in case of butt-welded joints. (c) All gun metal body valves shall have screwed ends. (d) All flanged end valves/specialties. shall be furnished along with matching counter flanges, fasteners, gaskets etc. as required to complete the joints. (e) Gate/sluice valves shall be used for isolation of flow. All gate valves shall be of the full-way type, and when in the full open position the bore of the valve shall not be constricted by any part of the gate. Gate valves shall be of the solid/elastic or articulated wedge disc. Gate valves shall be provided with the following accessories in addition to other standard items: (1) Hand wheel (2) Position indicator (for above 50 mm NB valve size) (3) Draining arrangement wherever required. (f) Globe valves shall be used for regulation purposes. They shall be provided with hand wheel, position indicator, draining arrangement (wherever required) and arrow indicating flow direction. Preferably, the valves shall be of the vertical stem type. Globe valves shall preferably have radiused or spherical seating and discs shall be free to revolve on the spindle. The pressure shall preferably be under the disc of the valve. However, globe valves, with pressure over the disc shall also be accepted provided (i) no possibility exists that flow from above the disc can remove either the disc from stem or component from disc (ii) manual globe valves can easily be operated by hand. If the fluid load on the top of the disc is higher than 40-60 KN, bypass valve shall be provided which permits the downstream system to be pressurized before the globe valve is opened. (g) Check valves shall be used for non-return service. They shall be swing. check type or double door (Dual plate)check type with a permanent arrow inscription on the valve body indicating the fluid flow direction. In long distance pipes lines with possibility of surge-occurrence, dual plate check valves are preferable for its spring controlled opening /closing of flaps/doors against flow reversals. However, dual plate check valves shall not be used for sizes more than 600mm NB. (h) For bore greater than 2" the valves must be swing check type or dual plate check type suitable for installation in all positions (vertical and horizontal); (i) For bore smaller than or equal to 2" the valves must be of the piston type to be installed, in horizontal position. (j) All gate and globe valves shall be provided with back seating arrangement to enable on line changing of gland packing. The valves shall be preferably outside screw & yoke type. (k) All gate and globe valves shall be rising stem type and shall have limit switches for full OPEN and full CLOSED indication wherever required. This will include motor-operated valves also wherever required. In such cases the limit switches shall form			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
2.13.01	an integral part of the valve. Stop-gap arrangement in this respect is not acceptable.			
	(l)	All valves except those with rising stems shall be provided with continuous mechanical position indicators; rising stem valves shall have only visual indication through plastic/metallic stem cover for sizes above 50 mm nominal bore.		
	(m)	For CI gate, globe and check valves wherever thickness of body/bonnet is not mentioned in the valves standards, thickness mentioned in IS- 1538 for fitting shall be applicable.		
	MATERIAL OF CONSTRUCTION (GATE/GLOBE/CHECK VALVE)			
	(a)	The materials shall generally comply with the following:		
	(1)	Cast Steel Valves		
		Body & bonnet	ASTM A 216 Gr. WCB/ ASTM A 105	
		Disc for non-return Valves	ASTM A 216 Gr. WCB/ ASTM A 105	
		Trim.	ASTM A 182 Gr. F6 or Equivalent	
	(2)	Stainless steel valves		
		Body & Bonnet	SS 304	
		Disc	-do-	
		Trim.	SS 316	
	(3)	Cast iron valves		
		Body & bonnet	BS 1452 Gr. 14/ IS-210 Gr. FG 260	
		Seating surfaces and rings	13% chromium steel/ 13% Chrome overlay	
		Disc for non-return valves	BS 1452 Gr. 14/IS-210 Gr FG 260	
	Hinge pin for non-return valves	AISI 316		
	Stem for gate globe valves	13% chromium steel or Equivalent		
	Back seat	13 % chromium steel / 13% Chrome overlay		
(4)	Gun Metal valves			
	Body and bonnet	IS 318 Gr. 2/ Equivalent Standard		
	Trim.	-do-		
(b)	Cast iron body valves shall have high alloy steel stem and seat.			
(c)	Material for counter flanges shall be the same as for the piping.			
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2.14.00	(d) Forged carbon steel valves are also acceptable in place of Gun metal valves.			
	Air Release Valve			
	(a) The air release valves shall be of automatic double air valve with two orifices and two floats. The float shall not close the valve at higher air velocities. The orifice contact joint with the float shall be leak tight joint. (b) The valve shall efficiently discharge the displaced air automatically from ducts/pipes while filling them and admit air automatically into the ducts/pipes while they are being emptied. The valve shall also automatically release trapped air from ducts/pipes during operation at the normal working pressure. (c) Body material of automatic air release valves shall comply generally with BS 1452 Gr. 14/IS: 210 Gr. FG 260. and spindle shall conform to high tensile brass. (d) Air release valves shall not have any integral isolation device within them. Each Air release valve shall be mounted, preceded by a separate isolation gate/ butterfly valve.			
	2.15.00 Butterfly valves			
2.15.01	Design/Construction (a) The valves shall be designed for the design pressure/temperature of the system on which it is installed and in accordance with AWWA-C-504, EN-593 or any other approved equivalent standard latest edition. Fabricated steel (IS: 2062 GR. E-250B) butterfly valves instead of cast iron body valves are also acceptable for size above 300 mm nb diameter. (b) The valves shall be suitable for installation in any position (horizontal/vertical etc.) and shall be generally of double-flanged construction. However for sizes 600 NB and below the valves of Wafer construction are also acceptable (c) Valves-350Nb and above shall have pressure equalizing bypass valves, wherever system parameters warrant the same. (d) Valves-200Nb and above shall also be provided with gear operator arrangement as a standard practice suitable for manual operation. Manual operation of valve shall be through gear arrangement having totally enclosed gearing with hand wheel diameter and gear ratio designed to meet the required operating torque It shall be designed to hold the valve disc in intermediate position between full open and full closed position without creeping or fluttering. Adjustable stops shall be provided to prevent over travel in either direction. Limit and torque switches (if applicable) shall be enclosed in water tight enclosures along with suitable space heaters for motor actuated valves, which may be either for On-Off operation or inching operation with position transmitter.			
NCTPP,DADRI ST-II (2X490MW) & IGSTPP,JHAJJAR(3X500MW) PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC. NO.:CS-6130/0330-109-9	SUB-SECTION-I-M7 (LOW PRESSURE PIPING)	PAGE 14 OF 16

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2.15.02	Material of Construction (Butterfly Valves)			
	Materials and other design details shall be as indicated below :			
	(a) Cast Iron Butterfly Valves			
	Body & Disc	ASTM A48, Gr. 40 with 2% Ni / IS: 210. Gr. FG-260, with 2% Ni / SG iron BSEN 1563, Gr EN GJS-400-15 with 2%Ni and epoxy coated		
	Shaft	BS 970 431 S: 291 / EN 57, or AISI-410 or AWWA-permitted shaft material equivalent to EN-57/AISI-410 or better.		
	Seat ring	18-8 Stainless steel		
	Seal	Nitrile Rubber		
	(b) Stainless Steel Butterfly Valves			
	Body & Disc	SS 304		
	Shaft	SS 316		
	Seat Rings	EPT/BUNA-N/Neoprene		
	(c) Carbon steel Butterfly Valves			
	Body & Disc	ASTM A 216, Gr. WCB		
	Shaft	SS 304		
Disc & Seat Rings	EPT/BUNA-N/Neoprene			
2.15.03	(d) Elastomer lined Butterfly Valves			
	Body & Disc	ASTM A48, Gr. 40 / IS: 210. Gr. FG-260 / SG Iron (ductile iron) IS 1865 Gr 400-15 or BSEN 1563, Gr EN GJS-400-15 / ASTM A 216, Gr. WCB with elastomer lining.		
	Shaft	SS 316		
	Proof of Design Test (Type Test) for Butterfly Valves			
Proof of Design (P.O.D.) test certificates shall be furnished by the bidder for all applicable size-ranges and classes of Butterfly valves supplied by him, in the absence of which actual P.O.D. test shall be conducted by the bidder.				
All valves that are designed and manufactured as per AWWA-C-504 / AWWA-C-516 shall be governed by the relevant clauses of P.O.D test in AWWA-C-504/AWWA-C-516. For Butterfly valves, designed and manufactured to EN-593 or equivalent, the P.O.D. test methods and procedures shall generally follow the guidelines of AWWA-C-504 in all respect except that Body & seat hydro test and disc-strength test shall be conducted at the pressures specified in EN-593 or the applicable code. Actuators shall also meet requirements of P.O.D. test of AWWA-C-504/AWWA-C-516.				
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2.16.00	Float operated valves (a) Valve shall automatically control the rate of filling and will shut off when a predetermined level is reached and close to prevent over flow on pre-set maximum water level. Valve shall also open and close in direct proportion to rise or fall of water level. (b) DESIGN AND CONSTRUCTION FEATURES The following design and construction feature of the valve shall be the minimum acceptable. (c) Valves shall be right-angled or globe pattern. (d) Valves shall be balance piston type with float ball. (e) Leather liner shall not be provided. (f) The body and cover material shall be cast iron conforming to ASTM-A 126 Grade 'B' or IS: 210 Grade 200 or equivalent, and Float shall be of copper with epoxy painting of two (2) coats. (g) Valves shall be suitable for flow velocities of 2 to 2.5m/sec. (h) The valves shall have flanged connections.			
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		VOLUME: II B	
		SECTION : C2-B	
		REV. 00	DATE: 19.03.18
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PROJECT SPECIFIC GENERAL REQUIREMENTS

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
1.00.00	INTRODUCTION This part covers technical requirements which will form an integral part of the Contract. The following provisions shall supplement all the detailed technical specifications and requirements brought out in Section-VI, the Technical Specification and the Technical Data Sheets.			
2.00.00	BRAND NAME Whenever a material or article is specified or described by the name of a particular brand, manufacturer or vendor, the specific item mentioned shall be understood to be indicative of the function and quality desired, and not restrictive; other manufacturer's products may be considered provided sufficient information is furnished to enable the Employer to determine that the products proposed are equivalent to those named.			
3.00.00	BASE OFFER & ALTERNATE PROPOSALS The Bidder's proposal shall be based upon the use of equipment and material complying fully with the requirements specified herein. It is recognised that the Contractor may have standardized on the use of certain components, materials, processes or procedures different than those specified herein. Alternate proposals offering similar equipment based on the manufacturer's standard practice will also be considered, provided the base offer is in line with technical specifications and such proposals meet the specified design standards and performance requirement and are acceptable to the Employer. Sufficient amount of information for justifying such proposals shall be furnished to Employer alongwith the bid to enable the Employer to determine the acceptability of these proposals.			
4.00.00	COMPLETENESS OF FACILITIES			
4.01.00	Bidders may note that this is a contract inclusive of the scope as indicated elsewhere in the specification. Each of the plant shall be engineered and designed in accordance with the specification requirement. All engineering and associated services are required to ensure a completely engineered plant shall be provided.			
4.02.00	All equipments furnished by the Contractor shall be complete in every respect, with all mountings, fittings, fixtures and standard accessories normally provided with such equipment and/or those needed for erection, completion and safe operation of the equipment and for the safety of the operating personnel, as required by applicable codes, though they may not have been specifically detailed in the respective specifications, unless included in the list of exclusions. All same standard components/ parts of same equipment provided, shall be interchangeable with one another.			
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
4.03.00	For the C&I systems, the Contractor shall be required to provide regular information about future upgrades and migration paths to the Employer.			
5.00.00	RULES, REGULATIONS, CODES & STANDARDS			
5.01.00	In addition to the codes and standards specifically mentioned in the relevant technical specifications for the equipment / plant / system, all equipment parts, systems and works covered under this specification shall comply with all currently applicable statutory regulations and safety codes of the Republic of India, NTPC rules/codes of practices as well as of the locality where they will be installed, including the following: a) Indian Electricity Act b) Indian Electricity Rules c) Indian Explosives Act d) Indian Factories Act and State Factories Act e) Indian Boiler Regulations (IBR) f) Regulations of the Central Pollution Control Board, India g) Regulations of the Ministry of Environment & Forest (MoEF), Government of India h) Pollution Control Regulations of Department of Environment, Government of India i) State Pollution Control Board. (j.) Rules for Electrical installation by Tariff Advisory Committee (TAC). (k.) Building and other construction workers (Regulation of Employment and Conditions of services) Act, 1996 (l.) Building and other construction workers (Regulation of Employment and Conditions of services) Central Rules, 1998 (m.) Explosive Rules, 1983 (n.) Petroleum Act, 1984 (o.) Petroleum Rules, 1976,			
NCTPP DADRI(2X490MW) & IGSTPP JHAJJAR (3X500MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-6130/0330-109-9	GENERAL TECHNICAL REQUIREMENTS	PAGE 2 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
5.02.00	(p.) Gas Cylinder Rules, 1981 (q.) Static and Mobile Pressure Vessels (Unified) Rules, 1981 (r.) Workmen's Compensation Act, 1923 (s.) Workmen's Compensation Rules, 1924 (t.) NTPC Safety Rules for Construction and Erection (u.) NTPC Safety Policy (v.) Any other statutory codes / standards / regulations, as may be applicable. Unless covered otherwise in the specifications, the latest editions (as applicable as on date of bid opening), of the codes and standards given below shall also apply: a) Bureau of Indian standards (BIS) b) Japanese Industrial Standards (JIS) c) American National Standards Institute (ANSI) d) American Society of Testing and Materials (ASTM) e) American Society of Mechanical Engineers (ASME) f) American Petroleum Institute (API) g) Standards of the Hydraulic Institute, U.S.A. h) International Organisation for Standardisation (ISO) i) Tubular Exchanger Manufacturer's Association (TEMA) j) American Welding Society (AWS) k) National Electrical Manufacturers Association (NEMA) l) National Fire Protection Association (NFPA) m) International Electro-Technical Commission (IEC)/European Norm (EN) n) Expansion Joint Manufacturers Association (EJMA) o) Heat Exchange Institute (HEI)			
NCTPP DADRI(2X490MW) & IGSTPP JHAJJAR (3X500MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-6130/0330-109-9		GENERAL TECHNICAL REQUIREMENTS PAGE 3 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
5.03.00	p) IEEE standard q) JEC standard Other International/ National standards such as DIN, JIS, VDI, EN, BS, GOST etc. shall also be accepted for only material codes and manufacturing standards, subject to the Employer's approval, for which the Bidder shall furnish, adequate information to justify that these standards are equivalent or superior to the standards mentioned above. In all such cases the Bidder shall furnish specifically the variations and deviations from the standards mentioned elsewhere in the specification together with the complete word to word translation of the standard that is normally not published in English.			
5.04.00 Not	used.			
5.05.00	In the event of any conflict between the codes and standards referred to in the above clauses and the requirement of this specification, the requirement of Technical Specification shall govern.			
5.06.00	Two (2) English language copies of all national and international codes and/ or standards used in the design of the plant, equipment, civil, structural and architectural works shall be provided by the Contractor to the Employer within two calendar months from the date of the Notification of Award.			
5.07.00	In case of any change in codes, standards & regulations between the date of bid opening and the date when vendors proceed with fabrication, the Employer shall have the option to incorporate the changed requirements or to retain the original standard. It shall be the responsibility of the Contractor to bring to the notice of the Employer such changes and advise Employer of the resulting effect.			
5.08.00	A detailed list of standards apart from those mentioned in the respective detailed specifications in other parts of Section-VI to which all equipment/systems/civil works should conform as indicated in this Part C and elsewhere in the specification.			
6.00.00	EQUIPMENT FUNCTIONAL GUARANTEE			
6.01.00	The functional guarantees of the equipment under the scope of the Contract is given in Section-VI Part - A of Technical Specifications. These guarantees shall supplement the general functional guarantee provisions covered under Defect liabilities Section-IV, General Conditions of Contract.			
6.02.00	Liquidated damages for shortfall in meeting functional guarantee(s) during the performance and guarantee tests shall be assessed and recovered from the Contractor as specified elsewhere in this specification.			
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
7.00.00	DESIGN OF FACILITIES/ MAINTENANCE & AVAILABILITY CONSIDERATIONS			
7.01.00	DESIGN OF FACILITIES All the design procedures, systems and components proposed shall have already been adequately developed and shall have demonstrated good reliability under similar conditions elsewhere. The Contractor shall be responsible for the selection and design of appropriate equipments to provide the best co-ordinated performance of the entire system. The basic requirements are detailed out in various clauses of the Technical Specifications. The design of various components, assemblies and subassemblies shall be done so that it facilitates easy field assembly and dismantling. All the rotating components shall be so selected that the natural frequency of the complete unit is not critical or close to the operating range of the unit.			
7.02.00	MAINTENANCE AND AVAILABILITY CONSIDERATIONS Equipment/works offered shall be designed for high availability, low maintenance and ease of maintenance. The Bidders shall specifically state the design features incorporated to achieve high degree of reliability/ availability and ease of maintenance. The Bidders shall also furnish details of availability records in the reference plants stated in his experience list. Bidders shall state in his offer the various maintenance intervals, spare parts and man-hour requirement during such operation. The intervals for each type of maintenance namely inspection of the furnace, inspection of the entire hot gas path and the minor and major overhauls shall be specified in terms of fired hours, clearly defining the spare parts and man-hour requirement for each stage. Lifting devices i.e. hoists and chain pulley jacks, etc. shall be provided by the contractor for handling of any equipment or any of its part having weight in excess of 500 Kgs during erection and maintenance activities. Lifting devices like lifting tackles, slings, etc. to be connected to hook of the hoist / crane shall be provided by the contractor for lifting the equipment and accessories covered under the specification.			
8.00.00	DOCUMENTS, DATA AND DRAWINGS TO BE FURNISHED BY CONTRACTOR			
8.01.00	Bidders may note that this is a contract inclusive of the scope as indicated elsewhere in the specification. Each of the plant and equipment shall be fully integrated, engineered and designed to perform in accordance with the technical specification. All engineering and technical services required to ensure a completely			
NCTPP DADRI(2X490MW) & IGSTPP JHAJJAR (3X500MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-6130/0330-109-9	GENERAL TECHNICAL REQUIREMENTS	PAGE 5 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
8.02.00 8.03.00 8.03.01 A)	engineered plant shall be provided in respect of mechanical, electrical, control & instrumentation, civil & structural works as per the scope. Each main and auxiliary equipment/item of the plant including instruments shall be assigned a unique tag number. The assignment of tag numbers shall be in accordance with KKS system. In all drawings/documents/data sheet etc. KKS tag number of the equipment/item/instrument etc. shall be indicated. The Contractor shall furnish engineering data/drawings in accordance with the schedule of information as specified in Technical Data Sheets and Technical Specification. A comprehensive engg and quality coordination procedure shall be finalized with the successful bidder covering salient features as described in this section of specifications. The number of copies/prints/CD-ROMs/manuals to be furnished for various types of document is given in Annexure-VI to this Part-C, Section-VI of the Technical Specification. The documentation that shall be provided by the Contractor is indicated in the various sections of specification. This documentation shall include but not be limited to the following: BASIC ENGINEERING DOCUMENTATION (AS APPLICABLE) Prior to commencement of the detailed engineering work, the Contractor shall furnish a Plant Definition Manual within 12 weeks from the date of the Notification of Award. This manual shall contain the following as a minimum: i) System description of all the mechanical, electrical, control & instrumentation & civil systems. ii) Technology scan for each system / sub-system & equipment. iii) Selection of appropriate technology / schemes for various systems/subsystems including techno-economic studies between various options. iv) Optimisation studies including thermal cycle optimisation. v) Sizing criteria of all the systems, sub-systems/ equipment s/ structures/ equipment foundations alongwith all calculations justifying and identifying the sizing and the design margins. vi) Schemes and Process & Instrumentation diagrams for the various systems/ sub-system with functional write-ups.			
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B)	vii) Operation Philosophy and the control philosophy of the equipments/system covered under the scope. ix) General Layout plan of the FGD System incorporating all facilities in Bidder's as well as those in the Employer's scope. This drawing shall also be furnished in the form of CD-ROMs to the Employer for engineering of areas not included in bidder's scope. x) Basic layouts and cross sections of the main plant building (various floor elevations), boiler, fuel oil area and other areas included in the scope of the bidder. xi) Documentation in respect of Quality Assurance System as listed out elsewhere in this specification. The successful bidder shall furnish within three (3) weeks from the date of Notification of Award, a list of contents of the Plant Definition Manual (PDMs) including techno-economic studies, which shall then be mutually discussed & finalised with the Employer.			
	DETAILED ENGINEERING DOCUMENTS (AS APPLICABLE) i) General layout plan of the System. ii) Layouts, general arrangements, elevations and cross-sections drawings for all the equipment and facilities of the plant. iii) Flow diagram, process and instrumentation diagrams along with write up and system description. iv) Performance curves v) Piping isometric, composite layout and fabrication drawings. vi) Piping engineering diagrams, pipe and fittings schedules, valve schedules, hanger and support schedules, insulation schedules. vii) Technical data sheets for all bought out and manufactured items. Contractor shall use the Employer's specifications as a base for placement of orders on their sub vendors. viii) Detailed design calculations for components, system, piping etc., wherever applicable including sizing calculations for all auxiliaries like mills, fans etc- as per criteria specified elsewhere in specification. ix) Various sizing calculations. Compressor performance data.			
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	x)Void xi)Characteristic Curves/ Performance Correction Curves. xii)Comprehensive list of all termin al point s which interface with Employer's facilities, givi ng details of loca tion, termina l pressure, temperature, fluid handled & end connection details, forces, moments etc. xiii)Power supp ly si ngle line di agram, block logics, contro l schematics, electrical schematics, etc. xiv)Protection system diagrams and relay settings. xv)Cables schedules and interconnection diagrams. xvii)Cable routing plan. xviii)Instrument schedule, measuring point list, I/O list, Interconnection & wiring diagram, functional write-ups, and installation drawings for field mounted instruments, logic di agrams, control schematics, wiring and tubing diagrams of panels and enclosures etc. Drawing s for ope n loop and close loop controls (both hardware and software). Motor list and valve schedule including type of actuator etc. xix)Alarm and a nnunciation/ Sequence of Event (SOE) list and alarms & trip set points. xx)Sequence and protection interlock schemes. xxi)Type test reports, insulation co-ordination study report xxii)Control system configuration diagramsand card circuit diagrams and maintenance details. xxiii)Detailed Control system manuals. xxiv)Detailed flow chart for digital control system. xv)Mimic di agram l ayout, A ssignment for other application engg.drawings and documents. xxvi)Civil and Structural wor ks drawings and documents for all structures, facilities, architectura l works, foundations underground a nd overground works and super-stru ctural works as in cluded i n the			
NCTPP DADRI(2X490MW) & IGSTPP JHAJJAR (3X500MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-6130/0330-109-9	GENERAL TECHNICAL REQUIREMENTS	PAGE 8 OF 83

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8.03.03	longer intervals to ensure trouble free operation and quantity required for complete replacement. (j) Tolerance for fitment of various components. (k) Details of sub vendors with their part no. in case of bought out items. (l) List of spare parts with their Part No, total population, life expediency & their interchangeability with already supplied spares to NTPC. (m) List of mandatory and recommended spare list along with manufacturing drawings, material specification & quality plan for fast moving consumable spares. (n) Lead time required for ordering of spares from the equipment supplier, instructions for storage and preservation of spares. (o) General information on the equipment such as modification carried out in the equipment from its inception, equipment population in the country / foreign country and list of utilities where similar equipments have been supplied. After finalization and approval of the Employer, the O & M Manuals shall be submitted as indicated in Annexure-VI. The Contract shall not be considered to be completed for purposes of taking over until the final Instructions manuals (both erection and O & M manuals have been supplied to the Employer. If after the commissioning and initial operation of the plant, the instruction manuals (Erection and / or O & M manuals) require modifications/additions/changes, the same shall be incorporated and the updated final instruction manuals shall be submitted by the Contractor to the Employer for records and number of copies shall be as mentioned in Annexure-VI.	
8.03.03	PLANT HANDBOOK AND PROJECT COMPLETION REPORT	
8.03.03.01	PLANT HANDBOOK The Contractor shall submit to the Employer a preliminary plant handbook preferably in A-4 size sheets which shall contain the design and performance data of various plants, equipments and systems covering the complete project including i) Design and performance data. ii) Process & Instrumentation diagrams. iii) Single line diagrams.	
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vi	iv) Sequence & Protection Interlock Schemes. v) Alarm and trip values.) Performance Curves. vii) General layout plan and layout of main plant building and auxiliary buildings viii) Important Do's & Don't's The plant handbook shall be submitted within twelve (12) months from the date of award of contract. After the incorporation of Employer's comments, the final plant handbook complete in all respects shall be submitted three (3) months before start-up and commissioning activities.			
8.03.03.02	PROJECT COMPLETION REPORT The Contractor shall submit a Project Completion Report at the time of handing over the plant.			
8.03.04	DRAWINGS a) i) All the FGD plant layouts shall be made in computerised 3D modelling system. The Employer reserves the right to review the 3D model at different stages during the progress of engineering. The layout drawings submitted for Employer's review shall be fully dimensioned and extracted from 3D model after interference check. ii) All documents submitted by the Contractor for Employer's review shall be in electronic form (soft copies) along with the desired number of hard copies as specified elsewhere in Spec. The soft copies shall be uploaded by the vendors in C-folders, a Web-based system of NTPC ERP, for which a username and password will be allotted to the new vendor by NTPC. Similarly, the vendor can download the drawings/documents, approved/ commented by NTPC, through above site. The soft copies of identified drawings/documents shall be in pdf format, whereas the attachments/reply to the submitted document(s) can be in .doc, .xls, .pdf, .dwg or .std formats. iii) Void iv) Contractor shall prepare the model of all the facilities located in FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE (including all			
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	facilities), and any other facility in an integrated & intelligent 3D software solution using rule-based, data centric 3D Design software with equipment drawings, data sheets, intelligent P&ID correlated with intelligent 3D Model, BOQ, schematics and logic diagrams etc. attached to the respective equipment / systems in the aforesaid 3D model. Contractor shall make a presentation on 3D model every 3 months from LQA to enable NTPC to review the progress of engineering. After the completion of engineering the corresponding complete 3D review model shall be handed over to the employer for its reference. Contractor shall provide 3D model (which shall include visual interference check, walk-through animation, video simulation for major equipment placement and removal, visual effect, photo realism etc), which is extracted from intelligent 3D model, for employer's review as & when desired by employer. However, all piping layouts, equipment layouts, floor plans, ducting layout (Air/flue gas, A/C, Ventilation etc.), General Arrangement drawings of major buildings, structural arrangement drawings and RCC layout drawings shall necessarily be extracted from the aforesaid 3D model and submitted for employer's review along with the 3D review model to enable NTPC to review and approve these drawings. b) All documents/text information shall be in latest version of MS Office / MS Excel / PDF FORMAT as applicable. c) All drawings submitted by the Contractor including those submitted at the time of bid shall be in sufficient detail indicating the type, size, arrangement, weight of each component for packing and shipment, the external connection, fixing arrangement required, the dimensions required for installation and interconnections with other equipments and materials, clearance and spaces required between various portions of equipment and any other information specifically requested in the drawing schedules. d) Each drawing submitted by the Contractor (including those of sub vendors) shall bear a title block at the right hand bottom corner with clear mention of the name of the Employer, the system designation, the specifications title, the specification number, the name of the Project, drawing number and revisions. If standard catalogue pages are submitted the applicable items shall be indicated there in. All titles, notings, markings and writings on the drawing shall be in English. All the dimensions should be in metric units. e) The drawings submitted by the Contractor (or their subvendors) shall bear Employer's drawing number in addition to contractor's (their sub-vendor's) own drawing number. Employer's drawing numbering system shall be made available to the successful bidder so as to enable him to assign Employer's drawing numbers to the drawings to be submitted by him during the course of execution of the Contract.			
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	The Contractor shall also furnish a "Master Drawing List" which shall be a comprehensive list of all drawings/ documents/ calculations envisaged to be furnished by him during the detailed engineering to the Employer. Such list should clearly indicate the purpose of submission of these drawings i.e. "FOR APPROVAL" or "FOR INFORMATION ONLY". Similarly, all the drawings/ documents submitted by the Contractor during detailed engineering stage shall be marked "FOR APPROVAL" or "FOR INFORMATION" prior to submission. Further, space shall be identified on each drawing for Approval stamp and electronic signature. f) The furnishing of detailed engineering data and drawings by the Contractor shall be in accordance with the time schedule for the project. The review of these documents/ data/ drawings by the Employer will cover only general conformance of the data/ drawings/ documents to the specifications and contract, interfaces with the equipments provided by others and external connections & dimensions which might affect plant layout. The review by the Employer should not be construed to be a thorough review of all dimensions, quantities and details of the equipments, materials, any devices or items indicated or the accuracy of the information submitted. The review and/ or approval by the Employer/ Project Manager shall not relieve the Contractor of any of his responsibilities and liabilities under this contract. g) After the approval of the drawings, further work by the Contractor shall be in strict accordance with these approved drawings and no deviation shall be permitted without the written approval of the Employer. h) All manufacturing, fabrication and execution of work in connection with the equipment / system, prior to the approval of the drawings, shall be at the Contractor's risk. The Contractor is expected not to make any changes in the design of the equipment /system, once they are approved by the Employer. However, if some changes are necessitated in the design of the equipment/system at a later date, the Contractor may do so, but such changes shall promptly be brought to the notice of the Employer indicating the reasons for the change and get the revised drawing approved again in strict conformance to the provisions of the Technical Specification. i) Drawings shall include all installations and detailed piping layout drawings. Layout drawings for all piping of 65 mm and larger diameter shall be submitted for review/ approval of Employer prior to erection. Small diameter pipes shall however be routed as per site conditions in consultation with site authority/ representative of Employer based on requirements of such piping indicated in approved/ finalised Flow Scheme/ Process & Instrumentation Diagrams and/or the requirements cropping up for draining & venting of larger diameter piping or otherwise after their erection as per actual physical condition for the entire scope of work of this package.			
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8.04.00	Assessing & anticipating the requirements and supply of all piping and equipment shall be done by the contractor well in advance so as not to hinder the progress of piping & equipment erection, subsequent system charging and its effective draining & venting arrangement as per site suitability. j) As Built Drawings After final acceptance of individual equipment / system by the Employer, the Contractor will update all original drawings and documents for the equipment / system to "as built" conditions and submit no. of copies as specified. k) Drawings must be checked by the Contractor in terms of its completeness, data adequacy and relevance with respect to Engineering schedule prior to submission to the Employer. In case drawings are found to be submitted without proper checking by the Contractor, the same shall not be reviewed and returned to the Contractor for re-submission. The contractor shall make a visit to site to see the existing facilities and understand the layout completely and collect all necessary data/ drawings at site which are needed as an input to the engineering. The contractor shall do the complete engineering including interfacing and integration of all his equipment, systems & facilities within his scope of work as well as interface engineering & integration of systems, facilities, equipment & works under Employer's scope and submit all necessary drawings/ documents for the same. l) The Contractor shall submit adequate prints of drawing / data / document for Employer's review and approval. The Employer shall review the drawings and return soft copy to the Contractor authorizing either to proceed with manufacture or fabrication, or marked to show changes desired. When changes are required, drawings shall be re-submitted promptly, with revisions clearly marked, for final review. Any delays arising out of the failure of the Contractor to submit/rectify and resubmit in time shall not be accepted as a reason for delay in the contract schedule. m) All engineering data submitted by the Contractor after final process including review and approval by the Project Manager/ Employer shall form part of the contract documents and the entire works covered under these specifications shall be performed in strict conformity with technical specifications unless otherwise expressly requested by the Project Manager in writing. n) The Contractor shall submit drawings in line with the suggestive MDL covered in Part-B, Section-VI of Technical Specification and which shall be duly integrated with approved PERT network. ENGINEERING INFORMATION SUBMISSION SCHEDULE			
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	Prior to the award of Contract, a Detailed Engineering Information Submission Scheduler/Master Drawing List duly integrated with approved PERT network shall be tied up with the Employer. For this, the bidder shall furnish a detailed list of engineering information alongwith the proposed submission schedule. This list would be a comprehensive one including all engineering data / drawings / information for all bought out items and manufactured items. The information shall be categorized into the following parts. i) Information that shall be submitted for the approval to the Employer before proceeding further, and ii) Information that would be submitted for Employer's information only. The Master Drawing List (MDL) shall be updated periodically and submitted to the employer, highlighting the changes made in MDL. The schedule should allow adequate time for proper review and incorporation of changes/ modifications, if any, to meet the contract without affecting the equipment delivery schedule and overall project schedule. The early submission of drawings and data is as important as the manufacture and delivery of equipment and hardware and this shall be duly considered while determining the overall performance and progress.			
8.05.00	ENGINEERING PROGRESS AND EXCEPTION REPORT			
8.05.01	The Contractor shall submit every month an Engineering progress and Exception Report giving the status of each engineering information including a) A list of drawings/engineering information which remain unapproved for more than four (4) weeks after the date of first submission b) Drawings which were not submitted as per agreed schedule.			
8.05.02	The draft format for this report shall be furnished to the Employer within four (4) weeks of the award of the contract, which shall then be discussed and finalised with the Employer.			
8.06.00	Engineering Co-ordination Procedure			
8.06.01	The following principal coordinators will be identified by respective organizations at time of award of contract: NTPC Engineering Coordinator (NTPC EC): Name :			
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	thereafter, shall indicate NTPC's drawing number in subsequent Submission, in the space provided for this purpose in title plate, in addition to his own drawing number. e) The contractor shall make a visit to site to see the existing facilities and understand the layout completely and collect all necessary data / drawings at site which are needed as an input to the engineering. The contractor shall do the complete engineering including interfacing and integration of all his equipment, systems & facilities within his scope of work as well as interface engineering & integration of systems, facilities, equipment & works under Employer's scope and submit all necessary drawing s/ documents for the same. f) Drawings must be checked by the Contractor in terms of its completeness, data adequacy and relevance with respect to engineering schedule prior to submission to the Employer. In case drawings are found to be submitted without proper endorsement for checking by the Contractor, the same shall not be reviewed and returned to the Contractor for re-submission. g) The Contractor shall submit adequate prints of drawing / data / document for Employer's review and approval. The drawings submitted by the Contractor/vendor shall be reviewed by NTPC and their comments shall be forwarded within four (4) weeks of receipt of drawings. Upon review of each drawing, depending on the correctness and completeness of the drawing, the same will be categorized and approval accorded in one of the following categories : CATEGORY- I: Approved CATEGORY- II Approved, subject to incorporation of comments / modification as noted. Resubmit revised drawing incorporating the comments. CATEGORY –III Not approved. Resubmit revised drawings for approval after incorporating comments/ modification as noted. CATEGORY -IV For information and records. h) Contractor shall resubmit the drawings approved under Category II, III & IV within three (3) weeks of receipt of comments on the drawings, incorporating all comments. Every revision of the drawing shall bear a revision index wherein such revisions shall be highlighted in the form of description or marked up in the drawing identifying the same with relevant revision Number enclosed in a triangle (eg. 1, 2, 3 etc). Contractor shall not make any changes in the portions of the drawing other than those commented. If changes are required to be made in the portions already approved, the		
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	Contractor shall resubmit the drawing identifying the changes for Employer's review and approval. Drawings resubmitted shall show clearly the portions where the same are revised marking the relevant revision numbers and Employer shall review only such revised portion of documents. i) In case, the Contractor/ Vendor does not agree with any specific comment, he shall furnish the explanation for the same to NTPC for consideration. In all such cases the Contractor shall necessarily enclose explanations along with the revised drawing (taking care of balance comments) to avoid any delay and/or duplication in review work. j) It is responsibility of the Contractor/ Vendor to get all the drawings approved in the Category I & IV (as the case may be) and complete engineering activities within the agreed schedule. Any delay arising out of submission and modification of drawings shall not alter the contract completion schedule. k) If Contractor/ Vendor fails to resubmit the drawings as per the schedule, construction work at site will not be held up and work will be carried out on the basis of comments furnished on previous issues of the drawing. l) These comments will be taken care by the contractor while submitting the revised drawing. The contractor shall use a single transmittal for drawings. Submission. This shall include transmittal numbers and date, number of copies being sent, names of the agencies to whom copies being sent, drawing number and titles, remarks or special notes if any etc.		
9.00.00	TECHNICAL CO-ORDINATION MEETING		
9.01.00	The Contractor shall be called upon to organise and attend monthly Design/ Technical Co-ordination Meetings (T CMs) with the Employer/Employer's representatives and other Contractors of the Employer during the period of contract. The Contractor shall attend such meetings at his own cost at NEW DELHI / NOIDA or at mutually agreed venue as and when required and fully co-operate with such persons and agencies involved during the discussions.		
9.02.00	The Contractor should note that Time is the essence of the contract. In order to expedite the early completion of engineering activities, the Contractor shall submit all drawings as per the agreed Engineering Information Submission Schedule. The drawings submitted by the Contractor will be reviewed by the Employer as far as practicable within three (3) weeks from the date of receipt of the drawing. The comments of the Employer shall then be discussed across the table during the above Technical Co-ordination Meeting (s) wherein best efforts shall be made by both sides to ensure the approval of the drawing.		
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9.02.01	The Contractor shall ensure availability of the concerned experts / consultants / personnel who are empowered to take necessary decisions during these meetings. The Contractor shall be equipped with necessary tools and facilities so that the drawings/documents can be resubmitted after incorporating necessary changes and approved during the meeting itself.			
9.02.02	Should any drawing remain unapproved for more than six (6) weeks after its first submission, this shall be brought out in the monthly Engineering Progress and Exception Report with reasons thereof.			
9.03.0	Any delays arising out of failure by the Contractor to incorporate Employer's comments and resubmit the same during the TCM shall be considered as a default and in no case shall entitle the Contractor to alter the Contract completion date.			
10.00.00	DESIGN IMPROVEMENTS The Employer or the Contractor may propose changes in the specification of the equipment or quality thereof and if the parties agree upon any such changes the specification shall be modified accordingly. If any such agreed upon change is such that it affects the price and schedule of completion, the parties shall agree in writing as to the extent of any changing the price and/or schedule of completion before the Contractor proceeds with the change. Following such agreement, the provision thereof, shall be deemed to have been amended accordingly.			
11.00.00	EQUIPMENT BASES A cast iron or welded steel base plate shall be provided for all rotating equipment which is to be installed on a concrete base, unless otherwise specifically agreed to by the Employer. Each base plate shall support the unit and its drive assembly, shall be of a neat design with pads for anchoring the units, shall have a raised lip all around, and shall have threaded drain connections.			
12.00.00	PROTECTIVE GUARDS Suitable guards shall be provided for protection of personnel on all exposed rotating and/or moving machine parts. All such guards shall be designed for easy installation and removal for maintenance purpose.			
13.00.00	LUBRICANTS, SERVO FLUIDS AND CHEMICALS			
13.01.00	I. All the first fills of consumables and one years topping requirement of consumables such as greases, oil, lubricants, servo fluids / control fluids, gases and essential chemicals etc. which will be required to put the equipment covered under the scope of specifications, into successful commissioning / initial operation and to establish completion of facilities shall			
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13.02.00	be supplied by the Contractor. Suitable standard lubricants as available in India are desired. Efforts should be made to limit the variety of lubricants to minimum. Bidder shall supply a quantity not less than 10 % of the full charge or one (1) year topping requirement mentioned above (whichever is higher) of each variety of lubricants, servo fluids, gases, chemicals etc (as detailed above) which is expected to be utilized during the first year of operation. The additional quantity shall be supplied in separate container. As far as possible lubricants marketed by the Indian Oil Corporation shall be used. The variety of lubricants shall be kept to a minimum possible. Detailed specifications for the lubricating oil, grease, gases, servo fluids, control fluids, chemicals etc. required for the complete plant covered herein shall be furnished. On completion of erection, a complete list of bearings/ equipment giving their location and identification marks shall be furnished to the Employer alongwith lubrication requirements.		
14.00.00	LUBRICATION		
14.01.00	Equipment shall be lubricated by systems designed for continuous operation. Lubricant level indicators shall be furnished and marked to indicate proper levels under both standstill and operating conditions.		
15.00.00	MATERIAL OF CONSTRUCTION		
15.01.00	All materials used for the construction of the equipment shall be new and shall be in accordance with the requirements of this specification. Materials utilised for various components shall be those which have established themselves for use in such applications.		
16.00.00	RATING PLATES, NAME PLATES & LABELS		
16.01.00	Each main and auxiliary item of plant including instruments shall have permanently attached to it in a conspicuous position, a rating plate of non-corrosive material upon which shall be engraved manufacturer's name, equipment, type or serial number together with details of the ratings, service conditions under which the item of plant in question has been designed to operate, and such diagram plates as may be required by the Employer.		
16.02.00	Each item of plant shall be provided with nameplate or label designating the service of the particular equipment. The inscriptions shall be approved by the Employer or as detailed in appropriate section of the technical specifications.		
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16.03.00	Such nameplates or labels shall be of white nonhygroscopic material with engraved black lettering or alternately, in the case of indoor circuit breakers, starters, etc. of transparent plastic material with suitably coloured lettering engraved on the back. The name plates shall be suitably fixed on both front and rear side.			
16.04.00	Items of plant such as valves, which are subject to handling, shall be provided with an engraved chromium plated nameplate or label with engraving filled with enamel. The name plates for valves shall be marked in accordance with MSS standard SP-25 and ANSI B 16.34 as a minimum.			
16.05.00	Hanger/ support numbers shall be marked on all pipe supports, anchors, hangers, snubbers and restraint assemblies. Each constant and variable spring support shall also have stamped upon it the designed hot and cold load which it is intended to support. Suitable scale shall also be provided to indicate load on support or hanger.			
16.06.00	Valves, steam traps and strainers shall be identified by Employer's tag number of a metal tap permanently attached to non pressure parts such as the yoke by a stainless steel wire. The direction of flow shall also be marked on the body.			
16.07.00	Safety and relief valves shall be provided with the following: a) Manufacturer's identification. b) Nominal inlet and outlet sizes in mm. c) Set pressure in Kg/cm ² (abs). d) Blowdown and accumulation as percentage of set pressure. e) Certified capacity in Kg of saturated steam per hour or in case of liquid certified capacity in litres of water per minute.			
16.08.00	All such plates, instruction plates, etc. shall be bilingual with Hindi inscription first, followed by English. Alternatively, two separate plates one with Hindi and the other with English inscriptions may be provided.			
16.09.00	All segregated phases of conductors or bus ducts, indoor or outdoor, shall be provided with coloured phase plates to clearly identify the phase of the system.			
17.00.00	TOOLS AND TACKLES The Contractor shall supply with the equipment one complete set of all special tools and tackles and other instruments required and other instruments for the erection, assembly, disassembly and proper maintenance of the plant and equipment and systems (including software). These special tools will also include special material handling equipment, jigs and fixtures for maintenance and calibration / readjustment,			
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	checking and measurement aids etc. A list of such tools and tackles shall be submitted by the Bidder alongwith the offer. The price of each tool / tackle shall be deemed to have been included in the total bid price. These tools and tackles shall be separately packed and sent to site. The Contractor shall also ensure that these tools and tackles are not used by him during erection, commissioning and initial operation. For this period the Contractor should bring his own tools and tackles. In case these tools and tackles are used by the Contractor during erection, commissioning or initial operation the same shall be refurbished repaired/replaced as required to the satisfaction of the Employer before handing over to the Employer. All the tools and tackles shall be of reputed make acceptable to the Employer.			
18.00.00	WELDING			
18.01.00	If the manufacturer has special requirements relating to the welding procedures for welds at the terminals of the equipments to be performed by others the requirements shall be submitted to the Employer in advance of commencement of erection work.			
19.00.00	COLOUR CODE FOR ALL EQUIPMENTS/ PIPINGS/ PIPE SERVICES			
19.01.00	All equipment/ piping/ pipe services are to be painted by the Contractor in accordance with Employer's standard colour coding scheme, which will be furnished to the Contractor during detailed engineering stage.			
20.00.00	PROTECTION AND PRESERVATIVE SHOP COATING			
20.01.00	PROTECTION			
	All coated surfaces shall be protected against abrasion, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either metallic or a nonmetallic protection device. All ends of all valves and piping and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage. The parts which are likely to get rusted, due to exposure to weather, should also be properly treated and protected in a suitable manner. All primers/paints/coatings shall take into account the hot humid, corrosive & alkaline, subsoil or over ground environment as the case may be. The requirements for painting specification shall be complied with as detailed out in Part-A & B of the Technical Specification.			
20.02.00	PRESERVATIVE SHOP COATING			
	All exposed metallic surfaces subject to corrosion shall be protected by shop application of suitable coatings. All surfaces which will not be easily accessible after the shop assembly, shall be treated beforehand and protected for the life of the			
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	equipment. All surfaces shall be thoroughly cleaned of all mill scales, oxides and other coatings and prepared in the shop. The surfaces that are to be finish-painted after installation or require corrosion protection until installation, shall be shop painted as per the requirements covered in the relevant part of the Technical Specification. Transformers and other electrical equipments, if included shall be shop finished with one or more coats of primer and two coats of high grade resistance enamel. The finished colors shall be as per manufacturer's standards, to be selected and specified by the Employer at a later date. 20.03.00 Shop primer for all steel surfaces which will be exposed to operating temperature below 95 degrees Celsius shall be selected by the Contractor after obtaining specific approval of the Employer regarding the quality of primer proposed to be applied. Special high temperature primer shall be used on surfaces exposed to temperature higher than 95 degrees Celsius and such primer shall also be subject to the approval of the Employer. 20.04.00 All other steel surfaces which are not to be painted shall be coated with suitable dust preventive compound subject to the approval of the Employer. 20.05.00 All piping shall be cleaned after shop assembly by shot blasting or other means approved by the Employer. Lube oil piping or carbon steel shall be pickled. 20.06.00 Painting for Civil structures and equipment/system covered under this package shall be done as specified under technical requirements on civil works in relevant part of this specifications. 21.00.00 QUALITY ASSURANCE PROGRAMME 21.01.00 To ensure that the equipment and services under the scope of contract whether manufactured or performed within the Contractor's works or at his sub-contractor's premises or at the Employer's site or at any other place of work are in accordance with the specifications, the Contractor shall adopt suitable quality assurance programme to control such activities at all points, as necessary. Such programmes shall be outlined by the Contractor and shall be finally accepted by the Employer/authorised representative after discussions before the award of the contract. The QA programme shall be generally in line with ISO-9001/IS-14001. A quality assurance programme of the contractor shall generally cover the following: a) His organisation structure for the management and implementation of the proposed quality assurance programme b) Quality System Manual c) Design Control System			
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	d) Documentation Control System e) Qualification data for Bidder's key Personnel. f) The procedure for purchase of materials, parts, components and selection of sub-contractor's services including vendor analysis, source inspection, incoming raw-material inspection, verification of materials purchased etc. g) System for shop manufacturing and site erection control including process controls and fabrication and assembly controls. h) Control of non-conforming items and system for corrective actions. i) Inspection and test procedure both for manufacture and field activities. j) Control of calibration and testing of measuring testing equipments. k) System for Quality Audits. l) System for indication and appraisal of inspection status. m) System for authorising release of manufactured product to the Employer. n) System for handling storage and delivery. o) System for maintenance of records, and p) Furnishing of quality plans for manufacturing and field activities detailing out the specific quality control procedure adopted for controlling the quality characteristics relevant to each item of equipment/component as per formats enclosed as Annexure-I and Annexure-II respectively.			
22.00.00	GENERAL REQUIREMENTS - QUALITY ASSURANCE			
22.01.00	All materials, components and equipment covered under this specification shall be procured, manufactured, erected, commissioned and tested at all the stages, as per a comprehensive Quality Assurance Programme. An indicative programme of inspection/tests to be carried out by the contractor for some of the major items is given in the respective technical specification. This is, however, not intended to form a comprehensive programme as it is the contractor's responsibility to draw up and implement such programme duly approved by the Employer. The detailed Quality Plans for manufacturing and field activities shall be drawn up by the Bidder and will be submitted to Employer for approval. Schedule of finalisation of such quality plans will be finalised before award on enclosed format No. Q S-01-QAI-P-1/F3-R0. Monthly progress reports shall be furnished.			
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22.02.00	Manufacturing Quality Plan will detail out for all the components and equipment, various tests/inspection, to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by Contractor's/ Sub-contractor's/ sub-supplier's Quality Control Organisation, the relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of materials procurement, manufacture, assembly and final testing/performance testing. The Quality Plan shall be submitted on electronic media through C-folders, a web based system of NTPC ERP in addition to hard copy, for review and approval. After approval the same shall be submitted in compiled form on CD-ROM (As per format at Annexure-I)			
22.03.00	Field Quality Plans will detail out for all the equipment, the quality practices and procedures etc. to be followed by the Contractor's "Site Quality Control Organisation", during various stages of site activities starting from receipt of materials/equipment at site (As per format at Annexure – II).			
22.04.00	The Bidders shall also furnish copies of the reference documents/plant standards/acceptance norms/tests and inspection procedure etc., as referred in Quality Plans along with Quality Plans. These Quality Plans and reference documents/standards etc. will be subject to Employer's approval without which manufacturer shall not proceed. These approved documents shall form a part of the contract. In these approved Quality Plans, Employer shall identify customer hold points (CHP), i.e. test/checks which shall be carried out in presence of the Employer's Project Manager or his authorised representative and beyond which the work will not proceed without consent of Employer in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and referred to Employer along with technical justification for approval and dispositioning.			
22.05.00	The contractor shall submit to the Employer Field Welding Schedule for field welding activities in the format enclosed at Annexure-V . The field welding schedule shall be submitted to the Employer along with all supporting documents, like welding procedures, heat treatment procedures, NDT procedures etc. at least ninety days before schedule start of erection work at site.			
22.06.00	The contractor shall have suitable Field Quality Organization with adequate manpower at Employer's site, to effectively implement the Field Quality Plan (FQP) and Field Quality Management System for site activities. The contractor shall submit the details of proposed FQA setup (organizational structure and manpower) for employer's approval. The FQA setup shall be in place at least one month before the start of site activities.			
22.07.00	No material shall be despatched from the manufacturer's works before the same is accepted, subsequent to pre-despatch final inspection including verification of records of all previous tests/inspections by Employer's Project Manager/Authorised representative and duly authorised for despatch by issuance of Material Despatch			
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	Clearance Certificate (MDCC).			
22.08.00	All material used for equipment manufacture including casting and forging etc. shall be of tested quality as per relevant codes/standards. Details of results of the tests conducted to determine the mechanical properties; chemical analysis and details of heat treatment procedure recommended and actually followed shall be recorded on certificates and time temperature chart. Tests shall be carried out as per applicable material standards and/or agreed details			
22.09.00	All welding and brazing shall be carried out as per procedure drawn and qualified in accordance with requirements of ASME Section IX/BS-4870 or other International equivalent standard acceptable to the Employer. All welding/brazing procedures shall be submitted to the Employer or its authorised representative for approval prior to carrying out the welding/brazing.			
22.10.00	All brazers, welders and welding operators employed on any part of the contract either in Contractor's/his sub-contractor's works or at site or elsewhere shall be qualified as per ASME Section-IX or BS-4871 or other equivalent International Standards acceptable to the Employer.			
22.11.00	Welding procedure qualification & Welder qualification test results shall be furnished to the Employer for approval. However, where required by the Employer, tests shall be conducted in presence of Employer/authorized representative.			
22.12.00	For all IBR pressure parts and high pressure piping welding, the latest applicable requirements of the IBR (Indian Boiler Regulations) shall also be essentially complied with. However, other piping system ASME B31.1 or other relevant code as applicable shall be followed. Similarly, any other statutory requirements for the equipment/systems shall also be complied with. On all back-gauged welds MPI/LPI shall be carried before seal welding			
22.13.00	All the heat treatment results shall be recorded on time temperature charts and verified with recommended regimes.			
22.14.00	No welding shall be carried out on cast iron components for repair.			
22.15.00	Unless otherwise proven and specifically agreed with the Employer, welding of dissimilar materials and high alloy materials shall be carried out at shop only.			
22.16.00	All non-destructive examination shall be performed in accordance with written procedures as per International Standards. The NDT operator shall be qualified as per SNT-TC-1A (of the American Society of non-destructive examination) or equivalent. NDT shall be recorded in a report, which includes details of methods and equipment used, result/evaluation, job data and identification of personnel employed and details of co-relation of the test report with the job.			
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22.21.00 22.22.00 22.23.00 22.24.00	mechanical accuracy of components, compliance with drawings, conformance to functional and performance requirements, identity and acceptability of all materials parts and equipment. Contractor shall carry out all tests/inspection required to establish that the items/equipment conform to requirements of the specification and the relevant codes/standards specified in the specification, in addition to carrying out tests as per the approved quality plan. Quality audit/surveillance/approval of the results of the tests and inspection will not, however, prejudice the right of the Employer to reject the equipment if it does not comply with the specification when erected or does not give complete satisfaction in service and the above shall in no way limit the liabilities and responsibilities of the Contractor in ensuring complete conformance of the materials/equipment supplied to relevant specification, standard, data sheets, drawings, etc. For all spares and replacement items, the quality requirements as agreed for the main equipment supply shall be applicable. Repair/rectification procedures to be adopted to make the job acceptable shall be subject to the approval of the Employer/ authorised representative. Environmental Stress Screening All solid state electronic system / equipment / sub assembly shall be free from infant mortile components. For establishing the compliance to this requirement, the contractor / sub – contractor should meet the following. 1) The Contractor / Sub – contractor shall furnish the established procedure being followed for eliminating infant mortile components. The procedure followed by the Contractor / Sub – contractor should be substantiated along with the statistical figures to validate the procedure being followed. The necessary details as required under this clause shall be furnished at the stage of QP finalization. Or In case the Contractor / Sub – contractor do not have any established procedure to eliminate infant mortile components then two or 10% whichever is less, most densely populated Panels shall be tested for Elevated Temperature Cycle Test as per the following procedure. <u>Elevated Temperature Test Cycle</u> During the elevated temperature test which shall be for 48 hours, the ambient temperature shall be maintained at 50° C. The equipment shall be interconnected with devices and kept under energized conditions so as to repeatedly perform all operations it is expected to perform in actual service		
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	with load on various components being equal to those which will be experienced in actual service. During the elevated temperature test the cubicle doors shall be closed (or shall be in the position same as they are supposed to be in the field) and inside temperature in the zone of highest heat dissipating components / modules shall be monitored. The temperature rise inside the cubicle should not exceed 10° C above the ambient temperature at 50° C. In case of any failure during the test cycle, the further course of action should be mutually discussed for demonstrating the intent of the above requirement. 2) <u>Burn in Test Cycle</u> The tests shall be conducted on all the panels fully assembled and wired including the panels having undergone the above mentioned elevated temperature test. The period of Burn in Test Cycle shall be 120 hrs and process shall be similar to the elevated temperature test as above except that the temperature shall be reduced to the ambient temperature prevalent at that time. During the above tests, the process I/O and other load on the systems shall be simulated by simulated inputs and in the case of control systems; the process which is to be controlled shall also be simulated. Testing of individual components or modules shall not be acceptable. During the Burn in Test the cubicle doors shall be closed (or shall be in the position same as they are supposed to be in the field) and inside temperature in the zone of highest heat dissipating components / modules shall be monitored. The temperature rise inside the cubicle should not exceed 10° C above the ambient temperature. 22.25.00 The Contractor / Sub-contractor shall carry out routine test on 100% item at contractor / sub-contractor's works. The quantum of check / test for routine & acceptance test by employer shall be generally as per criteria / sampling plan defined in referred standards. Wherever standards have not been mentioned quantum of check / test for routine / acceptance tests shall be as agreed during detailed engineering stage. 23.00.00 QUALITY ASSURANCE DOCUMENTS 23.01.00 The Contractor shall be required to submit the QA Documentation in two hard copies and two CD ROMs, as identified in respective quality plan with tick (✓) mark.		
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23.01.01	Each QA Documentation shall have a project specific Cover Sheet bearing name & identification number of equipment and including an index of its contents with page control on each document. The QA Documentation files shall be progressively completed by the Supplier's sub-supplier to allow regular reviews by all parties during the manufacturing. The final quality document will be compiled and issued at the final assembly place of equipment before despatch. However CD-Rom may be issued not later than three weeks.			
23.02.00	Typical contents of QA Documentation is as below:- (a.) Quality Plan (b.) Material mill test reports on components as specified by the specification and approved Quality Plans. (c.) Manufacturer / works test reports /results for testing required as per applicable codes and standard referred in the specification and approved Quality Plans. (d.) Non-destructive examination results /reports including radiography interpretation reports. Sketches/drawings used for indicating the method of traceability of the radiographs to the location on the equipment. (e.) Heat Treatment Certificate/Record (Time- temperature Chart) (f.) All the accepted Non-conformance Reports (Major/Minor)/deviation, including complete technical details / repair procedure). (g.) CHP / Inspection reports duly signed by the Inspector of the Employer and Contractor for the agreed Customer Hold Points. (h.) Certificate of Conformance (COC) wherever applicable. (i.) M DCC			
23.03.00	Similarly, the contractor shall be required to submit two sets (two hard copies and two CD ROMs), containing QA Documentation pertaining to field activities as per Approved Field Quality Plans and other agreed manuals/ procedures, prior to commissioning of individual system.			
23.04.00	Before despatch / commissioning of any equipment, the Supplier shall make sure that the corresponding quality document or in the case of protracted phased deliveries, the applicable section of the quality document file is completed. The			
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	supplier will then not ify the In spector regarding the readiness of the quality document (or applicable section) for review. (a.) If the res ult of the re view carri ed out by the Inspecto r is satisfactory, the Inspector shall stamp the qual ity docu ment (or appl icable section) for release. (b.) If the quali ty doc ument i s uns atisfactory, the Suppli er shall endea vor to correct the incompleteness, thus allowing to finalize the quality document (or applicable section) by time compatible with the requirements as per contract documents. When it is done, the quality document (or applicable section) is stamped by the Inspector. (c.) If a decision is made for despatch, whereas all outstanding actions cannot be readily cleared for the rel ease of the quality docu ment by that time, the supplier shall immediately, upon shipment of th e equipment, send a copy of the quality document Review Status signed by the Supplier Representative to the Ins pector and noti fy of the c ommitted dat e fo r the c ompletion o f all outstanding a ctions & submission. The Ins pector shall stamp the qual ity document for applicable s ection when it is effe ctively c ompleted. The submission of QA documentation package shall not be later than 3 weeks after the despatch of equipment.			
23.05.00	TRANSMISSION OF QA DOCUMENTATION On release of QA Documentation by Inspector, one set of quality document shall be forwarded to Corporate Quality Assurance Department and other set to respec tive Project Site of Employer. For the particular case of phased deliveries, the complete quality document to the Employer shall be issued not later than 3 weeks after the date of the last delivery of equipment.			
24.00.00	PROJECT MANAGER’S SUPERVISION			
24.01.00	To el iminate delays a nd av oid d isputes and l itigation, it i s agreed between the parties to the Contract that all matters and questions shall be referred to the Project Manager and without prejudice to t he provisi ons of ‘ Arbitration’ claus e in S ection GCC, the Contractor shall proceed to comply with the Project Manager's decision.			
24.02.00	The work shall be performed under the supervision of the Project Manager. The scope of the duties of the Project Manager pursuant to the Contract, will include but not be limited to the following:			
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	(a.) Interpretation of all the terms and conditions of these documents and specifications (b.) Review and interpretation of all the Contractor's drawing, engineering data, etc (c.) Witness or his authorised representative to witness tests and trials either at the manufacturer's works or at site, or at any place where work is performed under the contract (d.) Inspect, accept or reject any equipment, material and work under the contract (e.) Issue certificate of acceptance and/or progressive payment and final payment certificates (f.) Review and suggest modifications and improvement in completion schedules from time to time, and (g.) Supervise Quality Assurance Programme implementation at all stages of the works.			
25.00.00	INSPECTION, TESTING AND INSPECTION CERTIFICATES			
25.01.00	The word 'Inspector' shall mean the Project Manager and/or his authorised representative and/or an outside inspection agency acting on behalf of the Employer to inspect and examine the materials and workmanship of the works during its manufacture or erection.			
25.02.00	The Project Manager or his duly authorised representative and/or an outside inspection agency acting on behalf of the Employer shall have access at all reasonable times to inspect and examine the materials and workmanship of the works during its manufacture or erection and if part of the works is being manufactured or assembled on other premises or works, the Contractor shall obtain for the Project Manager and for his duly authorised representative permission to inspect as if the works were manufactured or assembled on the Contractor's own premises or works.			
25.03.00	The Contractor shall give the Project Manager/Inspector fifteen (15) days written notice of any material being ready for testing. Such tests shall be to the Contractor's account except for the expenses of the Inspector's. The Project Manager/Inspector, unless the witnessing of the tests is virtually waived and confirmed in writing, will attend such tests within fifteen (15) days of the date on which the equipment is noticed as being ready for test/inspection failing which the contractor may proceed with test which shall be deemed to have been made in the inspector's presence and he shall forthwith forward to the inspector duly certified copies of test reports in two			
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25.04.00 25.05.00 25.06.00 25.07.00 25.08.00 25.09.00	(2) copies. The Project Manager or Inspector shall within fifteen (15) days from the date of inspection as defined herein give notice in writing to the Contractor, or any objection to any drawings and all or any equipment and workmanship which is in his opinion not in accordance with the contract. The Contractor shall give due consideration to such objections and shall either make modifications that may be necessary to meet the said objections or shall inform in writing to the Project Manager/Inspector giving reasons therein, that no modifications are necessary to comply with the contract. When the factory tests have been completed at the Contractor's or sub-contractor's works, the Project Manager /Inspector shall issue a certificate to this effect fifteen (15) days after completion of tests but if the tests are not witnessed by the Project Manager /Inspectors, the certificate shall be issued within fifteen (15) days of the receipt of the Contractor's test certificate by the Project Manager /Inspector. Project Manager /Inspector to issue such a certificate shall not prevent the Contractor from proceeding with the works. The completion of these tests or the issue of the certificates shall not bind the Employer to accept the equipment should it, on further tests after erection be found not to comply with the contract. In all cases where the contract provides for tests whether at the premises or works of the Contractor or any sub-contractor, the Contractor, except where otherwise specified shall provide free of charge such items as labour, material, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the Project Manager /Inspector or his authorised representatives to carry out effectively such tests on the equipment in accordance with the Contractor and shall give facilities to the Project Manager/Inspector or to his authorised representative to accomplish testing. The inspection by Project Manager / Inspector and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Contractor in respect of the agreed Quality Assurance Programme forming a part of the contract. To facilitate advance planning of inspection in addition to giving inspection notice as specified at clause no 25.03.00 of this chapter, the Contractor shall furnish quarterly inspection programme indicating schedule dates of inspection at Customer Hold Point and final inspection stages. Updated quarterly inspection plans will be made for each three consecutive months and shall be furnished before beginning of each calendar month. All inspection, measuring and test equipment used by contractor shall be calibrated periodically depending on its use and criticality of the test/measurement to be done. The Contractor shall maintain all the relevant records of periodic calibration and instrument identification, and shall produce the same for inspection by NTPC. Wherever asked specifically, the contractor shall re-calibrate the measuring/test equipment in the presence of Project Manager / Inspector.			
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25.10.00	Associated document for Quality Assurance programme			
25.10.01	Manufacturing Quality Plan Format No. : Q S-01-QAI-P-09/F1-R1 enclosed at Annexure-I.			
25.10.02	Field Quality Plan Format No.: QS-01-QAI-P-09/F2-R1 enclosed at Annexure-II.			
25.10.03	List of items requiring quality plan and sub supplier approval. Format No.: QS-01-QAI-P-01/F3-R0 (Annexure-III).			
25.10.04	Status of items requiring Quality Plan and sub supplier approval. Format enclosed at Annexure-IV.			
25.10.05	Field Welding Schedule Format enclosed at Annexure-V.			
25.11.00	Not Used			
25.12.00	DEMONSTRATION OF APPLICATION ENGINEERING			
25.12.01	Based on NTPC inputs, the Contractor shall prepare and submit typical implemented scheme in their system (Control system & HMI) on sample basis. The typical cases to be covered shall include but not be limited to the following. (i) Logics/Loops: a) Drive logics implementation for each type of binary drive along with its display in HMI. b) Sequence implementation along with its display in HMI. c) Single non-cascade controller implementation. d) Cascade loop implementation. e) Master slave implementation with different slave combination. f) Temperature & pressure compensation for flow signals & pressure compensation for level signals as applicable. (ii) HMI Functions: a) LVS Annunciation. b) Graphics. c) HSR d) Logs/Reports.			
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	e) Calculations (Basic & Performance Calculations).			
25.12.02	The above typical cases shall be finalized with the Employer through Technical Coordination meetings. After review and finalization of the typical cases, the implementation of each logic & control loop shall be carried out by the Contractor based on NTPC inputs. After implementation of these logics & loops, the Contractor shall test each logic /loop and record the observations in a format to be provided by the Employer and demonstrate to Employer at Employer premises during engineering finalization. Any modifications as a result of the demonstration shall be done and documented as part of the test report along with the final scheme. Similarly, HMI functions shall also be demonstrated by the Contractor at Employer premises & the results shall be documented as part of test report.			
25.12.03	During the integrated testing at the Contractor's works, only sample checks shall be done by the Employer for the items covered in above application engineering demonstration.			
26.00.00	PRE-COMMISSIONING AND COMMISSIONING FACILITIES			
26.01.00	(a) As soon as the facilities or part thereof has been completed operationally and structurally and before start-up, each item of the equipment and systems forming part of facilities shall be thoroughly cleaned and then inspected jointly by the Employer and the Contractor for correctness of and completeness of facility or part thereof and acceptability for initial pre-commissioning tests, commissioning and start-up at Site. The list of pre-commissioning tests to be performed shall be as mutually agreed and included in the Contractor's quality assurance programme as well as those included in Part-D, Section-VI and elsewhere in the Technical Specifications. (b) The Contractor's pre-commissioning/ commissioning/start-up engineers, specially identified as far as possible, shall be responsible for carrying out all the pre-commissioning tests at Site. On completion of inspection, checking and after the pre-commissioning tests are satisfactorily over, the commissioning of the complete facilities shall be commenced during which period the complete facilities, equipments shall be operated integral with sub-systems and supporting equipment as a complete plant. (c) All piping system shall be flushed, steam blown, air blown as required and cleanliness demonstrated using acceptable industry standards. Procedures to accomplish this work shall be submitted for approval to the Employer six months prior to the respective implementations. The Employer will approve final verification of cleanliness.			
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26.01.00	(d) The time consumed in the inspection and checking of the units shall be considered as a part of the erection and installation period. (e) The check outs during the pre - commissioning period should be programmed to follow the construction completion schedule. Each equipment/system, as it is completed in construction and turned over to Employer's commissioning (start-up) Engineer(s), should be checked out and cleaned. The checking and inspection of individual systems should then follow a prescribed commissioning documentation [SLs(stand and check list)/TS(testing schedule)/CS(commissioning schedule)] approved by the employer. (f) The Contractor during initial operation and performance testing shall conduct vibration testing to determine the 'base line' of performance of all plant rotating equipment. These tests shall be conducted when the equipment is running at the base load, peak load as well as lowest sustained operating condition as far as practicable. Contractors shall furnish the commissioning organization chart for review & acceptance of employer at least eighteen months prior to the schedule date of synchronization of 1st unit. The chart should contain: (1.) Biodata including experience of the Commissioning Engineers. (2.) Role and responsibilities of the Commissioning Organisation members. (3.) Expected duration of posting of the above Commissioning Engineers at site.			
26.02.00	Initial Operation (a) On completion of all pre-commissioning activities/ tests and as a part of commissioning the complete facilities shall be put on 'Initial Operation' during which period all necessary adjustments shall be made while operating over the full load range enabling the facilities to be made ready for the Guarantee Tests. (b) The 'Initial Operation' of the complete facility as an integral unit shall be conducted for 720 continuous hours. During the period of initial operation of 720 hours, the FGD System shall operate continuously at full load for a period not less than 72 hours. The Initial Operation shall be considered successful, provided that each item/ part of the facility can operate continuously at the specified operating characteristics, for the period of Initial Operation with all operating parameters within the specified limits and at or near the predicted performance of the equipment/ facility.			
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26.03.00	The Contractor shall intimate the Employer about the commencement of initial operation and shall furnish a adequate notice to the Employer in this respect. (c) Any loss of generation due to constraints attributable to the Employer shall be construed as Deemed Generation. (d) An Initial Operation report comprising of observations and recordings of various parameters to be measured in respect of the above Initial Operation shall be prepared by the Contractor. This report, besides recording the details of the various observations during initial operation shall also include the dates of start and finish of the Initial Operation and shall be signed by the representatives of both the parties. The report shall have sheets, recording all the details of interruptions occurred, adjustments made and any minor repairs done during the Initial Operation. Based on the observations, necessary modifications/repairs to the plant shall be carried out by the Contractor to the full satisfaction of the Employer to enable the latter to accord permission to carry out the Guarantee tests on the facilities. However, minor defects which do not endanger the safe operation of the equipment, shall not be considered as reasons for withholding the aforesaid permission.			
	Guarantee Tests a) The final test as to prove the Functional Guarantees shall be conducted at Site by the Contractor in presence of the Employer. The contractor's Commissioning, start-up and initial operation shall make the unit ready to conduct such test. Such test will be commenced, within a period of <u>three (3) months</u> after the successful completion of Initial Operations. Any extension of time beyond the above <u>three (3) months</u> shall be mutually agreed upon. b) These tests shall be binding on both the parties of the Contract to determine compliance of the equipment with the functional guarantee. c) For performance/ demonstration tests in instrumentations, of accuracy class shall be as per specified test codes. The numbers and location of the instruments shall be as per the specified test codes. In addition the values of parameters shall be logged from the information system provided under Employer's Distributed Digital Control Monitoring and Information system. Test will be conducted at specified load points. d) Any special equipment, tools and tackles required for the successful completion of the Guarantee Tests shall be provided by the Contractor, free of cost.			
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	e) The Guarantee tests and specific tests to be conducted on equipments have been brought out in detail elsewhere in the specifications.		
27.00.00	TAKING OVER Upon successful completion of Initial Operations and all the tests conducted to the Employer's satisfaction, the Employer shall issue to the Contractor a Taking over Certificate as a proof of the final acceptance of the equipment. Such certificate shall not unreasonably be withheld nor will the Employer delay the issuance thereof, on account of minor omissions or defects which do not affect the commercial operation and/or cause any serious risk to the equipment. Such certificate shall not relieve the Contractor of any of his obligations which otherwise survive, by the terms and conditions of the Contract after issuance of such certificate.		
28.00.00	TRAINING OF EMPLOYER'S PERSONNEL		
28.01.00	Training for Employers O&M Personnel The scope of service under training of Employer's engineers shall include a training module covering upto six (6) man months in the areas of Operation & Maintenance. Such training should enable the personnel to individually take the responsibility of operating and maintaining the FGD system in a manner acceptable to the Employer.		
28.02.00	Training for Employers Engineering Personnel The scope of services under training for Employer's engineering personnel shall also necessarily include three (03) man months. This shall cover all disciplines viz, Mechanical, Electrical, C&I, & QA etc. and shall include all the related areas like Design familiarization, training on product design features and product design softwares of major equipment and systems, engineering, manufacturing, erection, commissioning, training on operating features of equipment, quality assurance and testing, plant visits and visits to manufacturer's works, exposure to various kinds of problems which may be encountered in fabrication, manufacturing, erection, welding etc. An indicative module of the training requirement of Employer's Engineering personnel is attached as Annexure-VII.		
28.03.00	Bidder shall furnish in his offer, details of training module(s) covering above requirements which shall be subject to Employer's approval. Consolidated training period included above {i.e. 6 man months (7 man months in case of projects where ZLD system is included in scope) and 3 man months (4 man months in case of projects where ZLD system is included in scope) respectively for O & M and		
NCTPP DADRI(2X490MW) & IGSTPP JHAJJAR (3X500MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-6130/0330-109-9	GENERAL TECHNICAL REQUIREMENTS PAGE 41 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	Engineering) is indicative only . Employer reserves the right to re a p p r o p r i a t e t h e training period between O&M and engineering depending upon the details of training module proposed by the Bidder.			
28.04.00	Exact details, extent of training and the training schedule shall be finalised based on the Bidder's proposal within two (2) months from placement of award.			
28.05.00	In all the above cases, wherever the training of Employer's personnel is arranged at the works of the manufacturer's it shall be noted that the lodging and boarding of the Employer's personnel shall be at the cost of Contractor. The Contractor shall make all necessary arrangements towards the same.			
28.06.00	Take off prices (product wise) should be indicated by the Bidder in the Bid Proposal Sheets. Employer reserves the right to include or exclude these item(s) during placement of Award. Note: For training purposes, one (1) man month implies 30 working days (excluding all intervening holidays) per person.			
29.00.00	SAFETY ASPECTS DURING CONSTRUCTION AND ERECTION In addition to the requirements given in Erection Conditions of Contract (ECC) the following shall also cover: i) Working platforms should be fenced and shall have means of access. ii) Ladders in accordance with Employer's safety rules for construction and erection shall be used. Rungs shall not be welded on columns. All the stairs shall be provided with handrails immediately after its erection.			
30.00.00	NOISE LEVEL The equivalent 'A' weighted sound pressure level measured at a height of 1.5 m above floor level in elevation and at a distance of one (1) metre horizontally from the nearest surface of any equipment/machine, furnished and installed under these specifications, expressed in decibels to a reference of 0.0002 mic robar, shall not exceed 85 dBA . However for Ball Mills and lime stone crusher the noise levels as per following shall also be acceptable: a) Ball Mill < 90 dBA b) Lime stone Crusher < 90 dBA			
NCTPP DADRI(2X490MW) & IGSTPP JHAJJAR (3X500MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-6130/0330-109-9		GENERAL TECHNICAL REQUIREMENTS
				PAGE 42 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS											
31.00.00	PACKAGING AND TRANSPORTATION All the equipments shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at Site till the time of erection. While packing all the materials, the limitation from the point of view of the sizes of railway wagons available in India should be taken account of. The Contractor shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. The Contractor shall ascertain the availability of Railway wagon sizes from the Indian Railways or any other agency concerned in India well before effecting despatch of equipment. Before despatch it shall be ensured that complete processing and manufacturing of the components is carried out at shop, only restricted by transport limitation, in order to ensure that site works like grinding, welding, cutting & preassembly to bare minimum. The Employer's Inspector shall have right to insist for completion of works in shop before despatch of materials for transportation.											
32.00.00	ELECTRICAL EQUIPMENTS/ENCLOSURES											
32.01.00	All electrical equipments and devices, including insulation, heating and ventilation devices shall be designed for ambient temperature and a maximum relative humidity as specified elsewhere in the specifications.											
33.00.00	INSTRUMENTATION AND CONTROL All instrumentation and control systems/ equipment/ devices/ components, furnished under this contract shall be in accordance with the requirements stated herein, unless otherwise specified in the detailed specifications.											
33.01.00	All instrument scales and charts shall be calibrated and printed in metric units and shall have linear graduation. The ranges shall be selected to have the normal reading at 75% of full scale. All scales and charts shall be calibrated and printed in Metric Units as follows: <table><tr><td>1. Temperature</td><td>- Degree centigrade (deg C)</td></tr><tr><td>2. Pressure</td><td>- Kilograms per square centimetre (Kg/cm²). Pressure instrument shall have the unit suffixed with 'a' to indicate absolute pressure. If nothing is there, that will mean that the indicated pressure is gauge pressure.</td></tr><tr><td>3. Draught</td><td>- Millimetres of water column (mm wc).</td></tr><tr><td>4. Vacuum</td><td>- Millimeters of mercury gauge (mm Hg)</td></tr></table>				1. Temperature	- Degree centigrade (deg C)	2. Pressure	- Kilograms per square centimetre (Kg/cm ²). Pressure instrument shall have the unit suffixed with 'a' to indicate absolute pressure. If nothing is there, that will mean that the indicated pressure is gauge pressure.	3. Draught	- Millimetres of water column (mm wc).	4. Vacuum	- Millimeters of mercury gauge (mm Hg)
1. Temperature	- Degree centigrade (deg C)											
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3. Draught	- Millimetres of water column (mm wc).											
4. Vacuum	- Millimeters of mercury gauge (mm Hg)											
NCTPP DADRI(2X490MW) & IGSTPP JHAJJAR (3X500MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-6130/0330-109-9	GENERAL TECHNICAL REQUIREMENTS	PAGE 43 OF 83								

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS		एन टी पी सी NTPC	
		or water column (mm Wcl).		
	5. Flow (Gas)	- Tonnes/ hour		
	6. Flow (Steam)	- Tonnes/ hour		
	7. Flow (Liquid)	- Tonnes / hour		
	8. Flow base	- 760 mm Hg. 0 deg.C		
	9. Density	- Grams per cubic centimeter.		
33.02.00	All instruments and control devices provided on panels shall be of miniaturized design, suitable for modular flush mounting on panels with front draw out facility and flexible plan-in connection at rear.			
33.03.00	All electronic modules shall have gold plated connector fingers and further all input and output modules shall be short circuit proof. These shall also be tropicalised & components shall be of industrial grade or better.			
34.00.00	ELECTRICAL NOISE CONTROL The equipment furnished by the Contractor shall incorporate necessary techniques to eliminate measurement and control problems caused by electrical noise. Areas in Contractor's equipment which are vulnerable to electrical noise shall be hardened to eliminate possible problems. Any additional equipment, services required for effectively eliminating the noise problems shall be included in the proposal. The equipment shall be protected against ESD as per IEC-61000-2. Radio Frequency interference (RFI) and Electro Magnetic Interference (EMI) protection against hardware damage and control system mal-operations/errors shall be provided for all systems as per EN-50082-2 (1995).			
35.00.00	SURGE PROTECTION FOR SOLID STATE EQUIPMENT All solid state systems /equipment shall be able to withstand the electrical noise and surge as encountered in actual service conditions and inherent in a power plant and shall meet the requirements of surge protection as defined in ANSI C37.90.1-1989 on its suitable equivalent class of IEC 254-4. Details of the features incorporated and relevant tests carried out. The test certificates. etc. shall be submitted by the Bidder.			
36.00.00	INSTRUMENT AIR SYSTEM The instrument air supply system as supplied by the Bidder for various pneumatic control & instrumentation devices like pneumatic actuators, power cylinders, E/P converters, piping / tubing etc.			
NCTPP DADRI(2X490MW) & IGSTPP JHAJJAR (3X500MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-6130/0330-109-9		GENERAL TECHNICAL REQUIREMENTS PAGE 44 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 		
37.00.00	Each pneumatic instrument shall have an individual air shut - off valve. The pressure regulating valve shall be equipped with an internal filter, a 50 mm pressure gauge and a built-in filter housing blow down valve. TAPPING POINTS FOR MEASUREMENTS Tapping points shall include probes, wherever applicable, for analytical measurements and sampling. For direct temperature measurement of all working media, one stub with internal threading of approved pattern shall be provided along with suitable plug and washer. The Contractor will be intimated about thread standard to be adopted. The following shall be provided on equipment by the Bidder. The standard which is to be adopted, will be intimated to the Contractor. i) Temperature test pockets with stub and thermowell ii) Pressure test pockets		
38.00.00	SYSTEM DOCUMENTATION The Bidders shall provide drawings, system overview & description, hardware/software details, technical literature, functional & hardware schemes, bill of material, parts list, interconnection diagrams, data sheets, erection/ installation/ commissioning procedures, instruction/ operating manuals, etc. for each of the C& I system / sub-systems/ equipment supplied under this package. The documentation shall include complete details of the C&I systems/ sub-systems/ equipment to enable review by Employer during detailed engineering stage and to provide information to plant personnel for operation & Maintenance (including quick diagnostics & trouble shooting) of these C&I systems / sub-systems/ equipment at site. The minimum documentation requirements for C&I systems shall be as stipulated under C&I "Technical Data Sheets" Part of specific stations. In addition to this, system documentation for control system shall include as a minimum to that specified elsewhere in the Technical Specification. The exact format, submission schedule and contents of various documents shall be as finalised during detailed engineering stage.		
38.01.00	Bill of material (instrument list) for all C&I equipment/ devices shall be furnished by the bidder in standard formats as approved by the Employer.		
39.00.00	MAINTENANCE MANUALS OF ELECTRONIC MODULES The Contractor shall have to furnish two (2) sets of all maintenance manual of each and every electronic card/module as employed on the various systems and		
NCTPP DADRI(2X490MW) & IGSTPP JHAJJAR (3X500MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-6130/0330-109-9	GENERAL TECHNICAL REQUIREMENTS PAGE 45 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 			
	equipment including peripherals etc., offered by him. The Contractor will also have to furnish the data regarding the expected failure rate of various modules and other system components. Further, the contractor shall furnish a set of operating manuals which should include block diagrams, make, model/type, details wiring and external connection drawings etc. as required to do the testing and maintenance of the electronic modules.			
NCTPP DADRI(2X490MW) & IGSTPP JHAJJAR (3X500MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-6130/0330-109-9	GENERAL TECHNICAL REQUIREMENTS	PAGE 46 OF 83	



2 X 490 MW NCTPPP, DADRI, STAGE-II

COMPRESSED AIR SYSTEM

SPECIFICATION No: PE-TS-436-555-A001

VOLUME: II B

SECTION : C2-C

REV. 00

DATE: 19.03.18

SHEET: 1 OF 1

SECTION: C2-C
PERFORMANCE GUARANTEE TESTS

CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES	एनटीपीसी NTPC
	Corrections for background noise shall be considered in line with the applicable standards. All the necessary data for determining these corrections, in line with the applicable standards, shall be collected during the tests. (xi) Mist Outlet Droplet Content The mist eliminator outlet droplet content shall be guaranteed to be ≤ 20 mg/Nm³ at absorber outlet measured over a period of 24 hrs continuous operation. Mist outlet-droplet content shall be measured as per applicable clauses in VDI Norm 3679 and the Contractor shall carry out the tests as per the test procedure approved by the Employer. (xii) Availability of FGD Plant The Contractor shall guarantee the maximum availability of FGD Plant on yearly basis for the range of coal and limestone specified in line with the requirements stipulated in clause 7.00.00(B) of this Sub-Section. (xiii) Air Conditioning System A. Following shall be demonstrated at Shop 1) Capacity and static pressure of AHU fans at its rated duty point. B. Following shall be demonstrated at Site 1) Capacity (TR) of air cooled condensing units (D-X type) for A/C system of FGD control room building. 2) Guaranteed room conditions during summer for all the Air conditioned areas. 3) Vibration and noise level of condensing units & centrifugal fans of AHUs. (xiv) Ventilation System A. Following shall be demonstrated at Shop 1) Capacity and discharge pressure of pumps of UAF units at its rated duty point of Ventilation system. 2) Capacity and static pressure of UAF fans at its rated duty point of Ventilation system. B. Following shall be demonstrated at Site 1) Vibration & Noise level of centrifugal fans & pumps of UAF units. (xv) Compressed Air System a) Following shall be demonstrated at shop:	
NCTPP DADRI(2X490MW) & IGSTPP JHAJJAR (3X500MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-A BID DOCUMENT NO.: CS-6130/0330-109-9	SUB-SECTION-VI FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES PAGE 11 OF 16

CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES			एनटीपीसी NTPC
5.00.00	i) Capacity and discharge pressure of each air compressor. b) Following shall be demonstrated at site: ii) Dew point of air at the outlet of air drying plants of air compressor. iv) Pressure drop across air drying plant. v) Vibration and noise level of air compressors, blowers of air drying plant (if applicable)			
	xvi) Equipment Cooling Water System i) Vibration, noise and parallel operation without hunting & abnormal noise and with flow sharing within 10% of each other at the rated duty point shall be demonstrated at site. ii) Design heat load of plate type heat exchangers and Inlet & Outlet temperatures of the Plate type heat exchangers on the primary and secondary side to be demonstrated at site. Pressure drop across the Plate type heat exchanger on the primary & secondary water circuit to be demonstrated at site.			
AUXILIARY POWER CONSUMPTION (PA) FOR EACH PROJECT Power consumption for Compressed air system shall be shown and proof in this regard.				
NCTPP DADRI(2X490MW) & IGSTPP JHAJJAR (3X500MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-A BID DOCUMENT NO.: CS-6130/0330-109-9		SUB-SECTION-VI FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES
PAGE 12 OF 16				



2 X 490 MW NCTPPP, DADRI, STAGE-II

COMPRESSED AIR SYSTEM

SPECIFICATION No: PE-TS-436-555-A001

VOLUME: II B

SECTION : C2-D

REV. 00

DATE: 19.03.18

SHEET: 1 OF 1

SECTION: C2-D
QUALITY ASSURANCE

CLAUSE NO.	QUALITY ASSURANCE			
1.00.00 1.01.00 1.01.01 1.02.00	<u>AIR COMPRESSOR SYSTEM</u> 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). MPI/DP test will be done on machined areas of the above components. e. Rotor shall be statically and dynamically balanced. PERFORMANCE TEST (SHOP TEST) : a) Performance test on the compressors shall be carried out in accordance relevant standard. 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 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 (iii) 10% RT on butt welds which shall include all T- joints.			
NCTPP DADRI ST-II (2X490MW) & IGSTPP, JHAJJAR (3X500MW) PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC NO.:CS-6130/0330-109-9	SUB-SECTION -V- QM6 COMPRESSED AIR SYSTEM	Page 1 of 2	

CLAUSE NO.	QUALITY ASSURANCE			एनटीपीसी NTPC
1.04.00	c) Tube to Tube sheet joint of the heat exchangers shall be subject to Mock-up test as per the relevant standards. d) Reactivation blowers shall be tested for FAD, temp. rise noise & vibration. Rotating parts shall be dynamically balanced. 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.			
	H.O.T. CRANE : a) Chain pulley Blocks shall be tested as per IS: 3832. b) Following NDT requirements shall be met : (i) 100% RT of Butt welds in tension and 10% RT of butt welds in compression. (ii) DP at random on all weldments. Deflection, load, overload & travel check on HOT crane assembly shall be carried out as per IS:3177.			
1.05.00	PIPINGS, VALVES, AND FITTINGS a. All pipes and fittings shall be tested as per applicable code. b. All valves shall be hydraulically tested for body, seat and back-seat (if applicable) as per relevant standard. Check valves shall also be tested for leak tightness test at 25% of the specified seat test pressure. c. Valves shall be offered for hydro test in unpainted condition. d. Functional checks of the valves for smooth opening and closing shall also be done. All forgings, dia ≥ 50 mm shall be Ultrasonic Tested irrespective of the type, size & rating of the valve.			
NCTPP DADRI ST-II (2X490MW) & IGSTPP, JHAJJAR (3X500MW) PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC NO.:CS-6130/0330-109-9	SUB-SECTION -V- QM6 COMPRESSED AIR SYSTEM	Page 2 of 2

MANUFACTURE'S NAME & ADDRESS				MANUFACTURING QUALITY PLAN				PROJECT															
ITEM : BALL VALVE				QIP NO.				CONTRACT NO.															
P.O. NO. :				REV. NO. :				END USER :															
P.O. DATE :				DATE :				CONTRACTOR : BHARAT HEAVY ELECTRICAL LIMITED															
PAGE : 1 OF 1																							
SL. NO.				COMPONENTS & OPERATION		CHARACTERISTICS		CLASS		TYPE OF CHECK		QUANTUM OF CHECK		REFERENCE DOCUMENTS		ACCEPTANCE		FORMATS OF RECORDS		AGENCY		REMARKS	
1.0				MATERIALS																			
1.1				BODY, END PIECES, BALL & FASTENERS		Chemical Composition	Critical	Chemical Testing	One / Heat	One / Heat	Appt / Drgs Tech Spec	Appt Drgs / DS/MSFG STD	Foundary TC	V	P	V	V						
						Mechanical Properties	Critical	Mechanical Testing	One / Heat / Heat Treatment Batch				Foundary TC	V	P	V	V						
						Heat Treatment (Only For Casting)	Critical	Heat treatment	100%	100%			Report	V	P	V	V						
1.2				BALL STEM AND GLAND (BAR STOCK)		Surface Defects	Major	Visual	100%	100%	MSS-SP-55	MSS-SP-55	Inspection report	-	P	-	-						
						Chemical Composition	Critical	Chemical Testing	One / Heat	One / Heat	ASTM STD	ASTM STD	Foundary TC & Lab Reports	V	P	V	V						
						Mechanical Properties	Critical	Mechanical Testing	One / Heat / Batch	One / Heat / Batch	ASTM STD	ASTM STD	Foundary TC & Lab Reports	V	P	V	V						
				STEM		Ultrasonic Test for Stem	Critical	Ultrasonic Test	100%	100%	ASTM B 16-34	ASTM B 16-348 ASME B 16-34 ANNEXURE E	UT REPORT	V	P	V	V						For dia>50mm above only.
1.3				Body Seat & Seal (as applicable)		Hardness	Critical	Hardness Test	100%	100%	Tech. Spec/Applicable Sid	Tech Spec. / Applicable Sid	Test Certificate	V	P	V	V						
1.4				QT		Functional port leakage test	Major	Review of Manufacturer TC	100%	100%	Apptd Drg/DS/Mfg	Apptd. Drg / DS / Mfg Sid	Test Certificate	V	P	V	V						
2.0				INPROCESS INSPECTION																			
2.1				MACHINING OF BODY, END PIECES, BALL & STEM		Dimension	Major	Measurement	100%	100%	Mfg Drgs	Mfg Drgs	Inspection report	V	P	V	-						
2.2				Ball & Seat		Blue Matching (For Metal Seat)	Critical	Visual	100%	100%	The Surface shall be smooth and shall have uniform contact with seating surface.		IR	V	-	P	-						
3.0				ASSEMBLY		Dimension	Major	Measurement	10%	10%	Apptd Drgs	Apptd Drgs	-	V	P	V	V						
4.0				TESTING																			
4.1				SHELL		Leakage	Critical	Hydrostatic Pressure	100%	10%	Approved Drawings / DS/ Rel standard	No Leakage	Test Certificate	V	P	V	W						
4.2				HYDRO SEAT		Leakage	Critical	Hydrostatic Pressure	100%	10%	Approved Drawings / DS/ Rel standard	No Leakage	Test Certificate	V	P	V	W						
4.3				PNEUMATIC SEAT		Leakage	Critical	Air Pressure	100%	10%	Approved Drawings / DS/ Rel standard	No Leakage	Test Certificate	V	P	V	W						
4.4				PERFORMANCE / FUNCTIONAL CHECK		Operation (Opening & Closing)	Major	Visual	100%	10%	Drawing & Technical Spec.	Smooth Operation	Inspection report	V	P	V	W						
5.0				FINAL INSPECTION		Cleanliness Completeness &	Major	Visual	100%	10%	As per Drg/ Tech Spec.	As per Drg/ Tech Spec.	Inspection report	V	P	V	V						
5.1				PAINTING		DFT CHECK	Major	Visual	100%	10%	As per Drg/ Tech Spec.	As per Drg/ Tech Spec.	Inspection report	V	P	V	V						
6.0				PROVISION OF NAME PLATE		As Per Spec	Major	Visual			As per Specification	As per Specification	Inspection report	-	P	V	V						
NOTE: SS PARTS SHALL BE CHECKED AT 10% POSITIVE MATERIAL IDENTIFICATION (PMI) GRADE ANALYSER																							
LEGEND:												DOC. NO. :											
RECORDS IDENTIFIED WITH TICK (✓) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.																							
M. MANUFACTURER / SUB-SUPPLIER																							
C. MAIN SUPPLIER N. END USER & SHIEL																							
P. PERFORMANCE W. WITNESS V. VERIFICATION																							
AS APPROPRIATE																							
MANUFACTURER/SUB SUPPLIER				MAIN SUPPLIER				SIGNATURE				REVIEWED BY				APPROVED BY				APPROVAL SEAL			

MANUFACTURE'S NAME & ADDRESS										MANUFACTURING QUALITY PLAN									
ITEM : CHECK VALVE					ACIOP NO. :					CONTRACT NO. :									
P.O. NO. :					REV. NO. :					END USER :									
P.O. DATE :					W.O. NO. :					CONTRACTOR : BHARAT HEAVY ELECTRICAL LIMITED									
PAGE : 1 OF 1					REFERENCE DOCUMENTS					ACCEPTANCE NORMS									
QUANTUM OF CHECK					FORMATS OF RECORDS					AGENCY									
M					C/N					M									
C/N					D					N									
CLASS					TYPE OF CHECK					REMARKS									
CHARACTERISTICS					CHEMICAL TESTING					MECHANICAL TESTING									
COMPOONENTS & OPERATION					One / Heat					One / Heat / Heat Treatment Batch									
1.0 MATERIALS					100%					100%									
1.1 BODY, COVER, DISC, SEATRING & FASTNERS					Heat treatment					Report									
1.2 HINGE PIN (BAR STOCK)					Visual					Inspection report									
					100%					Foundary TC & Lab Reports									
					100%					Foundary TC & Lab Reports									
					100%					UT REPORT									
					100%					For dia>50mm above only									
2.0 INPROCESS INSPECTION																			
2.1 MACHINING OF BODY, COVER, DISC					100%					Mfg Drgs									
2.2 DISC & SEATRING					100%					The Surface shall be smooth and shall have uniform contact with seating surface.									
3.0 ASSEMBLY					10%					Appd Drgs									
4.0 TESTING																			
4.1 SHELL					100%					Approved Drawings / DS/ Ref standard									
4.2 HYDRO SEAT					100%					Approved Drawings / DS/ Ref standard									
5.0 FINAL INSPECTION					100%					As per Drg/ Tech Spec.									
5.1 PAINTING					100%					As per Drg/ Tech Spec.									
6.0 PROVISION OF NAME PLATE					As per Specification					As per Specification									
NOTE:- SS PARTS SHALL BE CHECKED AT 10% POSITIVE MATERIAL IDENTIFICATION (PMI) GRADE ANALYSER																			
LEGEND:										DOC. NO. :									
*RECORDS IDENTIFIED WITH TICK(✓) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.																			
M : MANUFACTURER / SUB-SUPPLIER																			
C : MAIN SUPPLIER N : END USER & BHEL																			
P : PERFORMANCE W : WITNESS V : VERIFICATION AS APPROPRIATE																			
MANUFACTURER/SUB-SUPPLIER					MAIN SUPPLIER					REVIEWED BY									
SIGNATURE										APPROVED BY									
										APPROVAL SEAL									

MANUFACTURE'S NAME & ADDRESS

ITEM : GATE VALVE

ACIQP NO. :

REV. NO. :

W.O. NO. :

PAGE : 1 OF 1

DATE :

CONTRACTOR : BHARAT HEAVY ELECTRICAL LIMITED

PROJECT

CONTRACT NO.

END USER

CONTRACTOR : BHARAT HEAVY ELECTRICAL LIMITED

MANUFACTURING QUALITY PLAN

CLASS : 4

TYPE OF CHECK : 5

QUANTUM OF CHECK : 6

REFERENCE DOCUMENTS : 7

ACCEPTANCE NORMS : 8

FORMATS OF RECORDS : 9

AGENCY : 10

REMARKS : 11

COMPONENTS & OPERATION

1.0 MATERIALS

1.1 BODY, BONNET, WEDGE, SEATING & FASTENERS

CHARACTERISTICS

Critical

Critical

Critical

Major

Critical

Critical

Critical

Chemical Composition

One / Heat

One / Heat / Heat Treatment Batch

100%

100%

100%

One / Heat / Batch

100%

Chemical Testing

Mechanical Testing

Heat treatment

Visual

Chemical Testing

Mechanical Testing

Ultrasonic Test

1.2 STEM AND GLAND (BAR STOCK)

CHARACTERISTICS

Critical

Chemical Composition

One / Heat

Chemical Testing

Mechanical Testing

STEM

CHARACTERISTICS

Critical

Chemical Composition

One / Heat

Chemical Testing

Ultrasonic Test

2.0 INPROCESS INSPECTION

2.1 MACHINING OF BODY, BONNET, WEDGE & STEM

CHARACTERISTICS

Major

Dimension

Measurement

2.2 WEDGE & SEATING

CHARACTERISTICS

Critical

Blue Matching (For Metal Seat)

Visual

2.3 ASSEMBLY

CHARACTERISTICS

Major

Dimension

Measurement

4.0 TESTING

4.1 SHELL

CHARACTERISTICS

Critical

Leakage

Hydrostatic Pressure

4.2 HYDRO SEAT

CHARACTERISTICS

Critical

Leakage

Hydrostatic Pressure

4.3 PNEUMATIC SEAT

CHARACTERISTICS

Critical

Leakage

Air Pressure

4.4 PERFORMANCE / FUNCTIONAL CHECK

CHARACTERISTICS

Major

Operation (Opening & Closing)

Visual

5.0 FINAL INSPECTION

CHARACTERISTICS

Major

Cleanliness

Visual

5.1 PAINTING

CHARACTERISTICS

Major

DFT CHECK

Visual

6.0 PROVISION OF NAME PLATE

CHARACTERISTICS

Major

As Per Spec

Visual

NOTE:- SS PARTS SHALL BE CHECKED AT 10% POSITIVE MATERIAL IDENTIFICATION (PMI) GRADE ANALYSER

LEGEND:

"RECORDS IDENTIFIED WITH TICK(*) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION"

M : MANUFACTURER / SUB-SUPPLIER

C : MAIN SUPPLIER N : END USER & BHEL

P : PERFORMANCE W : WITNESS V : VERIFICATION

AS APPROPRIATE

MANUFACTURER/SUB-SUPPLIER

MAIN SUPPLIER

SIGNATURE

APPROVED BY

APPROVAL SEAL

DOC. NO. :

MANUFACTURE'S NAME & ADDRESS										PROJECT									
ITEM : BUTTERFLY VALVE										CONTRACT NO.									
P.O. NO. : DATE :										END USER :									
P.O. DATE : W.O. NO. : DATE :										CONTRACTOR : BHARAT HEAVY ELECTRICAL LIMITED									
PAGE : 1 OF 1																			
COMPONENTS & OPERATION		CHARACTERISTICS		CLASS		TYPE OF CHECK		QUANTUM OF CHECK		REFERENCE DOCUMENTS		ACCEPTANCE NORMS		FORMATS OF RECORDS		AGENCY		REMARKS	
1.0 MATERIALS																			
1.1 BODY & DISC		Chemical Composition	Critical	Chemical Testing	One / Heat	One / Heat	One / Heat	Appd / Drgs Tech Spec	Appd Drgs / DSIMFG STD	Foundary TC	Foundary TC	P	V	V	V	V			
		Mechanical Properties	Critical	Mechanical Testing	One / Heat	One / Heat	One / Heat	Foundary TC	Foundary TC	P	V	V	V	V	V	V			
		Heat Treatment (Only For Casting)	Critical	Heat treatment	100%	100%	100%	Report	Report	P	V	V	V	V	V	V			
		Surface Defects	Major	Visual	100%	100%	100%	Inspection report	Inspection report	P	V	V	V	V	V	V			
1.2 SHAFT (BAR STOCK)		Chemical Composition	Critical	Chemical Testing	One / Heat	One / Heat	One / Heat	ASTM STD	ASTM STD	Foundary TC & Lab Reports	Foundary TC & Lab Reports	P	V	V	V	V			
		Mechanical Properties	Critical	Mechanical Testing	One / Heat / Batch	One / Heat / Batch	One / Heat / Batch	ASTM STD	ASTM STD	Foundary TC & Lab Reports	Foundary TC & Lab Reports	P	V	V	V	V			
1.3 Shaft (BAR STOCK)		Ultrasonic Test for Stem	Critical	Ultrasonic Test	100%	100%	100%	ASTM B 16.34	ASTM B 16.34 & ASME B 16.34 ANNEXURE E	UT REPORT	UT REPORT	P	V	V	V	V			For dia>50mm above only.
		Physical & Ozone Test	Critical	Physical & Ozone Test	One sample / Lot	One sample / Lot	One sample / Lot	Material specification	Relevant Material Std	Test report	Test report	P	V	V	V	V			
2.0 INPROCESS INSPECTION																			
2.1 MACHINING OF BODY & DISC		Dimension	Major	Measurement	100%	100%	100%	Mfg Drgs	Mfg Drgs	Inspection report	Inspection report	P	V	V	V	V			
		Dimension	Major	Measurement	10%	10%	10%	Appd Drgs	Appd Drgs				P	V	V	V	V		
3.0 TESTING																			
4.1 SHELL		Leakage	Critical	Hydrostatic Pressure	100%	100%	10%	Approved Drawings / DS/ Ref standard	No Leakage	Test Certificate	Test Certificate	P	W	W	V	V			
		Leakage	Critical	Hydrostatic Pressure	100%	100%	10%	Approved Drawings / DS/ Ref standard	No Leakage	Test Certificate	Test Certificate	P	W	W	V	V			
4.2 HYDRO SEAT		Operation (Opening & Closing)	Major	Visual	100%	100%	10%	Drawing & Technical Spec.	Smooth Operation	Inspection report	Inspection report	P	W	W	V	V			
		Cleanliness	Major	Visual	100%	100%	10%	As per Drg/ Tech Spec	As per Drg/ Tech Spec	Inspection report	Inspection report	P	V	V	V	V			
4.3 PERFORMANCE / FUNCTIONAL CHECK		Completeness & DFT CHECK	Major	Visual	100%	100%	10%	As per Drg/ Tech Spec	As per Drg/ Tech Spec	Inspection report	Inspection report	P	V	V	V	V			
		Painting	Major	Visual	100%	100%	10%	As per Specification	As per Specification	Inspection report	Inspection report	P	V	V	V	V			
5.0 FINAL INSPECTION		As Per Spec	Major	Visual	As per Specification	As per Specification	As per Specification	As per Specification	As per Specification	Inspection report	Inspection report	P	V	V	V	V			
		As Per Spec	Major	Visual	As per Specification	As per Specification	As per Specification	As per Specification	As per Specification	As per Specification	Inspection report	Inspection report	P	V	V	V	V		
6.0 PROVISION OF NAME PLATE		As Per Spec	Major	Visual	As per Specification	As per Specification	As per Specification	As per Specification	As per Specification	Inspection report	Inspection report	P	V	V	V	V			
		As Per Spec	Major	Visual	As per Specification	As per Specification	As per Specification	As per Specification	As per Specification	As per Specification	Inspection report	Inspection report	P	V	V	V	V		
NOTE:- SS PARTS SHALL BE CHECKED AT 10% POSITIVE MATERIAL IDENTIFICATION (PMI) GRADE ANALYSER																			
LEGEND:										DOC. NO. :									
*RECORDS IDENTIFIED WITH TICK(✓) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION																			
M : MANUFACTURER / SUB-SUPPLIER																			
C : MAIN SUPPLIER N : END USER & BHEL																			
P : PERFORMANCE W : WITNESS V : VERIFICATION AS APPROPRIATE																			
MANUFACTURE/SUB-SUPPLIER										MAIN SUPPLIER									
SIGNATURE										APPROVED BY									
APPROVAL SEAL										APPROVAL SEAL									

REFERENCE QUALITY PLAN												
MANUFACTURE'S NAME & ADDRESS			ITEM : AIR DRYER		Qp No : Rev : Date : Page :		Sign of MGR		Qp No : Rev No : Date : Page :		Reviewed By	
SR NO.	COMPONENTS AND OPERATORS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE	FORMAT OF RECORD	AGENCY	REMARKS		
1	2	3	4	5	6	7	8	9	M	C	N	
A MATERIAL INSPECTION												
1.1	ROTOR DRUM	CHEMICAL	MAJOR	CHEMICAL ANALYSIS	100%	APPROVED DATASHEET	APPROVED DATASHEET	COC	V	V	V	
1.2	DRYER VESSEL COMPLETE	DIMENSIONS MECHANICAL	MAJOR	DIMENSIONS MECH PROPERTIES	100%	MFG DRG APPROVED DATASHEET	MFG DRG	COC	V	V	V	
1.3	REGEN COOLERS	MECHANICAL CHEMICAL	MAJOR	CHEMICAL & MECH.	100%	APPROVED DATASHEET	APPROVED DATASHEET	COC	V	V	V	
B INPROCESS INSPECTION												
2.1	REGEN COOLERS	TIGHTNESS	MAJOR	HYDROSTATIC	100%	1.5 X DESIGN PRESSURE FOR NO LEAKAGE 5 MIN.		COC [SEE NOTE 1]	V	P	V	
2.2	DRYER VESSEL WATER SEPARATOR	TIGHTNESS	MAJOR	HYDROSTATIC	100%	1.5 X DESIGN PRESSURE FOR NO LEAKAGE 5 MIN.		COC [SEE NOTE 1]	V	P	V	
2.3	WATER SEPARATOR GEAR BOX DRAIN VALVES MOTOR	FUNCTIONAL	MAJOR	FUNCTIONAL	100%	MFG DRAWINGS	MFG DRAWING	COC	V	P	V	
C FINAL INSPECTION												
ATLAS COPCO AIRPOWER BELGIUM												
3.1	ASSEMBLY AND TESTING	DIMENSIONAL APPEARANCE & COMPLETENESS	MAJOR	MEASUREMENT VISUAL	100%	APPROVED DRAWING	APPROVED DRAWING	INSPECTION REPORT	V	P	V	
		MECH RUN TEST TIGHTNESS	MAJOR	FUNCTIONAL TEST HYDROSTATIC		APPROVED DRAWING 1.5 X DESIGN PRESSURE	APPROVED DRAWING NO LEAKAGE	COC [SEE NOTE 1]	V	P	V	
LEGEND: * Records identified with " Tick () " shall be essentially included by supplier in QA documentation ** M: Manufacturer / Sub Supplier C: Supplier nominated inspection agency P: Perform W: Witness and V: Verification. N: END USER & BHEL												

MANUFACTURER'S NAME & ADDRESS		REFERENCE QUALITY PLAN					To be Filled				
		ITEM : AIR DRYER		SIGNATURES		Qp No : Rev No : Date : Page : Valid Upto :		Reviewed By			
Sr. No.	COMPONENTS AND OPERATORS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE	FORMAT OF RECORD	AGENCY	REMARKS	
1	2	3	4	5	6	7	8	9	M	C	N
1											
D FINAL INSPECTION 4.1 FINAL INSPECTION AT ATLAS COPCO INDIA MECH RUN TEST OF COMPLETE DRYER TIGHTNESS OF COMPLETE DRYER											
E PACKING AND DESPATCH 5.1 PACKING SHIPPING CHECK DOC. SEA WORTHY PACKING											
NOTE 1 : SPECIFIC CONFIRMATION FROM AIRPOWER REGARDING THE HYDROTEST PRESSURE NOTE 2 : MATERIAL SHALL BE AS PER APPROVED DRG/TDS. INCASE NOT MENTIONED IN APPROVED DRG/TDS THEN AC STANDARDS SHALL BE APPLICABLE											
LEGEND : * Records identified with "Tick" () shall be essentially included by supplier in QA documentation ** M : Manufacturer / Sub Supplier C : Supplier nominated inspection agency. P : Perform; W : Witness and V : Verification N : END USER & BHEL											

MANUFACTURING QUALITY PLAN									
MANUFACTURER'S NAME AND ADDRESS				AIR RECEIVER				OWNER :	
ITEM				SUB SYSTEM				CONSULTANT :	
COMPONENT & OPERATIONS				CHARACTERISTICS				PROJECT :	
CLASS				TYPE OF CHECK				PACKAGE VENDOR :	
3.				5.				BHEL DOC NO :	
2.				6.				PAGE 1 OF 2	
1.				7.				11.	
SLNO	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	REMARKS
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
1.0	RAW MATERIAL INSPECTION								
1.1	MS PLATE FOR SHELL, DISHED END, FLANGES, SOCKET / PIPE FOR NOZZLES	CHEMICAL PROPERTIES MECHANICAL PROPERTIES INTERNAL DEFECTS	B	CHEMICAL ANALYSIS MECHANICAL TESTS U.T. (32 MM & ABOVE THICK)	1 SAMPLE / HEAT 1 SAMPLE / HEAT 100 %	RELEVANT MATERIAL SPECIFICATION AS PER APPROVED DATA SHEET / APPROVED DRAWING ASME SEC. V / ASTM A 435	ASTM A 435	MILL TC / LAB TC U.T. REPORT	REFER NOTE 1
2.0	IN PROCESS INSPECTION								
2.1	DISHED END	CORRECT DIMENSIONS DPT ON KNUCKLE THICKNESS THINNING CUTTING OF PLATES EDGE PREPARATION AND FIT UP WPS / WELDER QUALIFICATION	B	MEASURE DPT TEST MEASURE VISUAL & MEASURE VISUAL & MEASURE VISUAL & MECHANICAL TEST	100 % 100 % 100 % 100 % 100 %	APPROVED DRAWING/MANUFACTURING DRAWING ASME SEC. V APPROVED DRAWING/MANUFACTURING DRAWING/TECHNICAL SPECIFICATION CUTTING PLAN / MANUFACTURING DRAWINGS APPROVED WPS / FABRICATION DRAWING	ASME SEC. V ASME SEC. V ASME SEC. IX ASME SEC. VIII DIV. 1 APPENDIX 8	DO ✓ DO REGISTER REGISTER QW 482, 483, 484 NDT REPORT RT REPORT	IN CASE OF JOINT IN DISH END, 100% RT ON JOINT TO BE DONE. REFER NOTE : 3 RT FILMS & REPORT WILL BE REVIEWED BY NTPC, CHP. CHP, NTPC SHALL WITNESS DPT DURING FINAL INSPECTION
2.2	FABRICATION OF AIR RECEIVER	NDT ON BUTT WELDS (LONGITUDINAL & CIRCUMFERENTIAL) WELD JOINT FOR ADSORPTION TOWERS) AFTER BACK GOUGING & FINAL WELDING NDT ON BUTT WELDS & FILLET JOINTS IN SHELL & DISH AFTER FINAL WELDING BOD SHELL STRENGTH TEST	B	RT AFTER FINAL WELDING DPT HYDRO TEST	10 % ON BUTT JOINT INCLUDING 100% CROSS JOINT 100 % 100 %	ASME SEC. V ASME SECTION V APPLICABLE DESIGN STANDARD/APPROVED DRAWING	ASME SEC. V ASME SEC. V ASME SEC. V	RT REPORT NDT REPORT IR	REFER NOTE 4
3.0	FINAL INSPECTION								
3.1	FINAL INSPECTION	DIMENSION, ORIENTATION	A	VISUAL & MEASURE	100 %	APPROVED DRAWING	IR	IR	W
3.2	PAINTING	DFT / SURFACE FINISH	B	VISUAL & MEASURE	100 %	AS PER MANUFACTURING STANDARDS.	IR	IR	W
LEGEND : CL: (ACRITICAL, B:MAJOR, C:MINOR) M: MANUFACTURER/SUB-SUPPLIER C: NOMINATED INSPECTION AGENCY N: CUSTOMER, PORT W: WITNESS AND V: VERIFICATION, ND:NDT LAB R:TEST / DIMENTIONAL F: RECORDS, IDENTIFIED WITH "TICK" (✓) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER QA DOCUMENTATION.									
MANUFACTURERS / SUB-SUPPLIER				SIGNATURE				DOCS NO :	
REVIEWED BY				APPROVED BY				APPROVAL SEAL	

MANUFACTURER'S NAME AND ADDRESS		MANUFACTURING QUALITY PLAN										OWNER :	
ITEM		AIR RECEIVER		QIP NO	CONSULTANT :		PROJECT :		PACKAGE VENDOR :		BHEL DOC NO :		
SUB SYSTEM		COMPRESSED AIR SYSTEM.		REV	DATE		BHEL DOC NO :		PACKAGE VENDOR :		BHEL DOC NO :		
SLNO	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY	REMARKS			
1.	2.	3.	4.	5.	M	C/N	6.	7.	8.	9.	10.	11.	
3.3	PACKING / AVAILABILITY OF ACCESSORIES	VISUAL	B	VISUAL	100%	-	APPROVED DRAWING	IR/CALIBRATION REPORT	P	V	-		
NOTE 1 MS PLATES USED SHALL BE REPUTED MANUFACTURERS ONLY & BEING THE TOTAL PLATES QTY IS LESS. THESE PLATES SHALL BE SOURCED FROM AUTHORIZED DEALERS LIKE SAIL, JINDAL, ESSAR, LLOYD, & WELSPUN, ETC. 2 i. THE MS PLATES SHALL BE CUT ACCORDING TO CUTTING PLAN AND HEAT NO. OF EACH PLATE SHALL BE TRANSFERRED BY PUNCHING ON EACH PIECE FOR PROPER CORRELATION & TRACEABILITY. THE CUTTING PLAN SHALL INCLUDE COMPLETE DETAILS OF HEAT NO, PLATE NO, OF EACH CUT PIECE. ii. THE WELDING PLAN OF EACH FABRICATED PIECE SHALL INCLUDE JOINT NUMBER, WELDER NO. WHO CARRY OUT WELDING FOR COMPLETE TRACEABILITY. 3 BHEL. APPROVED WPS WILL BE USED. QUALIFIED WELDERS WILL BE EMPLOYED. IF WELDERS ARE ALREADY QUALIFIED BY NTPC / LLOYDS/BVQ/BSI/BHEL/UTV AND DOING THE SIMILAR JOBS THEN SAME SHALL BE VERIFIED IN PLACE OF WITNESSING. RECORD WILL BE VERIFIED BY NTPC DURING INSPECTION. 4 INSIDE PAINTING IS APPLICABLE & SHALL BE DONE AS PER MANUFACTURING STANDARDS.													
ABBREVIATIONS:- M.T.C. - MANUFACTURER'S TEST CERTIFICATE, L.T.C. - LAB TEST CERTIFICATE, IR - INSPECTION REPORT, UT REPORT - ULTRASONIC TEST REPORT, RT REPORT - RADIOGRAPHIC REPORT, NDT - NON DESTRUCTIVE TESTING													

MANUFACTURER'S NAME AND ADDRESS		LEGEND : CL: (ACRITICAL, B: MAJOR C: MINOR)		DOC NO :	
SUB SYSTEM		COMPRESSED AIR SYSTEM.		BHEL DOC NO :	
M: MANUFACTURER/SUB-SUPPLIER C: NOMINATED INSPECTION AGENCY N: CUSTOMER, REPORT W: WITNESS AND V: VERIFICATION. ND: NDT LAB R: TEST / DIMENSIONAL RECORDS IDENTIFIED WITH "TICK" (✓) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER QA DOCUMENTATION.		APPROVED BY APPROVAL SEAL		REVISED BY APPROVAL SEAL	
SIGNATURE		SIGNATURE		SIGNATURE	

257 of 384		MANUFACTURER'S NAME AND ADDRESS		MANUFACTURING QUALITY PLAN										OWNER : CONSULTANT : PROJECT : PACKAGE VENDOR : BHEL DOC NO :											
				ITEM		HEAT OF COMPRESSION AIR DRYER		QP NO	REFERENCE DOCUMENT		ACCEPTANCE NORM		FORMAT OF RECORD			AGENCY			REMARKS						
						SUB SYSTEM		COMPRESSED AIR SYSTEM.													DATE	PAGE	Page 1 OF 4		

SLNO	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		7.	8.	9.	10.	11.
1.	2.	3.	4.	5.	6.	C/N					
1.0 RAW MATERIAL INSPECTION											
1.1	MS PLATE FOR SHELL & DISHED END.	CHEMICAL PROPERTIES MECHANICAL PROPERTIES INTERNAL DEFECTS	B	CHEMICAL ANALYSIS MECHANICAL TESTS U.T. (32 MM & ABOVE THICK	1 SAMPLE / HEAT 1 SAMPLE / HEAT 100 %		RELEVANT MATERIAL SPECIFICATION AS PER APPROVED DATA SHEET / APPROVED DRAWING ASME SEC. V / ASTM A 435	ASTM A 435	U.T. REPORT	✓	REFER NOTE 1
1.2	PIPES	CHEMICAL PROPERTIES MECHANICAL PROPERTIES	B	CHEMICAL ANALYSIS MECHANICAL TESTS	1 SAMPLE / HEAT 1 SAMPLE / HEAT		RELEVANT MATERIAL SPECIFICATION AS PER APPROVED DATA SHEET / APPROVED DRAWING		MILL TC / LAB TC	✓	REFER NOTE 2
1.3	BOUGHT OUT ITEMS	VISUAL, DIMENSIONAL	B	ITEM, MAKE, RANGE, DIMENSIONAL	100 %		APPROVED DATA SHEET / APPROVED DRAWING		MT C / CALIBRATION REPORT	✓	REFER NOTE - 6
2.0 IN PROCESS INSPECTION											
2.1	DISHED END	CORRECT DIMENSIONS RT ON DISHED ENDS (IF APPLICABLE) DPT ON KNUCKLE THICKNESS THINNING	B	MEASURE RT AFTER FINAL WELDING DPT TEST MEASURE	100 % 100 % 100 % 100 %		MANUFACTURING DRAWING ASME SEC. V ASME SEC. V APPROVED DRAWING / MANUFACTURING DRAWING / TECHNICAL SPECIFICATION CUTTING PLAN / MANUFACTURING DRAWINGS	ASME SEC. VIII DIV.1-UW-51 ASME SEC. V ASME SEC. V ASME SEC. V	IR RT FILM, RT REPORT DPT REPORT I.R.	✓ ✓ ✓ ✓	IN CASE OF JOINT IN DISH END, 100% RT ON JOINT TO BE DONE.
2.2	FABRICATION OF AIR DRYER	CUTTING OF PLATES EDGE PREPARATION AND FIT UP WPS / WELDER QUALIFICATION NDT ON BUTT WELDS (LONGITUDINAL & CIRCUMFERENTIAL WELD JOINT FOR ADSORPTION TOWERS) AFTER BACK GOUGING & FINAL WELDING NDT ON BUTT WELDS & FILLET JOINTS IN SHELL & DISH AFTER FINAL WELDING	B	MEASURE VISUAL & MEASURE VISUAL & MEASURE MECHANICAL TEST DPT AFTER BACK GOUGING RT AFTER FINAL WELDING DPT	100 % 100 % 100 % 100 % 100 % 100 %		APPROVED WPS / FABRICATION DRAWING ASME SEC. IX ASME SEC. V ASME SEC. V 10 % ON BUTT JOINT INCLUDING 100% CROSS JOINT	ASME SEC. IX ASME SEC. IX ASME SEC. V ASME SEC. VIII DIV.1 APPENDIX 8	QW 482, 483, 484 NDT REPORT RT REPORT NDT REPORT	✓ ✓ ✓ ✓	REFER NOTE : 3 RT FILMS & REPORT WILL BE REVIEWED
LEGEND : () Records, indentified with "Tick" () shall be essentially included by SUPPLIER in QA documentation.											
M: MANUFACTURER/SUB-SUPPLIER, C: NOMINATED INSPECTION AGENCY N: CUSTOMER , P: PERFORM, W: WITNESS AND V: VERIFICATION. ND:NDT LAB R:TEST / DIMENTIONAL REPORT * RECORDS, IDENTIFIED WITH "TICK" (✓) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.											
MANUFACTURERS / SUB-SUPPLIER		MAIN SUPPLIER		SIGNATURE		REVIMED BY		APPROVED BY		APPROVAL SEAL	

Page 1 OF 4

258 of 384		MANUFACTURER'S NAME AND ADDRESS				MANUFACTURING QUALITY PLAN										OWNER :			
		ITEM		HEAT OF COMPRESSION AIR DRYER				QP NO		CONSULTANT :									
				SUB SYSTEM		COMPRESSED AIR SYSTEM.				REV		PROJECT :							
						DATE		PACKAGE VENDOR :											
		PAGE		Page 2 OF 4				BHEL DOC NO											
SLNO	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS						
					M	C/N			9.	D	M	C	N						
1.		3.	4.	5.	6.		7.	8.			10.			11.					
2.3	WELD QUALITY OF PIPE WELD & FILTERS WELD	DPT ON ROOT RUN & FINAL OF BUTT WELD	B	NDT - DPT	100%		ASME SEC V	ASME SEC. VIII DIV. 1 APPENDIX 8	IR	✓	P	V	V						
2.4	HEAT EXCHANGER	TUBE TO TUBE SHEET FILLET WELD JOINT	B	NDT - DPT	100%		ASME SEC V	ASME SEC. VIII DIV. 1 APPENDIX 8	IR	✓	P	V	V						
2.5	VESSEL (TOWER) MOISTURE SEPARATOR & HEAT EXCHANGERS	BOD SHELL STRENGTH TEST	B	HYDRO TEST	100 %		HYDRO PRESSURE @ 1.3 TIMES OF DESIGN PRESSURE FOR 30 MIN	NO LEAKAGE & NO PRESSURE DROP	IR	✓	P	V	V						
2.6	PNEUMATIC TEST	FOR COMPLETE ASSEMBLY OF AIR DRYER	B	PNEUMATIC TEST WITH SOAP BUBBLE	100%		PNEUMATIC TEST PRESSURE @ 1.1 TIMES OF DESIGN PRESSURE FOR 30MIN	NO LEAKAGE & NO PRESSURE DROP	IR	✓	P	W	W	CHP 'W' AT THE TIME OF FINAL INSPECTION					
FINAL INSPECTION																			
3.0	FINAL INSPECTION	DIMENSION, ORIENTATION	B	VISUAL	100%		AS PER APPROVED GA DRAWING / DATA SHEET		IR	✓	P	W	W						
3.1	FUNCTIONAL TEST	PERFORMANCE TEST AT NO LOAD CONDITIONS	B	FUNCTIONAL / OPERATION OF VALVES & AUTO DRAIN TRAP	100%		APPROVED FUNCTIONAL TEST PROCEDURE (ENCLOSED) / APPROVED DRAWING / DATASHEET		IR	✓	P	W	W						
3.2	CONTROL PANEL	WORKMANSHIP FINISH, SHADE	B	VISUAL	100%	100%	AS PER ELECTRICAL DRAWING / APPROVED DATA SHEET/ MFG STANDARD		IR		P	W	W						
3.3		DRY FILM THICKNESS	B	MEASURE	100%	RANDOM	MINIMUM 50 MICRONS (POWDER COATED), 70 MICRONS (PAINTED)		IR		P	W	W						
3.4		ADHESION TEST (PEEL OFF TEST)	B	MEASURE	100%	1 PANEL (RANDOM)	ASTM D 3359	NO PEEL OFF	IR		P	W	W						
3.5		WIRING & COMPONENT LAYOUT, FITTING ACCESSIBILITY & SAFETY	B	VERIFICATION	100%	RANDOM	AS PER ELECTRICAL DRAWING / APPROVED DATA SHEET		IR		P	V	V						
3.6		COMPONENTS IDENTIFICATION (MARKING / NAME PLATES)	B	VERIFICATION	100%	100%	AS PER ELECTRICAL DRAWING / APPROVED DATA SHEET		IR	✓	P	V	V						
3.7		PROPER TERMINATION WIRE	B	VERIFICATION	100%	RANDOM	NO LOOSE CONNECTIONS. ALL TERMINATIONS TO BE LUGGED		IR		P	V	V						
3.8	DOOR AND LOCK FUNCTIONING	B	FUNCTIONAL	100%	RANDOM	PROPER OPENING & CLOSING, NO MISMATCH		IR		P	W	W							
3.9	EARTHING CHECK	B	VERIFICATION	100%	RANDOM	APPROVED DRAWING / AS PER ELECTRICAL DRAWING		IR		P	V	V							
		LEGEND : Records, identified with "Tick" (✓) shall be essentially included by SUPPLIER in QA documentation.																	
		M: MANUFACTURER/SUB-SUPPLIER, C: NOMINATED INSPECTION AGENCY N: CUSTOMER , P: PERFORM, W: WITNESS AND V: VERIFICATION. ND:NDT LAB R:TEST / DIMENTIONAL REPORT																	
		* RECORDS, IDENTIFIED WITH "TICK" (✓) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.																	
MANUFACTURERS / SUB-SUPPLIER		SIGNATURE				Page 2 OF 4				REVIMED BY		APPROVED BY		APPROVAL SEAL					

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MANUFACTURER'S NAME AND ADDRESS

HEAT OF COMPRESSION AIR DRYER

COMPRESSED AIR SYSTEM.

MANUFACTURING QUALITY PLAN

OWNER :
CONSULTANT :
PROJECT :
PACKAGE VENDOR :
BHEL DOC NO :

ITEM

Q.P NO

REV

DATE

PAGE

SUB SYSTEM

Page 3 OF 4

SLNO	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD		AGENCY			REMARKS
					M	C/N			9.	D	M	C	N	
1.	2.	3.	4.	5.	6.		7.	8.			10.			11.
		OVERALL DIMENSIONS	B	MEASURE	100%	RANDOM	AS PER ELECTRICAL DRAWING / DATA SHEET			IR		P	V	V
		DEGREE OF PROTECTION BY PAPER INSERTION	A	MEASURE	100%	100%	AS PER ELECTRICAL DRAWING / DATA SHEET			IR	✓	P	V	V
		IR TEST & HIGH VOLTAGE TEST	A	MEASURE	100%	100%	HV TEST AT 1.5 KV FOR ONE MINUTE IR TEST FOR 500V	WITH STOOD More than 50 MOhms		IR	✓	P	W	W
		FUNCTIONAL TEST	A	VISUAL MEASURE, VERIFICATION	100%	1 PANEL RANDOMLY SELECTED	AS PER ELECTRICAL DRAWING / DATA SHEET/ FINCTION TEST PROCEDURE			IR		P	W	W
3.4	PAINTING	DFT / SURFACE FINISH	B	VISUAL & MEASURE	100%		AS PER MANUFACTURING STANDARDS,			IR	✓	P	V	-
3.5	INSULATION / CLADDING (AS APPLICABLE)	COMPLETENESS	B	VARIFICATION	100%		APPROVED DRAWING / DATASHEET			IR	✓	P	V	-
3.3	PACKING / AVAILABILITY OF ACCESSORIES	VISUAL	B	VISUAL	100%	--	MANFACTURER PROCEDURE.			IR	✓	P	V	-

NOTE

- MS PLATES USED SHALL BE REPUTED MANUFACTURERS ONLY & BEING THE TOTAL PLATES QTY IS LESS. THESE PLATES SHALL BE SOURCED FROM AUTHORIZED DEALERS LIKE SAIL, JINDAL, ESSAR, LLOYD, & WELLSpun, ETC.
- ALL THE INTERCONNECTING PIPING USED SHALL BE REPUTED MAKES & BEING THE TOTAL PIPE QTY IS LESS. THESE PIPES SHALL BE SOURCED FROM AUTHORIZED DEALERS OF TATA, JINDAL, SURYA ROSHINI & WELLSpun
- LLOYDS/BVQI/BSI/BHEL/TUV APPROVED WPS WILL BE USED, QUALIFIED WELDERS WILL BE DEPLOYED. IF WELDERS ARE ALREADY QUALIFIED BY LLOYDS/BVQI/BSI/BHEL/TUV AND DOING THE SIMILAR JOBS THEN SAME SHALL BE VERIFIED IN PLACE OF WITNESSING.
- MEASUREMENT OF DEW POINT AND PERFORMANCE TEST DURING FINAL INSPECTION IS DEMONSTRATIVE AND INDICATIVE ONLY AND WILL BE DONE AT NO-LOAD AND THE SAME WILL BE ACCEPTED.FINAL DEW POINT & PERFORMANCE PARAMETER WILL BE DEMONSTRATED AT SITE ONLY.

BOUGHT OUT ITEMS

LEGEND

** M: MANUFACTURER/SUB-SUPPLIER, C: NOMINATED INSPECTION AGENCY N: CUSTOMER , P: PERFORM, W: WITNESS AND V: VERIFICATION. ND:NDT LAB R:TEST / DIMENTIONAL REPORT

* RECORDS, IDENTIFIED WITH "TICK" (✓) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.

MANUFACTURERS / SUB-SUPPLIER

MAIN SUPPLIER

SIGNATURE

Records, identified with "Tick" () shall be essentially included by SUPPLIER in QA documentation.

DOC NO :
REVISED BY
APPROVED BY
APPROVAL SEAL

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MANUFACTURER'S NAME AND ADDRESS

MANUFACTURING QUALITY PLAN

OWNER :
CONSULTANT :
PROJECT :
PACKAGE VENDOR :
BHEL DOC NO :

ITEM

HEAT OF COMPRESSION AIR DRYER

QIP NO
REV

SUB SYSTEM

COMPRESSED AIR SYSTEM.

DATE
PAGE

Page 4 OF 4

SLNO	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY	REMARKS
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
SN	ITEM	MAKE	REMARKS							
1.	PRESSURE GAUGE		BHEL	APPROVED MAKE			VERIFICATION OF MANUFACTURER'S CALIBRATION REPORT, TYPE, MAKE, RANGE, ACCURACY			
2.	TEMPERATURE GAUGE		BHEL	APPROVED MAKE			VERIFICATION OF MANUFACTURER'S CALIBRATION REPORT, TYPE, MAKE, RANGE, ACCURACY			
3.	CYCLE CHANGE OVER VALVE		BHEL	APPROVED MAKE			MANUFACTURER'S TEST CERTIFICATE FOR PNEUMATIC TEST OF BODY AND SEAT & MATERIAL			
4.	BUTTERFLY VALVE		BHEL	APPROVED MAKE			MANUFACTURER'S TEST CERTIFICATE FOR PNEUMATIC TEST OF BODY AND SEAT & MATERIAL			
5.	5/2 WAY SOLENOID VALVES		BHEL	APPROVED MAKE			MANUFACTURER'S TEST CERTIFICATE / INSPECTION REPORT			
6.	DEW POINT METER		BHEL	APPROVED MAKE			MANUFACTURER'S TEST CERTIFICATE / CALIBRATION REPORT			
7.	AUTO DRAIN VALVE		BHEL	APPROVED MAKE			MANUFACTURER'S TEST CERTIFICATE			
8.	DIFFERENTIAL PRESSURE GAUGE		BHEL	APPROVED MAKE			VERIFICATION OF MANUFACTURER'S TEST CERTIFICATE, TYPE, MAKE, RANGE, ACCURACY			
9.	DIFFERENTIAL PRESSURE SWITCH		BHEL	APPROVED MAKE			VERIFICATION OF MANUFACTURER'S TEST CERTIFICATE, TYPE, MAKE, RANGE, ACCURACY			
10.	TEMPERATURE ELEMENT		BHEL	APPROVED MAKE			VERIFICATION OF MANUFACTURER'S TEST CERTIFICATE, TYPE, MAKE, RANGE, ACCURACY			

Note : As per SL NO.5 , the bought out items vendor makes are as per approved data sheet. (Enclosed Documents for reference)

ABBREVIATIONS:-
M.T.C. – MANUFACTURER'S TEST CERTIFICATE, L.T.C. – LAB TEST CERTIFICATE, IR – INSPECTION REPORT, UT REPORT – ULTRASONIC TEST REPORT, RT REPORT – RADIOGRAPHIC REPORT, NDT – NON DESTRUCTIVE TESTING, HV – HIGH VOLTAGE TEST

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Records, identified with "Tick" (✓) shall be essentially included by SUPPLIER in QA documentation.

LEGEND :
M: MANUFACTURER/SUB-SUPPLIER,
C: NOMINATED INSPECTION AGENCY N: CUSTOMER ,
P: PERFORM, W: WITNESS AND V: VERIFICATION. ND:NDT LAB R:TEST / DIMENTIONAL REPORT
* RECORDS, IDENTIFIED WITH "TICK" (✓) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.

MANUFACTURERS / SUB-SUPPLIER

MAIN SUPPLIER

SIGNATURE

DOC NO

REVISED BY

APPROVED BY

APPROVAL SEAL

Page 4 OF 4

QUALITY PLAN				CUSTOMER: M/S GSECL BIDDER/VENDOR:		PROJECT: 2 X 490 MW NCTPPP, DADR1, STAGE-II		SPEC. NO.: PE-TS-436-555-A001				
SHEET 1 OF 3				BIDDER/VENDOR:		REV. 00 DT: 20.02.2018		SPEC. TITLE AIR TRAPS				
S.NO.	COMPONENT/ OPERATION	CHARACTERISTICS CHECKED	SYSTEM	SERVICE AIR/ INSTRUMENT AIR	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY	REMARKS		
			CATE- GORY	TYPE/METHOD OF CHECK					P W V			
1.0	MATERIALS											
1.1	BODY, COVER	1. PHYSICAL & CHEM. PROPERTIES	MA	PHYS. & CHEM. TEST	ONE /HEAT / HEAT BATCH	APPROVED DRAWING / TECH. SPEC.	APPROVED DRAWING / TECH. SPEC.	TEST CERT.	3/2	2	1	- CO-RELATED TCs SHALL BE FURNISHED.
		2. SURFACE DEFECTS	MA	VISUAL	100%	MSS-SP-55	MSS-SP-55	LOG BOOK	3/2	2	1	
1.2	FLOAT UNIT ASSEMBLY, VALVE SEAT, PIVOT FRAME, PIVOT PIN, GASKET	1. PHYS., CHEM. PROPERTIES	MA	PHYS., CHEM. TEST	ONE /HEAT / HEAT BATCH	APPD. DRG	APPD. DRG	TEST CERT	3/2	2	1	
		2. SURFACE DEFECTS	MA	VISUAL	100%	MSS-SP-55	MSS-SP-55	INSPN. REPORT	3/2	2	1	
1.3	FASTENERS	1. PHYS., CHEM. PROPERTIES	MA	PHYS., CHEM. TEST	ONE PER TYPE	APPD. DRG	APPD. DRG	TEST CERT	3/2	2	1	
2.0	IN-PROCESS											
2.1	ALL COMPONENTS	1. DIMENSIONS	MA	MEASUREMENT	100%	MFG. DRAWING	MFG. DRAWING	INT. INSPN. REPORT	3/2	-	2	
		2. SURFACE DEFECTS	MA	VISUAL	100%	-DO-	-DO-	INSPN. REPORT	3/2	-	2	
2.2	VALVE, VALVE SEAT	1. SURFACE DEFECTS	CR	PENETRANT TEST	100%	ASTME-165	NO DEFECTS	INT. INSPN. REPORT	2	2	1	
		2. HARDNESS	MA	TESTING	100%	APPD. DRG.	APPD. DRG.	INT. INSPN. REPORT	2	2	1	
		3. BALL IMPRES	MA	BY AIR	100%	SEAT SURFACE SHALL HAVE METAL TO METAL CONTACT	SEAT SURFACE SHALL HAVE METAL TO METAL CONTACT	INT. INSPN. REPORT	2	2	1	
3.0	SUB- ASSEMBLY											
3.1	VALVE & VALVE SEAT	1. LEAK TIGHTNESS	CR	AIR/HYDRO	100%	APPD. DRG	APPD. DRG.	INT. INSPN. REPORT	2	2	1	
BHEL												
PARTICULARS				BIDDER/VENDOR								
NAME												
SIGNATURE												
DATE												
				BIDDER'S/ VENDOR'S COMPANY SEAL								

QUALITY PLAN				CUSTOMER: M/S GSECL		PROJECT: 2 X 490 MW NCTPPP, DADRI, STAGE-II		SPEC. NO.: PE-TS-436-555-A001				
BIDDER/VENDOR:				Q.P. NO. PE-QP-408-555-M001		REV. 00		SPEC. TITLE AIR TRAPS				
SHEET 2 OF 3				SYSTEM		ITEM: BALL FLOAT AIR TRAP		SECTION VOLUME				
S.NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECKED	CATEGORY	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY	REMARKS		
									P	W	V	
3.2	COVER	1. ALIGNMENT	MA	VISUAL	100%	-DO-	PROPER FITTING	INT. INSPN. REPORT	2	2	1	
4.0	HYDRAULIC TEST (FOR CCS MATERIAL, TEST TO BE CONDUCTED BEFORE GALVANISING)											
4.1	BODY COVER SHELL TEST	LEAK TIGHTNESS OF BODY	CR	HYDRO. TEST AT 1.5 TIMES OF TRAP DESIGN PRESSURE	100%	APPD. DRG./TECH. SPEC./DATA SHEET	NO LEAKAGE	TEST CERT	2	2	1	
5.0	GALVANISING (APPLICABLE FOR CCS MATERIAL ONLY)											
5.1	HOT DIP GALVANISING OF BODY, COVER	1. SURFACE PREPARATION & THICKNESS OF GALVANISING & UNIFORMITY.	MA	VISUAL & MEASURE-MENT	100%	IS:2629	IS:2629	INSPN. REPORT	2	2,1*	-	The minimum thickness of galvanizing shall be minimum 40 microns.
6.0	ASSEMBLY (FOR CCS MATERIAL, TEST TO BE CONDUCTED AFTER GALVANISING)											
6.1	COMPLETE ASSEMBLY	1. CLEANLINESS & COMPLETENESS, DIMENSIONS, THREADING ENDS, ARROW MARKING ETC. 2. LEAK TIGHTNESS OF BODY 3. FUNCTIONAL TEST	MA	VISUAL & MEASURE-MENT	100%	APPROVED DRAWING	APPROVED DRAWING	INSPN. REPORT	2	2,1*	-	
			CR	HYDRO. TEST AT 1.5 TIMES OF TRAP DESIGN PRESSURE	100%	APPD. DRG./TECH. SPEC./DATA SHEET	NO LEAKAGE	TEST CERT	2	1*	-	
			CR	FUNCTIONAL TEST AT MINIMUM 6Kg/cm ² PRESSURE (VISUAL DISCHARGE OF CONDENSATE)	100 %	APPD DRG./ GIVEN PROCEDURE ON PAGE 3/3 OF THIS QP.	NO AIR LEAKAGE	TEST CERT.	2	1*	-	

BHEL		PARTICULARS		BIDDER/VENDOR	
		NAME			
		SIGNATURE			
		DATE			
				BIDDER'S/ VENDOR'S COMPANY SEAL	

		QUALITY PLAN		CUSTOMER: M/S GSECL		PROJECT: 2 X 490 MW NCTPPP, DADR, STAGE-II		SPEC. NO.: PE-TS-436-555-A001	
		BIDDER/VENDOR:		REV. 00 DT: 20.02.2018		Q.P. NO. PE-QP-408-555-M001		SPEC. TITLE AIR TRAPS	
SHEET 3 OF 3		SYSTEM		SERVICE AIR/INSTRUMENT AIR		ITEM: BALL FLOAT AIR TRAP		SECTION VOLUME	
S.NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECKED	CATEGORY	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY P W V
REMARKS									

6.2	FLOW CAPACITY TEST (TYPE TEST)	CONDENSATE DISCHARGE	CR	DISCHARGE FLOW	1 PER PRESSURE RATING & ORIFICE SIZE TRAP	APPD. FLOW CAPACITY	APPD. FLOW CAPACITY	TYPE TEST CERTIFICATION	3/2	2	1	
7.0	END CONN.	DIMENSIONS	CR	MEASUREMENT	100%	APPD. DRG./TECH. SPEC	APPD. DRG./TECH. SPEC	INSPN REPORT	3/2	2,1*	-	
8.0	PROVISION OF NAME PLATE WITH PURCHASER'S TRAP TAG NOS. & PACKING IN WOODEN CASES	AS PER TECHNICAL SPECIFICATION	MA	VISUAL	100%	--DO--	--DO--	(Soft copy of photographs)	2	2	1	Vendor to provide the following: Photographs of traps duly placed inside the wooden box just before final packing. Photographs of the wooden box in which the traps have been finally packed just before dispatch. Clearance for dispatch of traps will be given only after receiving the photos of traps in satisfactory condition as mentioned in the condition stated above.

FUNCTIONAL TEST PROCEDURE.

1. COMPRESSED AIR (MINIMUM AT 6 Kg/cm² PRESSURE) TO BE SUPPLIED IN A MIXING CHAMBER.
 2. WATER IS ADDED IN THE SAME CHAMBER SO THAT AIR IN THE CHAMBER HAS SUFFICIENT MOISTURE
 3. TRAP IS INSTALLED AT THE BOTTOM OF THIS CHAMBER AND ITS PERFORMANCE IS CHECKED.
- A GOOD PERFORMING TRAP **DRAINS OUT ONLY WATER DROPLETS** AND RETAINS **COMPRESSED AIR BACK IN THE SYSTEM**.

NOTE:- CR- MEANS CRITICAL ACTIVITY
1 = PURCHASER (BHEL/CUSTOMER)
P = PERFORMED BY

MA- MEANS MAJOR ACTIVITY
2 = VENDOR
W = WITNESSED BY

MI- MEANS MINOR ACTIVITY
3 = SUB VENDOR OF THE VENDOR
V = VERIFIED BY

* The Quantum of check to be witnessed is 10% of quantity or Min. 2 Nos. at random by BHEL/Customer & 100 % by Vendor for each type, Size & Rating.

BHEL	PARTICULARS		BIDDER/VENDOR
	NAME		
	SIGNATURE		
	DATE		
			BIDDER'S/ VENDOR'S COMPANY SEAL

QUALITY PLAN		CUSTOMER: M/S GSECL		PROJECT: 2 X 490 MW NCTPPP, DADRI, STAGE-II		SPEC. NO.: PE-TS-436-555-A001	
SHEET 1 OF 3		BIDDER/VENDOR:		QP NO.: PE-QP-408-555-M016		REV.00 DT: 20.02.2018	
S.N.O.		COMPONENT/ OPERATION		SYSTEM SERVICE/ INSTRUMENT		ITEM: EXTERNAL Y-TYPE AIR STRAINER	
S.N.O.		CHARACTERISTICS CHECKED		CATE- GORY		TYPE/METHOD OF CHECK	
S.N.O.		EXTENT OF CHECK		REFERENCE DOCUMENT		ACCEPTANCE NORMS	
S.N.O.		EXTENT OF CHECK		FORMAT OF RECORD		AGENCY	
S.N.O.		EXTENT OF CHECK		P		W V	
S.N.O.		EXTENT OF CHECK		REMARKS		VOLUME	

S.N.O.	COMPONENT/ OPERATION	CHARACTERISTICS CHECKED	CATE- GORY	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY	REMARKS
1.0	MATERIAL CONTROL									
1.1	BODY, CAP	1. PHYS & CHEM PROPERTIES	MA	PHYS TESTS	ONE/HEAT/ BATCH	APPD. DATA SHEET/ TECH.SPEC.	APPD. DATA SHEET/ TECH.SPEC.	TEST CERT.	3/2	2
		2. SURFACE DEFECTS	MA	VISUAL	100%	--DO--	--DO--	INSPN. REPORT	3/2	2
1.2	MESH	1. CHEM PROPERTIES	MA	CHEM. TESTS	1/SHEET	APPD. DATA SHEET/ TECH.SPEC.	APPD. DATA SHEET/ TECH. SPEC	TEST CERT	3/2	2
		2. MESH SIZE/ PERFORATION DIA	MA	MEASUREMENT	SAMPLE PIECE	--DO--	--DO--	INSPN REPORT	3/2	2
2.0	IN PROCESS CONTROL									
2.1	ALL COMPONENTS	1.WORKMANSHIP & FINISH	MA	VISUAL	100%	MFG DRG	MFG DRG	INSP REPORT	2	2
		2.DIMENSIONS	MA	MEASUREMENT	100%	MFG DRG	MFG DRG	MFG DRG	2	2
3.0	HYDRAULIC TEST (FOR CCS MATERIAL, TEST TO BE CONDUCTED BEFORE GALVANISING)									
3.1	BODY CAP	LEAK TIGHTNESS OF BODY	OR	HYDROTEST AT 1.5 TIMES OF STRAINER DESIGN PRESSURE	100%	APPD.DRG/T ECH. SPEC	NO LEAKAGE	TEST CERT	2	2
4.0	GALVANISING (APPLICABLE FOR CCS MATERIAL ONLY)									

BHEL		PARTICULARS		BIDDER/VENDOR	
		NAME			
		SIGNATURE			
		DATE			
				BIDDER'S/VENDOR'S COMPANY SEAL	

		QUALITY PLAN		CUSTOMER: M/S GSECL		PROJECT: 2 X 490 MW NCTPPP, DADRI, STAGE-II		SPEC. NO.: PE-TS-436-555-A001																					
		BIDDER/VENDOR:		BIDDER/VENDOR:		QP NO.: PE-QP-408-555-M016		REV.00 DT: 20.02.2018																					
SHEET 2 OF 3		SYSTEM SERVICE/ INSTRUMENT AIR		EXTENT OF CHECK		REFERENCE DOCUMENT		ACCEPTANCE NORMS		FORMAT OF RECORD		AGENCY		REMARKS															
S.N.O.		COMPONENT/ OPERATION		CHARACTERISTICS CHECKED		CATEGORY		CATE- TYPE/METHOD OF CHECK		EXTENT OF CHECK		IS:2629		IS:2629		INSPN REPORT		2		2,1		2		P		W		V	
4.1	HOT DIP GALVANISING OF BODY, COVER		1. SURFACE PREPARATION & THICKNESS OF GALVANISING & UNIFORMITY.		MA		VISUAL & MEASUREMENT		100%		IS:2629		IS:2629		INSPN REPORT		2		2,1		2		P		W		V		
5.0	ASSEMBLY CONTROL (FOR CCS MATERIAL, TEST TO BE CONDUCTED AFTER GALVANISING)																												
5.1	COMPLETE STRAINER		1. WORKMANSHIP AND FINISH		MA		VISUAL		100%		APPD.DRG		APPD.DRG		INSPN. REPORT		2		2		1								
			2. OVERALL DIMENSIONS		CR		MEASUREMENT		100%		DO--		DO--		--DO--		2		2,1		1								
			3. LEAK TIGHTNESS OF BODY		CR		HYDROTEST AT 1.5 TIMES OF STRAINER DESIGN PRESSURE		100%		APPD.DRG/ ECH. SPEC		NO LEAKAGE		TEST CERT		2		2,1		1								
6.0	END CONN.		DIMENSIONS		CR		MEASUREMENT		100%		APPD.DRG/ TECH SPEC.		APPD.DRG/ TECH SPEC.		INSPN REPORT		2		2,1		-								
7.0	PROVISION OF NAME PLATE WITH PURCHASER'S STRAINER TAG NOS IF ANY & PACKING IN WOODEN CASES		AS PER TECH. SPEC		MA		VISUAL		100%		TECH. SPEC		TECH. SPEC		(Soft copy of photographs)		3/2		2		1								
																Vendor to provide the following: a) Photographs of strainer duly placed inside the wooden box just before final packing. b) Photographs of the wooden box in which the strainer have been finally packed just before dispatch. Clearance for dispatch of valves/traps will be given													

BHEL		PARTICULARS		BIDDER/VENDOR	
		NAME			
		SIGNATURE			
		DATE			
BIDDER'S/ VENDOR'S COMPANY SEAL					



2 X 490 MW NCTPPP, DADRI, STAGE-II
COMPRESSED AIR SYSTEM

SPECIFICATION No: PE-TS-436-555-A001

VOLUME: II B

SECTION : C-3

REV. 00

DATE: 19.03.18

SHEET: 1 OF 1

SECTION: C-3
TECHNICAL SPECIFICATION (ELECTRICAL PORTION)



TITLE:

**ELECTRICAL EQUIPMENT SPECIFICATION
FOR****COMPRESSED AIR SYSTEM
2 X 490MW DADRI TPP-FGD**

SPECIFICATION NO.

VOLUME NO. : **II-B**SECTION: **I**REV NO. : **00** DATE: 01.03.2018

SHEET: 1 OF 1

CONTENTS

SECTION	TITLE	NO OF SHEETS
I	SPECIFIC TECHNICAL REQUIREMENTS	3
I	ELECTRICAL SCOPE BETWEEN BHEL & VENDOR (ANNEURE-I)	2
I	ELECTRICAL LOAD DATA FORMAT (ANNEXURE-II)	1
I	CABLE SCHEDULE FORMAT (ANNEXURE-III)	1
I	TECHNICAL SPECIFICATION FOR MOTORS	9
I	MOTOR DATASHEET-A	2
I	MOTOR DATASHEET-C	2
II	STANDARD SPECIFICATION FOR LV MOTORS	5
II	REFERENCE QUALITY PLAN	3
II	TECHNICAL SPECIFICATION FOR CABLE TRAYS & ACCESSORIES	5
II	TYPICAL DETAILS OF CABLE TRAYS AND ACCESSORIES	2

The requirements mentioned in Section-I shall prevail and govern in case of conflict between the same and the corresponding requirements mentioned in the descriptive portion in Section-II.



TITLE :
**ELECTRICAL EQUIPMENT SPECIFICATION
FOR
COMPRESSED AIR SYSTEM
2 X 490MW DADRI TPP-FGD**

SPECIFICATION NO.
VOLUME NO. : II-B
SECTION : I
REV NO. : 00 DATE : 01.03.2018
SHEET : 1 OF 3

**TECHNICAL SPECIFICATION
FOR
COMPRESSED AIR SYSTEM
(ELECTRICAL PORTION)**



TITLE :
ELECTRICAL EQUIPMENT SPECIFICATION
FOR
COMPRESSED AIR SYSTEM
2 X 490MW DADRI TPP-FGD

SPECIFICATION NO.
VOLUME NO. : II-B
SECTION : I
REV NO. : 00 DATE : 01.03.2018
SHEET : 2 OF 3

1.0 EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER:

- a) Services and equipment as per “Electrical Scope between BHEL and Vendor”.
- b) Any item/work either supply of equipment or erection material which have not been specifically mentioned but are necessary to complete the work for trouble free and efficient operation of the plant shall be deemed to be included within the scope of this specification. The same shall be provided by the bidder without any extra charge.
- ~~c) Supply of mandatory spares as specified in the specifications of mechanical equipments.~~
- d) Electrical load requirement for COMPRESSED AIR SYSTEM (all AC & DC loads at different voltage levels like 415V AC, 240 V AC, 220 V DC etc).
- e) All equipment shall be suitable for the power supply fault levels and other climatic conditions mentioned in the enclosed project information.
- f) Bidder to furnish list of makes for each equipment at contract stage, which shall be subject to customer/BHEL approval without any commercial and delivery implications to BHEL
- g) Various drawings, data sheets as per required format, Quality plans, calculations, test reports, test certificates, operation and maintenance manuals etc shall be furnished as specified at contract stage. All documents shall be subject to customer/BHEL approval without any commercial implication to BHEL.
- h) Motor shall meet minimum requirement of motor specification.
- i) Vendor to clearly indicate equipment locations and local routing lengths in their cable listing furnished to BHEL.
- j) Cable BOQ worked out based on routing of cable listing provided by the vendor for “ both end equipment in vendor’s scope”shall be binding to the vendor with +10 % margin to take care of slight variation in routing length & wastages.

2.0 EQUIPMENT & SERVICES TO BE PROVIDED BY PURCHASER FOR ELECTRICAL & TERMINAL POINTS:

Refer “Electrical Scope between BHEL and Vendor”.

3.0 DOCUMENTS TO BE SUBMITTED ALONG WITH BID

- 3.1 The electrical specification without any deviation from the technical/quality assurance requirements stipulated shall be deemed to be complied by the bidder in case bidder furnishes the overall compliance of package technical specification in the form of compliance certificate/No deviation certificate.
- 3.2 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.



TITLE :
**ELECTRICAL EQUIPMENT SPECIFICATION
FOR
COMPRESSED AIR SYSTEM
2 X 490MW DADRI TPP-FGD**

SPECIFICATION NO.
VOLUME NO. : **II-B**
SECTION : **I**
REV NO. : **00** DATE : **01.03.2018**
SHEET : 3 OF 3

4.0 List of enclosures :

- a) Electrical scope between BHEL & vendor (Annexure –I)
- b) Technical specification for motors.
- c) Datasheets & quality plan for motors.
- d) Electrical Load data format (Annexure –II)
- e) BHEL cable listing format (Annexure –III)

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)

PACKAGES : COMPRESSED AIR SYSTEM

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

PROJECT: 2 X 490 MW DADRI FGD

<u>S.NO</u>	<u>DETAILS</u>	<u>SCOPE SUPPLY</u>	<u>SCOPE E&C</u>	<u>REMARKS</u>
1	11 kV/ 6.6 KV / 3.3 KV / 415 V Switchgear	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 motors.
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, 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 & bimetallic strip for equipments 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.
8	Conduit and conduit accessories for cabling between equipments 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) & lightning protection	BHEL	BHEL	Refer note no. 4 for electronic earthing
11	Below grade grounding	BHEL	BHEL	--
12	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

APPROVED
By: [Signature] Date: 12/03/2018

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)

PACKAGES : COMPRESSED AIR SYSTEM

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

PROJECT: 2 X 490 MW DADRI FGD

15	Any other equipment/material/service required for completeness of system based on the system offered by vendor (to ensure trouble free and efficient operation of the system).	Vendor	Vendor	--	
16	a. Input cable schedules (C & I) b. Cable interconnection detail for the 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	Cabling layout drawings	BHEL/ Vendor	-		a. In case of Compressor are HT motors, cable tray/trench layout inside compressed air building shall be prepared by BHEL. Vendor to furnish drawing (both in print form as well as in AUTOCAD) of compressor room layout clearly indicating all motors, panels, JB's etc. which require cabling alongwith their terminal box/location/ Foundation etc. b. In case of Compressor are LT motors, for ensuring cabling requirements are met, vendor shall prepare & submit cable tray/trench & equipment layout (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 for BHEL review & approval.
18	Electrical equipment GA drawing	Vendor	-		For necessary interface review.

NOTES:

1. Make of all electrical equipments/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.
3. In case the requirement of junction box arises on account of power cable size mismatch 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.

LOAD TITLE	RATING (KW / A)		UNIT (U)/STN (S)	Nos.		VOLTAGE CODE*	FEEDER CODE**	EMER. LOAD (Y)	CONT.(C)/ INT.(I)	STARTING TIME >5 SEC (Y)	LOCATION	BOARD NO.	CABLE		BLOCK CABLE DRG. No.	CONT ROL CODE	REMA RKS	LOAD No.	VERIFICATI ON FROM MOTOR DATASHEE T (Y/N)	KKS NO	
	NAME PLATE	MAX. CONT. DEMAND (MCR)		RUNNING	STANDBY								SIZE CODE	Nos							
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	
ANNEXURE-II																					
NOTES: 1. COLUMN 1 TO 12 & 18 SHALL BE FILLED BY THE REQUISITIONER (ORIGINATING AGENCY); REMAINING COLUMNS ARE TO BE FILLED UP BY PEM (ELECTRICAL)/ CUSTOMER																					
2. ABBREVIATIONS : * VOLTAGE CODE (7):- (ac) A=11 KV, B=6.6 KV, C=3.3 KV, D=415 V, E=240 V (1 PH), F=110 V (cc): G=220 V, H=110 V, J=48 V, K=+24V, L=-24 V																					
: ** FEEDER CODE (8):- U=UNIDIRECTIONAL STARTER, B=BI-DIRECTIONAL STARTER, S=SUPPLY FEEDER, D=SUPPLY FEEDER (CONTACTOR CONTROLLED)																					
LOAD DATA (ELECTRICAL)	JOB NO.	436										ORIGINATING AGENCY				PEM (ELECTRICAL)					
	PROJECT TITLE	2 x 490MW DADRI TPP-FGD										NAME		DATA FILLED UP ON							
	SYSTEM	COMPRESSED AIR SYSTEM										SIGN.		DATA ENTERED ON							
	DEPTT. / SECTION	MAX										SHEET 1 OF 1		REV. 00		DE'S SIGN. & DATE					

SUB-SECTION-II-E2

MOTORS

NCTPP, DADRI(2X490MW) IGSTPP JHAJJAR (3X500MW)
FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE

TECHNICAL SPECIFICATION
SECTION-VI
BID DOCUMENT NO.: CS-6130/0330-109-9

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	MOTORS			
1.00.00	GENERAL REQUIREMENTS			
1.01.00	For the purpose of design of equipment/systems, an ambient temperature of 50 deg. Centigrade and relative humidity of 95% (at 40 deg C) shall be considered. The equipment shall operate in a highly polluted environment.			
1.02.00	All equipment shall be suitable for rated frequency of 50 Hz with a variation of +3% & -5%, and 10% combined variation of voltage and frequency unless specifically brought out in the specification.			
1.03.00	Contractor shall provide fully compatible electrical system, equipment, accessories and services.			
1.04.00	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.			
1.05.00	Paint shade shall be as per RAL 5012 (Blue) for indoor and outdoor equipment.			
1.06.00	The responsibility of coordination with electrical agencies and obtaining all necessary clearances for contractors equipment and systems shall be under the contractor scope.			
1.07.00	Degree of Protection Degree of protection for various enclosures as per IEC60034-05 shall be as follows:- i) Indoor motors - IP 54 ii) Outdoor motors - IP 55 iii) Cable box-indoor area - IP 54 iv) Cable box-Outdoor area - IP 55			
2.00.00	CODES AND STANDARDS			
	1) Three phase induction motors : IS/IEC:60034 2) Single phase AC motors : IS/IEC:60034 3) Crane duty motors : IS:3177, IS/IEC:60034 4) DC motors/generators : IS/IEC:60034 5) Energy Efficient motors : IS 12615, IEC: 60034-30			
NCTPP DADRI ST-II (2X490MW) & IGSTPP JHAJJAR (3X500MW) PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO. : CS-6130/0330-109-9	SUB-SECTION-II-E2 MOTORS	PAGE 1 OF 9

CLAUSE NO.	TECHNICAL REQUIREMENTS			
6.00.00	OPERATIONAL REQUIREMENTS			
6.01.00	Starting Time			
6.01.01	For motors with starting time upto 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.			
6.01.02	For motors with starting time more than 20 secs. and upto 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.			
6.01.03	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.			
6.01.04	Speed switches mounted on the motor shaft shall be provided in cases where above requirements are not met.			
6.02.00	Torque Requirements			
6.02.01	Accelerating torque at any speed with the lowest permissible starting voltage shall be at least 10% motor full load torque.			
6.02.02	Pull out torque at rated voltage shall not be less than 205% of full load torque. It shall be 275% for crane duty motors.			
6.03.00	Starting voltage requirement			
	(a) Up to 85% of rated voltage for ratings below 110 KW			
	(b) Up to 80% of rated voltage for ratings from 110 KW to 200 KW			
	(c) Up to 85% of rated voltage for ratings from 201 KW to 1000 KW			
	(d) Up to 80% of rated voltage for ratings from 1001 KW to 4000 KW			
	(e) Up to 75 % of rated voltage for ratings above 4000KW			
	Except AOP & JOP motors running on D.G emergency supply, starting voltage shall be 80%.			
7.00.00	DESIGN AND CONSTRUCTIONAL FEATURES			
7.01.00	Suitable single phase space heaters shall be provided on motors rated 30KW and above to maintain windings in dry condition when motor is standstill. Separate			
NCTPP DADRI ST-II (2X490MW) & IGSTPP JHAJJAR (3X500MW) PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO. : CS-6130/0330-109-9	SUB-SECTION-II-E2 MOTORS	PAGE 3 OF 9

CLAUSE NO.	TECHNICAL REQUIREMENTS
7.02.00	terminal box for space heaters & RTDs shall be provided. However for flame proof motors, space heater terminals inside the main terminal box may be acceptable. 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). The method of movement of primary and secondary coolant shall be self-circulated by fan or pump directly mounted on the rotor of the main motor as per IEC 60034-6. However VFD driven motors can be offered with forced cooling type with machine mounted fan or pump driven by separate electric motor. Motors and EPB 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 : Group - IIC or (Group-I, Div-II as per plant area NEC) or (Class-1, Group-B, Div-II as per NEMA / IEC60034)
7.03.00	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) 11kV & 3.3 kV AC motors : Thermal class 155 (F) insulation. The winding insulation process shall be Global Vacuum Pressure Impregnated i.e. resin poor method. The lightning Impulse & intertern insulation surge withstand level shall be as per IEC-60034 part-15. However winding insulation for wet wound Boiler circulation pump motor shall be thermal class 90 (Y) or better. (d) 240VAC, 415V AC & 220V DC motors : Thermal Class (B) or better
7.04.00	Motors rated above 1000KW shall have insulated bearings to prevent flow of shaft currents.
7.05.00	Motors with heat exchangers shall have dial type thermometer with adjustable alarm contacts to indicate inlet and outlet primary air temperature.
7.06.00	Noise level for all the motors shall be limited to 85dB (A) except for BFP motor for which the maximum limit shall be 90 dB(A). Vibration shall be limited within the limits prescribed in IS/IEC 60034-14. Motors shall withstand vibrations produced by driven
NCTPP DADRI ST-II (2X490MW) & IGSTPP JHAJJAR (3X500MW) PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO. : CS-6130/0330-109-9 SUB-SECTION-II-E2 MOTORS PAGE 4 OF 9

CLAUSE NO.	TECHNICAL REQUIREMENTS									
	equipment. HT motor bearing housings shall have flat surfaces, in both X and Y directions, suitable for mounting 80mmX80mm vibration pads.									
7.07.00	In HT motors, at least four numbers simplex / two numbers duplex platinum resistance type temperature detectors shall be provided in each phase stator winding. Each bearing of HT motor shall be provided with dial type thermometer and 2 numbers duplex platinum resistance type temperature detectors.									
7.08.00	Motor body shall have two earthing points on opposite sides.									
7.09.00	11 KV motors shall be offered with Separable Insulated Connector (SIC) as per IEEE 386. The offered SIC terminations shall be provided with protective cover and trifurcating sleeves. SIC termination kit shall be suitable for fault level of 25 KA for 0.17 seconds.									
7.10.00	3.3 KV motors shall be offered with dust tight phase separated double walled (metallic as well as insulated barrier) Terminal box. Suitable termination kit shall be provided for the offered Terminal box. The offered Terminal Box shall be suitable for fault level of 250 MVA for 0.12 sec. 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.									
7.11.00	The spacing between gland plate & center of terminal stud shall be as per Table-I.									
7.12.00	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.									
7.13.00	The motors shall be suitable for bus transfer schemes provided on the 11kV, 3.3 kV /415V systems without any injurious effect on its life.									
7.14.00	For motors rated 2000 KW & above, neutral current transformers of PS class shall be provided on each phase in a separate neutral terminal box.									
7.15.00	The size and number of cables (for HT and LT motors) to be intimated to the successful bidder during detailed engineering and the contractor shall provide terminal box suitable for the same.									
8.00.00	The ratio of locked rotor KVA at rated voltage to rated KW shall not exceed the following (without any further tolerance) except for BFP motor. <table><tr><td>(a) From 50KW & upto 110KW</td><td>:</td><td>11.0</td></tr><tr><td>(b) From 110 KW & upto 200 KW</td><td>:</td><td>9.0</td></tr><tr><td>(c) Above 200 KW & upto 1000KW</td><td>:</td><td>10.0</td></tr></table>	(a) From 50KW & upto 110KW	:	11.0	(b) From 110 KW & upto 200 KW	:	9.0	(c) Above 200 KW & upto 1000KW	:	10.0
(a) From 50KW & upto 110KW	:	11.0								
(b) From 110 KW & upto 200 KW	:	9.0								
(c) Above 200 KW & upto 1000KW	:	10.0								
NCTPP DADRI ST-II (2X490MW) & IGSTPP JHAJJAR (3X500MW) PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO. : CS-6130/0330-109-9	SUB-SECTION-II-E2 MOTORS	PAGE 5 OF 9							

CLAUSE NO.	TECHNICAL REQUIREMENTS			
9.00.00	(d) From 1001KW & upto 4000KW : 9.0 (e) Above 4000KW : 6 to 6.5 CW motor shall be designed with minimum power factor of 0.8 at design duty point.			
10.00.00	TYPE TEST			
10.01.00	HT MOTORS			
10.01.01	The contractor shall carry out the type tests as listed in this specification on the equipment to be supplied under this contract. The bidder shall indicate the charges for each of these type tests separately in the relevant schedule of Section - VII- (BPS) and the same shall be considered for the evaluation of the bids. The type tests charges shall be paid only for the test(s) actually conducted successfully under this contract and upon certification by the employer's engineer.			
10.01.02	The type tests shall be carried out in presence of the employer's representative, for which minimum 15 days notice shall be given by the contractor. The contractor shall obtain the employer's approval for the type test procedure before conducting the type test. The type test procedure shall clearly specify the test set-up, instruments to be used, procedure, acceptance norms, recording of different parameters, interval of recording, precautions to be taken etc. for the type test(s) to be carried out.			
10.01.03	In case the contractor has conducted such specified type test(s) within last ten years as on the date of bid opening, he may submit during detailed engineering the type test reports to the employer for waiver of conductance of such test(s). These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. The employer reserves the right to waive conducting of any or all the specified type test(s) under this contract. In case type tests are waived, the type test charges shall not be payable to the contractor.			
10.01.04	Further the Contractor shall only submit the reports of the type tests as listed in "LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED" and carried out within last ten years from the date of bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. However if the contractor is not able to submit report of the type test(s) conducted within last ten years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to the employer either at third party lab or in presence of client/ employer's representative and submit the reports for approval.			
NCTPP DADRI ST-II (2X490MW) & IGSTPP JHAJJAR (3X500MW) PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO. : CS-6130/0330-109-9	SUB-SECTION-II-E2 MOTORS	PAGE 6 OF 9

CLAUSE NO.	TECHNICAL REQUIREMENTS
10.01.05	LIST OF TYPE TESTS TO BE CONDUCTED The following type tests shall be conducted on each type and rating of HT motor (a) No load saturation and loss curves upto approximately 115% of rated voltage (b) Measurement of noise at no load. (c) Momentary excess torque test (subject to test bed constraint). (d) Full load test (subject to test bed constraint) (e) Temperature rise test at rated conditions. During heat run test, bearing temp., winding temp., coolant flow and its temp. 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.
10.01.06	LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED The following type test reports shall be submitted for each type and rating of HT motor (a) Degree of protection test for the enclosure followed by IR, HV and no load run test. (b) Terminal box-fault level withstand test for each type of terminal box of HT motors only. (c) Lightning Impulse withstand test on the sample coil shall be as per clause no. 4.3 IEC-60034, part-15 (d) Surge-withstand test on interturn insulation shall be as per clause no. 4.2 of IEC 60034, part-15
10.02.00	LT Motors
10.02.01	LT Motors supplied shall be of type tested design. During detailed engineering, the contractor shall submit for employer's approval the reports of all the type tests as listed in this specification and carried out within last <i>ten</i> years from the date of bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client.
NCTPP DADRI ST-II (2X490MW) & IGSTPP JHAJJAR (3X500MW) PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO. : CS-6130/0330-109-9 SUB-SECTION-II-E2 MOTORS PAGE 7 OF 9

CLAUSE NO.	TECHNICAL REQUIREMENTS		
10.02.02	However if the contractor is not able to submit report of the type test(s) conducted within last ten years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to the employer either at third party lab or in presence of client/ employer's representative and submit the reports for approval.		
10.02.03	LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED The following type test reports shall be submitted for each type and rating of LT motor of above 50 KW only 1. Measurement of resistance of windings of stator and wound rotor. 2. No load test at rated voltage to determine input current power and speed 3. Open circuit voltage ratio of wound rotor motors (in case of Slip ring motors) 4. Full load test to determine efficiency power factor and slip. 5. Temperature rise test. 6. Momentary excess torque test. 7. High voltage test. 8. Test for vibration severity of motor. 9. Test for noise levels of motor(Shall be limited as per clause no 7.06.00 of this section) 10. Test for degree of protection and 11. Over speed test. 12. Type test reports for motors located in fuel oil area having flame proof enclosures as per IS 2148 / IEC 60079-1		
10.03.00	All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.		
10.04.00	The type test reports once approved for any projects shall be treated as reference. For subsequent projects of NTPC, an endorsement sheet will be furnished by the manufacturer confirming similarity and "No design Change". Minor changes if any shall be highlighted on the endorsement sheet.		
NCTPP DADRI ST-II (2X490MW) & IGSTPP JHAJJAR (3X500MW) PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO. : CS-6130/0330-109-9	SUB-SECTION-II-E2 MOTORS	PAGE 8 OF 9

CLAUSE NO.	TECHNICAL REQUIREMENTS																														
	TABLE - I DIMENSIONS OF TERMINAL BOXES FOR LV MOTORS <table><thead><tr><th>Motor MCR in KW</th><th>Minimum distance between centre of stud and gland plate in mm</th></tr></thead><tbody><tr><td>UP to 3 KW</td><td>As per manufacturer's practice.</td></tr><tr><td>Above 3 KW - upto 7 KW</td><td>85</td></tr><tr><td>Above 7 KW - upto 13 KW</td><td>115</td></tr><tr><td>Above 13 KW - upto 24 KW</td><td>167</td></tr><tr><td>Above 24 KW - upto 37 KW</td><td>196</td></tr><tr><td>Above 37 KW - upto 55 KW</td><td>249</td></tr><tr><td>Above 55 KW - upto 90 KW</td><td>277</td></tr><tr><td>Above 90 KW - upto 125 KW</td><td>331</td></tr><tr><td>Above 125 KW-upto 200 KW</td><td>203</td></tr></tbody></table> For HT motors the distance between gland plate and the terminal studs shall not be less than 500 mm. PHASE TO PHASE/ PHASE TO EARTH AIR CLEARANCE: NOTE: Minimum inter-phase and phase-earth air clearances for LT motors with lugs installed shall be as follows: <table><thead><tr><th>Motor MCR in KW</th><th>Clearance</th></tr></thead><tbody><tr><td>UP to 110 KW</td><td>10mm</td></tr><tr><td>Above 110 KW and upto 150 KW</td><td>12.5mm</td></tr><tr><td>Above 150 KW</td><td>19mm</td></tr></tbody></table>			Motor MCR in KW	Minimum distance between centre of stud and gland plate in mm	UP to 3 KW	As per manufacturer's practice.	Above 3 KW - upto 7 KW	85	Above 7 KW - upto 13 KW	115	Above 13 KW - upto 24 KW	167	Above 24 KW - upto 37 KW	196	Above 37 KW - upto 55 KW	249	Above 55 KW - upto 90 KW	277	Above 90 KW - upto 125 KW	331	Above 125 KW-upto 200 KW	203	Motor MCR in KW	Clearance	UP to 110 KW	10mm	Above 110 KW and upto 150 KW	12.5mm	Above 150 KW	19mm
Motor MCR in KW	Minimum distance between centre of stud and gland plate in mm																														
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NCTPP DADRI ST-II (2X490MW) & IGSTPP JHAJJAR (3X500MW) PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO. : CS-6130/0330-109-9	SUB-SECTION-II-E2 MOTORS	PAGE 9 OF 9																											



TITLE

LV MOTORS**DATA SHEET-A**

2 x 490MW DADRI TPP- FGD

SPECIFICATION NO.

VOLUME II B

SECTION D

REV NO. DATE: 01.03.2018

SHEET 1 OF 2

ANNEXURE-III

- 1.0 Design ambient temperature : 50 °C
- 2.0 Maximum acceptable kW rating of LV motor : 200KW *
- 3.0 Installation (Indoors/ Outdoors) : As required
- 4.0 Details of supply system
- a) Rated voltage (with variation) : 415V $\pm$ 10%
 - b) Rated frequency (with variation) : 50 Hz + 3 % to - 5%
 - c) Combined voltage & freq. variation : 10% (sum of absolute values)
 - d) System fault level at rated voltage : 50 kA for 1 sec
 - e) Short time rating for terminal boxes
 - o 110 kW and above (Breaker : 50 KA for 0.25 sec. Controlled)
 - o Below 110 kW (Contactor : 50 KA protected by HRC fuse Controlled)
 - f) LV System grounding : Solidly
- 5.0 Winding & Insulation : Class F with temp rise limited to class B
- 6.0 Minimum voltage for starting : 85% for motor ratings below 110kW
(As percentage of rated voltage) 80% for motor ratings from 110kW to 200kW.
- 7.0 Power cables data : Shall be given during detailed engg.
- 8.0 Earth Conductor Size & Material : Shall be given during detailed engg.
- 9.0 Space heater supply (for motors $\geq$ 30kW) : 240 V, 1 ϕ , 50 Hz
- 10.0 Rating up to which Single phase motor : Acceptable below 0.2 kW
- 11.0 Locked rotor current
- a) Limit as percentage of FLC : As per IS 12615
- 12.0 Makes : BHEL/ Customer approval (Package owner to take care)
- 13.0 Paint shade : Blue (RAL 5012) – Corrosion proof
- 14.0 Degree Of protection for motor/ terminal box : Degree of protection for various enclosures as per IEC60034-05 shall be as follows:-
- i) Indoor motors - IP 54
 - ii) Outdoor motors - IP 55
 - iii) Cable box-indoor area - IP 54
 - iv) Cable Box-Outdoor area - IP 55

*** LT motors of continuous duty shall be energy efficient IE3 class conforming to IS-12615**

15.0 TESTING REQUIREMENTS: IN LINE WITH SPECIFICATION

	TITLE MOTORS DATA SHEET – C 2 x 490MW DADRI TPP-FGD	SPECIFICATION NO.
		VOLUME II B
		SECTION D
		REV NO. 00 DATE 01.03.18
		SHEET 1 OF 2

S. No.	Description		Data to be filled by successful bidder
A.	General		
1	Manufacturer & country of origin		
2	Motor type		
3	Type of starting		
4	Name of the equipment driven by motor & Quantity		
5	Maximum Power requirement of driven equipment		
6	Rated speed of Driven Equipment		
7	Design ambient temperature		
B.	Design and Performance Data		
1	Frame size & type designation		
2	Type of duty		
3	Rated Voltage		
4	Permissible variation for		
5	a	Voltage	
6	b	Frequency	
7	c)	Combined voltage & frequency	
8	Rated output at design ambient temp (by resistance method)		
9	Synchronous speed & Rated slip		
10	Minimum permissible starting voltage		
11	Starting time in sec with mechanism coupled		
12	a) At rated voltage		
13	b) At min starting voltage		
14	Locked rotor current as percentage of FLC (including IS tolerance)		
15	Torque		
	a) Starting		
	b) Maximum		
16	Permissible temp rise at rated output over ambient temp & method		
17	Noise level at 1.0 m (dB)		
18	Amplitude of vibration		
19	Efficiency & P.F. at rated voltage & frequency		
	a) At 100% load		
	c) At 75% load		

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			

	TITLE MOTORS DATA SHEET – C 2 x 490MW DADRI TPP-FGD	SPECIFICATION NO.
		VOLUME II B
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		REV NO. 00 DATE 01.03.18
		SHEET 2 OF 2

S. No.	Description	Data to be filled by successful bidder
	c) At starting	
C.	Constructional Features	
1	Method of connection of motor driven equipment	
2	Applicable Standard	
3	DOP of Enclosure	
4	Method of cooling	
5	Class of insulation	
6	Main terminal box	
	a) Type	
	b) Power Cable details (Conductor, size, armour/unarmour)	
	c) Cable Gland & lugs details (Size, type & material)	
	d) Permissible Fault level (kArms & duration in sec)	
7	Space heater details (Voltage & watts)	
8	Flame proof motor details (if applicable)	
	a) Enclosure	
	b) suitability for hazardous area	
	i Zone	O / I / II
	ii Group	IIA / IIB / IIC
9	No. of Stator winding	
10	Winding connection	
11	Kind of rotor winding	
12	Kind of bearings	
13	Direction of rotation when viewed from NDE	
14	Paint Shade & type	
15	Net weight of motor	
16	Outline mounting drawing No (To be enclosed as annexure)	
D.	Characteristic curves/ drawings (To be enclosed for motors of rating $\geq 55\text{KW}$)	
	a) Torque speed characteristic	
	b) Thermal withstand characteristic	
	c) Current vs time	
	d) Speed vs time	

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			



TITLE :
GENERAL TECHNICAL REQUIREMENTS

FOR

LV MOTORS

SPECIFICATION NO.
PE-SS-999-506-E101
VOLUME NO. : **II-B**
SECTION : **D**
REV NO. : **00** DATE : 29/08/2005
SHEET : 1 OF 1

GENERAL TECHNICAL REQUIREMENTS

FOR

LV MOTORS

SPECIFICATION NO.: PE-SS-999-506-E101 Rev 00



TITLE :
GENERAL TECHNICAL REQUIREMENTS

FOR

LV MOTORS

SPECIFICATION NO.
PE-SS-999-506-E101
VOLUME NO. : **II-B**
SECTION : **D**
REV NO. : **00** DATE : 29/08/2005
SHEET : 1 OF 4

1.0 INTENT OF SPECIFICATION

The specification covers the design, materials, constructional features, manufacture, inspection and testing at manufacturer's work, and packing of Low voltage (LV) squirrel cage induction motors along with all accessories for driving auxiliaries in thermal power station.

Motors having a voltage rating of below 1000V are referred to as low voltage (LV) motors.

2.0 CODES AND STANDARDS

Motors shall fully comply with latest edition, including all amendments and revision, of following codes and standards:

IS:325	Three phase Induction motors
IS : 900	Code of practice for installation and maintenance of induction motors
IS: 996	Single phase small AC and universal motors
IS: 4722	Rotating Electrical machines
IS: 4691	Degree of Protection provided by enclosures for rotating electrical machines
IS: 4728	Terminal marking and direction of rotation rotating electrical machines
IS: 1231	Dimensions of three phase foot mounted induction motors
IS: 8789	Values of performance characteristics for three phase induction motors
IS: 13555	Guide for selection and application of 3-phase A.C. induction motors for different types of driven equipment
IS: 2148	Flame proof enclosures for electrical appliance
IS: 5571	Guide for selection of electrical equipment for hazardous areas
IS: 12824	Type of duty and classes of rating assigned
IS: 12802	Temperature rise measurement for rotating electrical machines
IS: 12065	Permissible limits of noise level for rotating electrical machines
IS: 12075	Mechanical vibration of rotating electrical machines

In case of imported motors, motors as per IEC-34 shall also be acceptable.

3.0 DESIGN REQUIREMENTS

3.1 Motors and accessories shall be designed to operate satisfactorily under conditions specified in data sheet-A and Project Information, including voltage & frequency variation of supply system as defined in Data sheet-A

3.2 Motors shall be continuously rated at the design ambient temperature specified in Data Sheet-A and other site conditions specified under Project Information
Motor ratings shall have at least a 15% margin over the continuous maximum demand of the driven equipment, under entire operating range including voltage & frequency variation specified above.

3.3 Starting Requirements

3.3.1 Motor characteristics such as speed, starting torque, break away torque and starting time shall be properly co-ordinated with the requirements of driven equipment. The accelerating torque at any speed with the minimum starting voltage shall be at least 10% higher than that of the driven equipment.

3.3.2 Motors shall be capable of starting and accelerating the load with direct on line starting without exceeding acceptable winding temperature.



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The limiting value of voltage at rated frequency under which a motor will successfully start and accelerate to rated speed with load shall be taken to be a constant value as per Data Sheet - A during the starting period of motors.

3.3.3 The following frequency of starts shall apply

- i) Two starts in succession with the motor being initially at a temperature not exceeding the rated load temperature.
- ii) Three equally spread starts in an hour the motor being initially at a temperature not exceeding the rated load operating temperature. (not to be repeated in the second successive hour)
- iii) Motors for coal conveyor and coal crusher application shall be suitable for three consecutive hot starts followed by one hour interval with maximum twenty starts per day and shall be suitable for minimum 20,000 starts during the life time of the motor

3.4 **Running Requirements**

3.4.1 Motors shall run satisfactorily at a supply voltage of 75% of rated voltage for 5 minutes with full load without injurious heating to the motor.

3.4.2 Motor shall not stall due to voltage dip in the system causing momentary drop in voltage upto 70% of the rated voltage for duration of 2 secs.

3.5 **Stress During bus Transfer**

3.5.1 Motors shall withstand the voltage, heavy inrush transient current, mechanical and torque stress developed due to the application of 150% of the rated voltage for at least 1 sec. caused due to vector difference between the motor residual voltage and the incoming supply voltage during occasional auto bus transfer.

3.5.2 Motor and driven equipment shafts shall be adequately sized to satisfactorily withstand transient torque under above condition.

3.6 Maximum noise level measured at distance of 1.0 metres from the outline of motor shall not exceed the values specified in IS 12065.

3.7 The max. vibration velocity or double amplitude of motors vibration as measured at motor bearings shall be within the limits specified in IS: 12075.

4.0 **CONSTRUCTIONAL FEATURES**

4.1 Indoor motors shall conform to degree of protection IP: 54 as per IS: 4691. Outdoor or semi-indoor motors shall conform to degree of protection IP: 55 as per IS: 4691 and shall be of weather-proof construction. Outdoor motors shall be installed under a suitable canopy

4.2 Motors upto 160KW shall have Totally Enclosed Fan Cooled (TEFC) enclosures, the method of cooling conforming to IC-0141 or IC-0151 of IS: 6362.

Motors rated above 160 KW shall be Closed Air Circuit Air (CACA) cooled

4.3 Motors shall be designed with cooling fans suitable for both directions of rotation.



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- 4.4. Motors shall not be provided with any electric or pneumatic operated external fan for cooling the motors.
- 4.5. Frames shall be designed to avoid collection of moisture and all enclosures shall be provided with facility for drainage at the lowest point.
- 4.6. In case Class 'F' insulation is provided for LV motors, temperature rise shall be limited to the limits applicable to Class 'B' insulation.
In case of continuous operation at extreme voltage limits the temperature limits specified in table-1 of IS:325 shall not exceed by more than 10°C.
- 4.7. **Terminals and Terminal Boxes**
- 4.7.1 Terminals, terminal leads, terminal boxes, windings tails and associated equipment shall be suitable for connection to a supply system having a short circuit level, specified in the Data Sheet-A.

Unless otherwise stated in Data Sheet-A, motors of rating 110 kW and above will be controlled by circuit breaker and below 110 kW by switch fuse-contactor. The terminal box of motors shall be designed for the fault current mentioned in data sheet "A".
- 4.7.2 unless otherwise specified or approved, phase terminal boxes of horizontal motors shall be positioned on the left hand side of the motor when viewed from the non-driving end.
- 4.7.3 Connections shall be such that when the supply leads R, Y & B are connected to motor terminals A B & C or U, V & W respectively, motor shall rotate in an anticlockwise direction when viewed from the non-driving end. Where such motors require clockwise rotation, the supply leads R, Y, B will be connected to motor terminals A, C, B or U W & V respectively.
- 4.7.4 Permanently attached diagram and instruction plate made preferably of stainless steel shall be mounted inside terminal box cover giving the connection diagram for the desired direction of rotation and reverse rotation.
- 4.7.5 Motor terminals and terminal leads shall be fully insulated with no bar live parts. Adequate space shall be available inside the terminal box so that no difficulty is encountered for terminating the cable specified in Data Sheet-A.
- 4.7.6 Degree of protection for terminal boxes shall be IP 55 as per IS 4691.
- 4.7.7 Separate terminal boxes shall be provided for space heaters.. If this is not possible in case of LV motors, the space heater terminals shall be adequately segregated from the main terminals in the main terminal box. Detachable gland plates with double compression brass glands shall be provided in terminal boxes.
- 4.7.8. Phase terminal boxes shall be suitable for 360 degree of rotation in steps of 90 degree for LV motors.
- 4.7.9 Cable glands and cable lugs as per cable sizes specified in Data Sheet-A shall be included. Cable lugs shall be of tinned Copper, crimping type.
- 4.8 Two separate earthing terminals suitable for connecting G.I. or MS strip grounding conductor of size given in Data Sheet-A shall be provided on opposite sides of motor frame. Each terminal box shall have a grounding terminal.

	TITLE : GENERAL TECHNICAL REQUIREMENTS FOR LV MOTORS	SPECIFICATION NO. PE-SS-999-506-E101
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4.9.1 Motors provided for similar drives shall be interchangeable.

4.9.2 Suitable foundation bolts are to be supplied alongwith the motors.

4.9.3 Motors shall be provided with eye bolts, or other means to facilitate safe lifting if the weight is 20Kgs. and above.

4.9.4 Necessary fitments and accessories shall be provided on motors in accordance with the latest Indian Electricity rules 1956.

4.9.5 All motors rated above 30 kW shall be provided with space heaters to maintain the motor internal air temperature above the dew point. Unless otherwise specified, space heaters shall be suitable for a supply of 240V AC, single phase, 50 Hz.

4.9.6 Name plate with all particulars as per IS: 325 shall be provided

4.9.7 Unless otherwise specified, the colour of finish shall be grey to Shade No. 631 and 632 as per IS:5 for motors installed indoor and outdoor respectively. The paint shall be epoxy based and shall be suitable for withstanding specified site conditions.

5.0 **INSPECTION AND TESTING**

5.1 All materials, components and equipments covered under this specification shall be procured, manufactured, as per the BHEL standard quality plan No. PED-506-00-Q-006/0 and PED-506-00-Q-007/2 enclosed with this specification and which shall be complied.

5.2 LV motors of type-tested design shall be provided. Valid type test reports not more than 5 year shall be furnished. In the absence of these, type tests shall have to be conducted by manufacturer without any commercial implication to purchaser.

5.3 All motors shall be subjected to routine tests as per IS: 325 and as per BHEL standard quality plan.

5.4 Motors shall also be subjected to additional tests, if any, as mentioned in Data Sheet A.

6.0 **DRAWINGS TO BE SUBMITTED AFTER AWARD OF CONTRACT**

a) OGA drawing showing the position of terminal boxes, earthing connections etc.

b) Arrangement drawing of terminal boxes.

c) Characteristic curves:
(To be given for motor above 55 kW unless otherwise specified in Data Sheet).

i) Current vs. time at rated voltage and minimum starting voltage.

ii) Speed vs. time at rated voltage and minimum starting voltage.

iii) Torque vs. speed at rated voltage and minimum voltage.
For the motors with solid coupling the above curves i), ii), iii) to be furnished for the motors coupled with driven equipment. In case motor is coupled with mechanical equipment by fluid coupling, the above curves shall be furnished with and without coupling.

iv) Thermal withstand curve under hot and cold conditions at rated voltage and max. permissible voltage.

SUB-SECTION-V-QE1

MOTORS

NCTPP, DADRI(2X490MW) IGSTPP JHAJJAR (3X500MW)
FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE

TECHNICAL SPECIFICATION
SECTION-VI
BID DOCUMENT NO.: CS-6130/0330-109-9

CLAUSE NO.		QUALITY ASSURANCE																		
MOTOR																				
TESTS/CHECKS	Visual	Dimensional	Make/Type/Rating /General	Physical Inspection	Mech/Chem. Properties	NDT /DP/MP/UT	Metallography	Electrical Characteristics	Welding/Brazing(WPS/PQR)	Heat Treatment	Magnetic Characteristics	Hydraulic/Leak/Pressure Test	Thermal Characteristics	Run out	Dynamic Balancing	Routine & Acceptance tests as per IS-325/IS-4722 /IS- 9283/IS-2148/IEC60034/IEC 60079-I/ IS-12615	Vibration	Over speed	Tan delta, shaft voltage & polarization index test	Paint shade, thickness & adhesion
TEMS/COMPONENTS																				
Plates for stator frame, end shield, spider etc.	Y	Y	Y	Y	Y	Y	Y			Y										
Shaft	Y	Y	Y	Y	Y	Y	Y	Y		Y										
Magnetic Material	Y	Y	Y	Y	Y			Y			Y									
Rotor Copper/Aluminium	Y	Y	Y	Y	Y			Y		Y										
Stator copper	Y	Y	Y	Y	Y			Y		Y										
SC Ring	Y	Y	Y	Y	Y	Y		Y	Y	Y										
Insulating Material	Y		Y	Y	Y	Y		Y		Y										
Tubes, for Cooler	Y	Y	Y	Y	Y	Y				Y		Y								
Sleeve Bearing	Y	Y	Y	Y	Y	Y				Y		Y								
Stator/Rotor, Exciter Coils	Y	Y	Y	Y		Y		Y	Y											
Castings, stator frame, terminal box and bearing housing etc.	Y	Y	Y		Y	Y			Y											
Fabrication & machining of stator, rotor, terminal box	Y	Y				Y			Y	Y										

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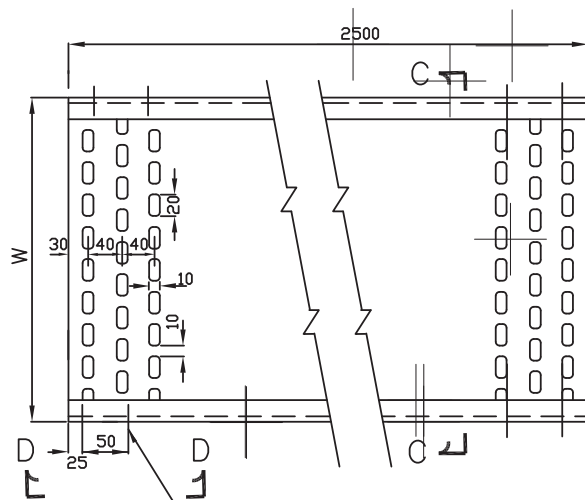
CLAUSE NO.	TECHNICAL REQUIREMENTS			
2.01.06	Exit signs shall be provided near doors for personnel escape in case of emergency Boiler Area Cable trays in boiler & ESP area shall be supported from the boiler and ESP structures. The same shall be coordinated with SG/ESP contractor. Cable trays in these areas shall be in vertical formation to avoid dust accumulation. No cable trenches shall be provided in boiler/ESP area.			
2.01.07	Two separate cable routes shall be provided for cable routing of working and standby drives or different set/group (say 50% capacity) of auxiliaries.			
2.01.08	OffSite Area For feeder in bidder's scope for offsite areas, overhead cable tray arrangement shall be followed. However cable trenches/slit may also be acceptable, for some areas, if found to be required during detailed engineering. Cable trenches provided shall be separated from fuel oil area to avoid oil accumulation.			
2.01.09	The cable slits to be used for motor/equipment power/control supply shall be sand filled & covered with PCC after cabling.			
2.01.10	Sizing criteria, derating factors for the cables shall be met as per respective chapters. However for the power cables, the minimum conductor size shall be 6 sq.mm. for aluminium conductor and 2.5 sq.mm. for copper conductor cable.			
2.01.11	Conscious exceptions to the above guidelines may be accepted under special conditions but suitable measures should be taken at such location to: - Meet all safety requirements - Safeguard against fire hazards, mechanical damage, flooding of water, oil accumulation, electrical faults/interferences, etc			
3.00.00	EQUIPMENT DESCRIPTION			
3.01.00	Cable trays, Fittings & Accessories			
3.01.01	Cable trays shall be ladder/perforated type as specified complete with matching fittings (like brackets, elbows, bends, reducers, tees, crosses, etc.) accessories (like side coupler plates, etc. and hardware (like bolts, nuts, washers, G.I. strap, hook etc.) as required. Cable tray shall be ladder type for power & control cables and perforated for instrumentation cables.			
3.01.02	Cable trays, fittings and accessories shall be fabricated out of rolled mild steel sheets free from flaws such as laminations, rolling marks, pitting etc. These (including hardware) shall be hot dip galvanized as per Clause No. 3.13.00 of this chapter.			
3.01.03	Cable trays shall have standard width of 150 mm, 300 mm & 600 mm and standard lengths of 2.5 metre. Thickness of mild steel sheets used for fabrication of cable trays and fittings shall be 2 mm. The thickness of side coupler plates shall be 3 mm.			
3.01.04	Cable troughs shall be required for branching out few cables from main cable route. These shall be U-shaped, fabricated of mild steel sheets of thickness 2 mm and shall be hot dip galvanised as per Clause No. 3.13.00 of this chapter. Troughs shall be standard width of 50 mm & 75 mm with depth of 25 mm.			
NCTPP DADRI ST-II (2X490MW) & IGSTPP JHAJJAR (3X500MW) PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-6130/0330-109-9	SUB SECTION-II-E6 CABLING, EARTHING & LIGHTNING PROTECTION	Page 3 of 23

CLAUSE NO.	TECHNICAL REQUIREMENTS 	
3.01.05 3.02.00 3.02.01 3.02.02 3.02.03	The tolerance for cable tray and accessories shall be as per IS 2102 (Part-1). Tolerance Class: - Coarse Support System for Cable Trays Cable tray support system shall be pre-fabricated out of single sheet as per enclosed tender drawings. Support system for cable trays shall essentially comprise of the two components i.e. main support channel and cantilever arms. The main support channel shall be of two types : (i) C1:- having provision of supporting cable trays on one side and (ii) C2:-having provision of supporting cable trays on both sides. The support system shall be the type described hereunder - Cable supporting steel work for cable racks/cables shall comprise of various channel sections, cantilever arms, various brackets, clamps, floor plates, all hardwares such as lock washers, hexagon nuts, hexagon head bolt, support hooks, stud nuts, hexagon head screw, channel nut, channel nut with springs, fixing studs, etc. - The system shall be designed such that it allows easy assembly at site by using bolting. All cable supporting steel work, hardwares fittings and accessories shall be prefabricated factory galvanised. - The main support and cantilever arms shall be fixed at site using necessary brackets, clamps, fittings, bolts, nuts and other hardware etc. to form various arrangements required to support the cable trays. Welding of the components shall not be allowed. However, welding of the bracket (to which the main support channel is bolted) to the overhead beams, structural steel, insert plates or reinforcement bars will be permitted. Any cutting or welding of the galvanised surface shall be brushed and red lead primer, oil primer & aluminium paint shall be applied - All steel components, accessories, fittings and hardware shall be hot dip galvanised after completing welding, cutting, drilling and other machining operation. - The typical arrangement of flexible support system is shown in the enclosed drawings and described briefly below: The main support channel and cantilever arms shall be fabricated out of 2.5 thick rolled steel sheet conforming to IS 1079. - Cantilever arms of 320 mm, 620mm and 750 mm in length are required, and shall be as shown in the enclosed drawing. The arm portion shall be suitable for assembling the complete arm assembly on to component constructed of standard channel section. The back plate shall allow sufficient clearance for fixing bolt to be tightened with tray in position. - Support system shall be able to withstand - weight of the cable trays - weight of the cables (75 Kg/Metre run of each cable tray) - Concentrated load of 75 Kg between every support span. - Factor of safety of minimum 1.5 shall be considered. The size of structural steel members or thickness of sheet steel of main support channel and cantilever arms and other accessories as indicated above or in the enclosed drawings	
NCTPP DADRI ST-II (2X490MW) & IGSTPP JHAJJAR (3X500MW) PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-6130/0330-109-9	SUB SECTION-II-E6 CABLING, EARTHING & LIGHTNING PROTECTION Page 4 of 23

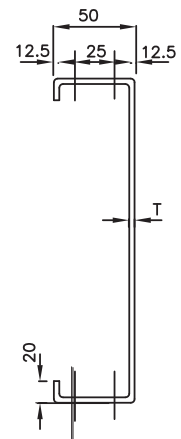
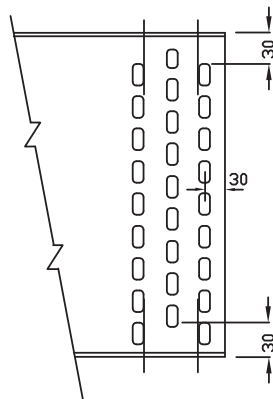
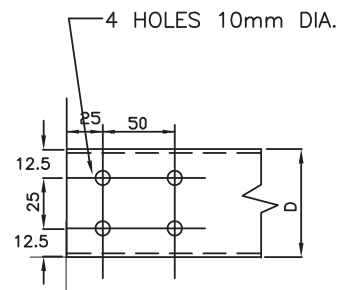
CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC	
	are indicative only. Nevertheless, the support system shall be designed by the bidder to fully meet the requirements of type tests as specified. In case the system fails in the tests, the components design modification shall be done by the Bidder without any additional cost to the Employer. The bidder shall submit the detailed drawings of the system offered by him alongwith the bid.		
3.02.04	Four legged structure shall be provided wherever there is change in elevation and change in direction		
3.02.05	FOR COAL HANDLING PLANT/FGD PLANT AREA THE FOLLOWING SHALL ALSO BE APPLICABLE:		
	a) All overhead cable routes shall be along the route of the conveyor gallery on separate supporting structures and cables shall be laid in vertical trays. The bottom of the steel shall be such that the existing facilities, movement of trucks/human beings etc. does not get affected. The cable trestle shall have a minimum 600mm clear walk way and shall have maintenance platforms as required. The bottom of the steel supporting structure shall be generally at 3.0M above the grade level except for rail/road crossings where it shall be at 8.0M above grade level. Tap offs from the overhead cable trestle can be through shallow trenches with prior approval of the Employer. Directly buried cable, if essential, shall not have concentration of more than 4 cables on one route. b) Cable trenches shall be provided only in Switchgear/MCC rooms. c) Cables shall not be routed through the conveyor galleries except for the equipment located in the conveyor galleries for a particular conveyor i.e. protection switches, receptacles etc. d) Cables for PCS and BSS shall be routed along the conveyors through GI conduits.		
3.03.00	Pipes, Fittings & Accessories		
3.03.01	Pipes offered shall be complete with fittings and accessories (like tees, elbows, bends, check nuts, bushings, reducers, enlargers, coupling caps, nipples etc.) The size of the pipe shall be selected on the basis of maximum 40% fill criteria		
3.03.02	GI Pipes shall be of medium duty as per IS: 1239		
3.03.03	Duct banks shall be High Density PE pipes encased in PCC (10% spare of each size, subject to minimum one) with suitable water-proof manholes.		
3.03.04	Hume pipes shall be NP3 type as per IS 458.		
3.03.05	TERNE Coated Flexible Steel Conduits shall be water proof and rust proof made of heat resistant lead coated steel. Conduit diameter shall be uniform throughout its length. Internal surface of the conduit shall be free from burrs and sharp edges. Conduits shall be complete with necessary accessories for proper termination of the conduit with junction boxes and lighting fixtures		
3.03.06	HDPE pipes and conduits shall be PE-80, PN-10 type as per IS 4984/IS 8008 part-I.		
3.04.00	Junction Boxes		
NCTPP DADRI ST-II (2X490MW) & IGSTPP JHAJJAR (3X500MW) PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-6130/0330-109-9	SUB SECTION-II-E6 CABLING, EARTHING & LIGHTNING PROTECTION
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
APPROVED As per format of NTPC, No. 33.3	drum jack shall be manufactured using BSEN-24 grade steel bar with locking collars. Jack nests shall be of SG cast steel. Cable drum jack supplied shall have undergone load testing and reports for the same shall be submitted. At least Two Nos. of jacks shall be supplied for NTPC use. Contractor has to make arrangements for his own jacks for cable reeling/unreeling under his scope of installation.			
	3.12.00	Galvanising		
	3.12.01	Galvanising of steel components and accessories shall conform to IS:2629 , IS4759 & IS:2633. Additionally galvanising shall be uniform, clean smooth, continuous and free from acid spots.		
	3.12.02	The amount of zinc deposit over threaded portion of bolts, nuts, screws and washers shall be as per IS:1367 . The removal of extra zinc on threaded portion of components shall be carefully done to ensure that the threads shall have the required zinc coating on them as specified		
	3.13.00	Welding		
	3.13.01	The welding shall be carried out in accordance with IS:9595. All welding procedures and welders qualification shall also be followed strictly in line with IS:9595		
	4.00.00	INSTALLATION		
	4.01.00	Cable tray and Support System Installation		
	4.01.01	Cables shall run in cable trays mounted horizontally or vertically on cable tray support system which in turn shall be supported from floor, ceiling, overhead structures, trestles, pipe racks, trenches or other building structures.		
	4.01.02	Horizontally running cable trays shall be clamped by bolting to cantilever arms and vertically running cable trays shall be bolted to main support channel by suitable bracket/clamps on both top and bottom side rails at an interval of 2000 mm in general. For vertical cable risers/shafts cable trays shall be supported at an interval of 1000mm in general. Fixing of cable trays to cantilever arms or main support channel by welding shall not be accepted. Cable tray installation shall generally be carried out as per the approved guidelines/ drawings. Vendor shall design the support system along with tray, spacing etc in line with tray loadings/drawings.		
4.01.03	The cantilever arms shall be positioned on the main support channel with a minimum vertical spacing of 300 mm unless otherwise indicated.			
4.01.04	The contractor shall fix the brackets/ clamps/ insert plates using anchor fasteners. Minimum size of anchor fasteners shall be M 8 X 50 and material shall be stainless steel grade 316 or better. Anchor fastener shall be fixed as recommended by manufacturer and as approved by site engineer. For brick wall suitable anchor fasteners shall be used as per the recommendations of manufacturer. Make of anchor fasteners subject to QA approval and the same shall be finalized at pre-award stage.			
4.01.05	All cable way sections shall have identification, designations as per cable way layout drawings and painted/stenciled at each end of cable way and where there is a branch connection to another cable way. Minimum height of letter shall be not less than 75 mm. For long lengths of trays, the identification shall be painted at every 10 meter. Risers shall additionally be painted/stenciled with identification numbers at every floor.			
4.01.06	In certain cases it may be necessary to site fabricate portions of trays, supports and other non standard bends where the normal prefabricated trays, supports and accessories may			
NCTPP DADRI ST-II (2X490MW) & IGSTPP JHAJJAR (3X500MW) PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-6130/0330-109-9	SUB SECTION-II-E6 CABLING, EARTHING & LIGHTNING PROTECTION	Page 8 of 23

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC										
	not be suitable. Fabricated sections of trays, supports and accessories to make the installation complete at site shall be neat in appearance and shall match with the prefabricated sections in the dimensions. They shall be applied with one coat of red lead primer, one coat of oil primer followed by two finishing coats of aluminium paint.													
4.02.00	Conduits/Pipes/Ducts Installation													
4.02.01	The Contractor shall ensure for properly embedding conduit pipe sleeves wherever necessary for cabling work. All openings in the floor/roof/wall / cable tunnel/cable trenches made for conduit installation shall be sealed and made water proof by the Contractor.													
4.02.02	GI pull wire of adequate size shall be laid in all conduits before installation. Metallic conduit runs at termination shall have two lock nuts wherever required for junction boxes etc.													
4.02.03	Conduit runs/sleeves shall be provided with PVC bushings having round edge at each end. All conduits/pipes shall have their ends closed by caps until cables are pulled. After cables are pulled, the ends of conduits/pipes shall be sealed with Glass wool/Cement Mortar/Putty to prevent entrance of moisture and foreign material													
4.02.04	Exposed conduit/pipe shall be adequately supported by racks, clamps, straps or by other approved means. Conduits /pipe support shall be installed square and true to line and grade with an average spacing between the supports as given below, unless specified otherwise <table><tr><th>Conduit /pipe size (dia).</th><th>Spacing</th></tr><tr><td>Upto 40 mm</td><td>1 M</td></tr><tr><td>50 mm</td><td>2.0 M</td></tr><tr><td>65-85 mm</td><td>2.5 M</td></tr><tr><td>100 mm and above</td><td>3.0 M</td></tr></table>				Conduit /pipe size (dia).	Spacing	Upto 40 mm	1 M	50 mm	2.0 M	65-85 mm	2.5 M	100 mm and above	3.0 M
Conduit /pipe size (dia).	Spacing													
Upto 40 mm	1 M													
50 mm	2.0 M													
65-85 mm	2.5 M													
100 mm and above	3.0 M													
4.02.05	For bending of conduits, bending machine shall be arranged at site by the contractor to facilitate cold bending. The bends formed shall be smooth.													
4.03.00	Junction Boxes Installation													
4.03.01	Junction boxes shall be mounted at a height of 1200mm above floor level or as specified in the drawings and shall be adequately supported/mounted on masonry wall by means of anchor fasteners/ expandable bolts or shall be mounted on an angle, plate or other structural supports fixed to floor, wall, ceiling or equipment foundations.													
4.04.00	Cable Installation													
4.04.01	Cable installation shall be carried out as per IS:1255 and other applicable standards.													
4.04.02	For Cable unloading, pulling etc following guidelines shall be followed in general: a) Cable drums shall be unloaded, handled and stored in an approved manner on hard and well drained surface so that they may not sink. In no case shall be drum be stored flat i.e. with flange horizontal. Rolling of drums shall be avoided as far as possible. For short distances, the drums may be rolled provided they are rolled slowly and in proper direction as marked on the drum. In absence of any indication, the drums may be rolled in the same direction as it was rolled during taking up the cables. For unreeling the cable, the drum shall be mounted on suitable jacks or on cable wheels and shall be rolled slowly so that cable comes out over the drum and													
NCTPP DADRI ST-II (2X490MW) & IGSTPP JHAJJAR (3X500MW) PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-6130/0330-109-9	SUB SECTION-II-E6 CABLING, EARTHING & LIGHTNING PROTECTION	Page 9 of 23										



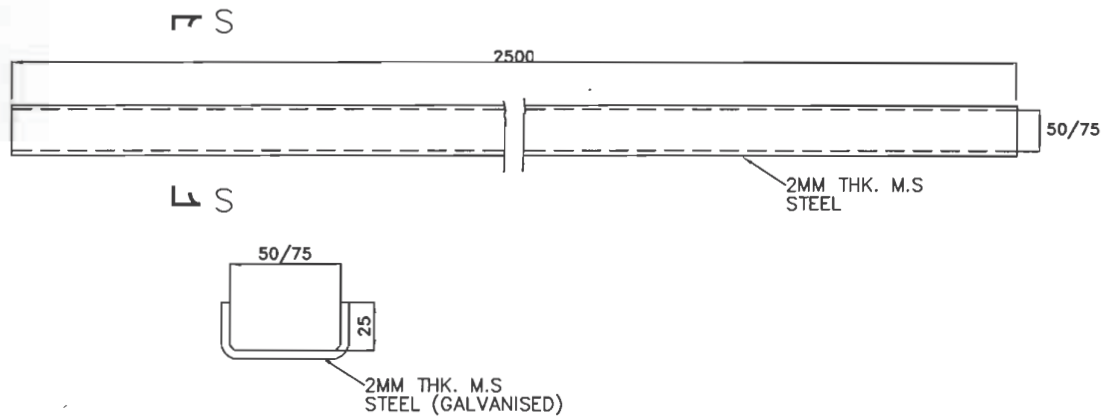
4 HOLES 10mm DIA.

SECTION-CC
(100/50 TRAYS)ARRANGEMENT OF
PERFORATIONSVIEW-DD
(100,50W TRAYS)

TRAY WIDTH W (mm)	100	50
TRAY DEPTH D (mm)	50	50
T (mm)	2	2

PERFORATED TYPE TRAYTYPICAL DETAILS OF CABLE TRAYS AND
ACCESSORIES

DWG. NO.



SECTION S-S

CABLE TROUGHS

SEE GENERAL NOTES IN SHEET 11.



TYPICAL DETAILS OF
CABLE TRAY AND ACCESSORIES

BHEL DRAWING NO.
PE-DG-427-507-E005

SH 10 OF 11

REV 00



2 X 490 MW NCTPPP, DADRI, STAGE-II
COMPRESSED AIR SYSTEM

SPECIFICATION No: PE-TS-436-555-A001

VOLUME: II B

SECTION : C-4

REV. 00

DATE: 19.03.18

SHEET: 1 OF 1

SECTION: C-4
TECHNICAL SPECIFICATION (C&I PORTION)



Technical specification for
COMPRESSED AIR SYSTEM

**2X490 MW NATIONAL CAPITAL POWER STATION
(NCPS) DADRI**

REV. NO.

00

DATE : 23.02.2018

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Technical specification for
COMPRESSED AIR SYSTEM

**2X490 MW NATIONAL CAPITAL POWER STATION
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REV. NO. 00 DATE : 23.02.2018

SECTION-C

SPECIFIC TECHNICAL REQUIREMENT



**2X490 MW NATIONAL CAPITAL
POWER STATION
(NCPS) DADRI**

**Specific Technical Requirement
For
Compressed Air System**

- 1. Complete C&I system** for Compressed Air System is in bidder scope of supply. Items not specifically mentioned however required for the completeness of the system shall be supplied by bidder.
- 2.** Integrated microprocessor based control system along with suitable operator interface shall be provided for each Instrument Air Compressor, Service Air Compressor & their Dryers. All PT, DPT, TE, and other instruments inside & outside the compressor skid shall also be hooked-up to this system. Critical signals exchange among the compressors shall be hardwired. Further critical signals through redundant soft link (MODBUS) between combox (integrating the soft communication among various compressors) to FGD DCS (FGD DCS in BHEL scope) shall be monitored. Protocol MODBUS for connectivity to FGD DCS shall be applicable. In addition to the soft link, provision for hardwired START, STOP and LOAD & UNLOAD commands, Dew point measurement from FGD DCS to all the compressors & their status feedbacks to FGD DCS shall also be provided. Bidder to furnish the configuration diagram of control system of compressor showing communication with FGD DCS along with the bid. Bidder to furnish signal exchange list between FGD DCS and compressed air system in BHEL format attached elsewhere.
- 3.** The requirements given are to be read in conjunction with detailed Technical specification enclosed.
- 4.** The scope of C&I cable shall be referred in Electrical scope split sheet in Electrical portion of the specification. FO Cable from Combox to FGD DCS for softlink shall be in BHEL scope.
- 5.** Bidder to include all the instruments required for the package along with fittings, accessories and valve manifold.
- 6.** All transmitters shall be smart type and shall have 4-20mA DC signal with superimposed digital communication (HART). Each Temperature element shall be complemented with temperature transmitters, compensating cable, JB/rack & other erection hardware.
- 7.** The solenoid operated valves shall have limit switches for open/close feedback.
- 8.** All pneumatic operated regulating control valves (if any) shall be envisaged with smart positioner.
- 9.** The junction boxes for termination of instruments /actuator limit switches/solenoid valve limit switches etc. are in bidder's scope.
- 10.** 230V 1 ϕ AC UPS supply shall be provided by BHEL at a single point, further distribution to various instruments/equipments of the CAS shall be in Bidder's scope. Bidder to include the necessary power distribution board in his scope. Any power supply other than the above, if required for any instrument/equipment has to be



**2X490 MW NATIONAL CAPITAL
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(NCPS) DADRI**

**Specific Technical Requirement
For
Compressed Air System**

derived from the above supply & all the necessary hardware for the same shall be in Bidder's scope.

11. Bidder to furnish electrical/UPS load data during detailed engineering.
12. Power supply derived for Transmitters, contact interrogation, interposing relay and solenoid shall generally be ungrounded 24V D.C only. In all cases redundancy in power modules shall be considered.
13. Bidder to note that all the transmitters/instruments supplied by Bidder shall be rack mounted. The racks shall be preassembled and provided by Bidder. Also no instruments / analyzers & JBs/Racks should be protruding on the walkway.
14. Instrument installation and accessories required and same shall be in Bidder's scope and shall be subject to customer/BHEL approval during detailed engineering.
15. Bidder to provide erection hardware including junction boxes, canopies, structural steel as required.
16. Integral to equipment which are not indicated in the tender drawings, but are required to control, monitoring and operation of the equipment/plant system for which no P&IDs are enclosed, all the instruments shall be provided to meet the actual system requirements and meeting redundancy and other requirements under technical specifications subject to Employer's approval.
17. For other critical binary and analog inputs required for protection and interlock purpose of other equipment (e.g. those interlocks which may result in loss of production, non-availability of a major equipment etc.), triple sensors shall be provided.
18. Temperature elements, electronic transmitters etc. are to be provided for all the cases. Use of process actuated switches is acceptable only in the cases as indicated in the tender drawings.
19. Single Input DIN rail mounting type temp transmitters (mounted in JBs) shall be provided by the Contractor for all temperature elements under Contractor's scope.
20. Process connection & piping including LIE / LIR, all impulse piping, pneumatic piping/tubing, valves, valve manifolds, fittings and all other accessories shall be provided on as required basis for proper installation & completeness of impulse piping system and air supply system, as stipulated under Sub-section PCP, Part-B, Section-VI of Technical Specification.
21. The system shall be arranged so that the failure of any monitoring device or control components or spurious intermediate grounding in the signal path shall not open the signal loop nor cause the loss or malfunction of signal to other devices using the same signal.



**2X490 MW NATIONAL CAPITAL
POWER STATION
(NCPS) DADRI**

**Specific Technical Requirement
For
Compressed Air System**

22. To ensure availability, adequate redundancy in system design shall be provided at hardware, software and sensor level. For the protection system, independent sensing device shall be provided to ensure adequate safety of plant equipment.
23. The design of the control systems and related equipments shall adhere to the principle of 'Fail Safe' Operation wherever safety of personnel / plant equipment is involved and shall not cause a hazardous condition. However, it shall also be ensured that occurrence of false trips are avoided / minimized.
24. All panels, desks, cabinets shall be provided with a continuous bare copper ground bus. The ground bus shall be bolted to the panel structure on bottom on both sides. The bolts shall face inside of panels. The system ground shall be isolated from the panel ground with suitable isolators. All internal component grounds or common shall be connected to the system ground, which shall be fabricated of copper flat (size 25mm x 6mm min., length as applicable).
25. Bidder to perform tests of C&I items/instruments/systems as per quality plans/type test attached in the specification.
26. The equipment shall be of modern, compact design incorporating the latest developments in proven technology. All instruments whether for local indication or remote transmission shall be of good quality and shall have an accuracy and repeatability appropriate to their duty.
27. Bidder shall provide Cable Schedule in BHEL excel format which shall be provided during detailed engineering. Also, Cable Interconnections for Complete System shall be in Bidders' scope. DCS side details for hardwired signals shall be furnished by BHEL during detailed engineering.
28. 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. In case of any contradiction most stringent clause/condition shall prevail.
29. Typical hardwired scheme is provided in section D. Same shall be used by bidder for deciding signal interface between Microprocessor panel & MCC/DCS/Solenoid valve /Field instruments etc.
30. For codes & standards refer detailed specification.
31. Instrument installation and accessories required shall be in Bidder's scope. Vendor submitted 'Instrument Installation Diagram' shall be subject to customer approval during detail engineering without any commercial and time implication. For



**2X490 MW NATIONAL CAPITAL
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(NCPS) DADRI**

**Specific Technical Requirement
For
Compressed Air System**

instruments for which Installation Diagram is not attached, vendor's Installation Diagram for such items will also be subject to customer approval during detail engineering without any commercial and delivery implication.

32. Drawings/Documents and data to be furnished after award of the contract shall be in line with MDL furnished elsewhere in the specification.

Notes:

1. 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.
2. Documents of C&I System shall be submitted to end user/owner for approval during detail engineering. Changes, if any, shall be accommodated by the bidder without any price/time implication.
3. In case of any discrepancy in Section-C and Section-D of the specification, Section-C shall prevail.



Technical specification for
COMPRESSED AIR SYSTEM

**2X490 MW NATIONAL CAPITAL POWER STATION
(NCPS) DADRI**

SECTION D

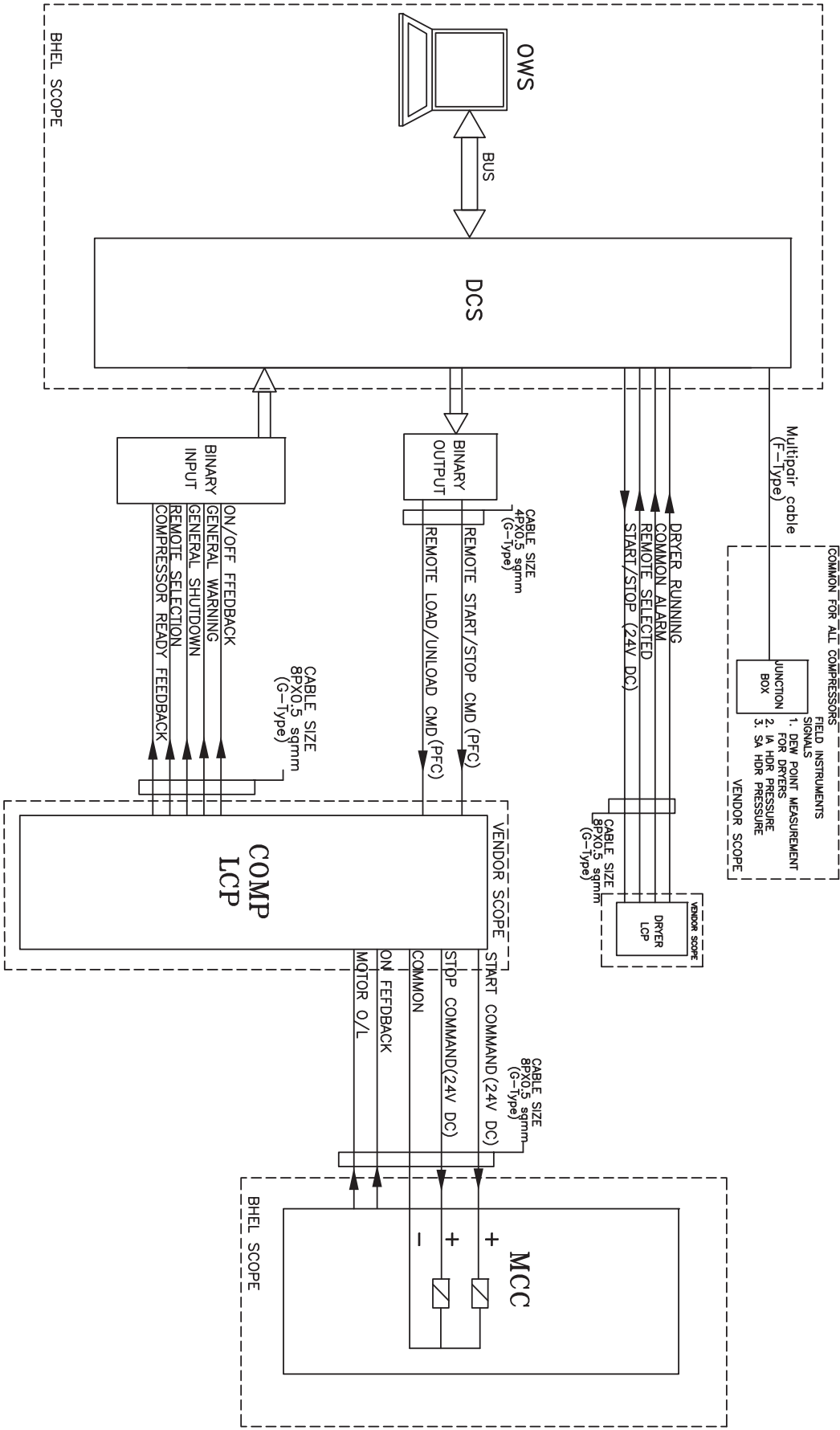
REV. NO. 00

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SECTION-D

HARDWIRE INTERFACE PHILOSOPHY

STANDARD HARDWIRED INTERFACE BETWEEN COMPRESSOR CONTROL SYSTEM, DCS AND MCC



NOTE:

1. CABLE SCOPE SHALL BE AS PER ELECTRICAL SCOPE MATRIX.

DRG. NO. DATE PROJECT:STANDARD HARDWARE INTERFACE		
TITLE DDCMIS/LCP/MCC INTERFACE FOR INDIVIDUAL COMPRESSOR/DRYER	REV.NO. 00	
	SHT	



**Technical specification for
COMPRESSED AIR SYSTEM**

**2X490 MW NATIONAL CAPITAL POWER STATION
(NCPS) DADRI**

SECTION D

REV. NO. 00

DATE : 23.02.2018

INSTRUMENTS & VALVES SPECIFICATIONS

CLAUSE NO.	TECHNICAL REQUIREMENTS			
3.00.00 3.01.00 3.02.00 3.03.00 3.04.00 3.05.01	MEASURING INSTRUMENTS (PRIMARY AND SECONDARY) 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. Refer Sub-section Basic Design Criteria. Further, all instruments shall be of proven reliability, accuracy, and repeatability requiring a minimum of maintenance and shall comply with the acceptable international standards and shall be subject to Employer's approval. All transmitters, sensors, switches and gauges for parameters like pressure, temperature, level, flow etc. as required for the safe and efficient operation and maintenance as well as for operator and management information (including all computation) of equipment in the system under the scope of specification shall be provided on as required basis with in quoted lump sum price. The necessary root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifolds 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 in flexible/rigid conduits, independently to suitably located common junction boxes. The proposal shall include the necessary cables, flexible conduits, junction boxes and accessories for the above purpose. Double root valves shall be provided for all pressure tapping where the pressure exceeds 40 Kg./sq.cm. (i) All instruments envisaged for sea water applications, shall be provided with wetted parts made of Monel/ Hastelloy C or any other material (if provenness experience of the proposed material for such applications is established by contractor). For Chlorine application: Instruments shall be provided with wetted parts (e.g. diaphragm seal, etc.) made of Hastelloy C. Also, filled liquid shall be Fluorolube oil/ Inert Hydrocarbon / CTFE etc., for these applications. For applications of FECL3 solution: Instruments shall be provided with wetted parts (e.g. diaphragm seal, etc.) made of Tantalum. (ii) For coastal areas, all instruments shall be provided with durable epoxy/ polyurethane coating for housings and all exposed surfaces of the instruments. (iii) For hazardous area, explosions proof enclosure as described in NEC article 500 shall be provided in instruments as applicable. Specification for Electronic Transmitters SPECIFICATION FOR ELECTRONIC TRANSMITTER FOR PRESSURE, DIFF PRESS AND DP BASED FLOW / LEVEL MEASUREMENTS Minimum technical requirements shall be as follows:-			
NCTPP DADRI ST—II (2X490MW) & IGSTPP, JHAJJAR (3X500MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC. NO.: CS-6130/0330-109-9	SUB-SECTION-III-C CONTROL & INSTRUMENTATION	PAGE 6 OF 34	

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	Microprocessor based 2 wire loop powered electronic transmitter with 4-20 mA DC HART output signal shall be provided. For calibration ranges greater than or equal to 400mmwc, accuracy of transmitter shall be ± 0.060 % of calibrated range(min), stability 0.25 % of calibrated range for 10 years and 50:1 turn down. For calibration ranges less than 400mmwc accuracy shall be ± 0.10 % of calibrated range (min) and 20:1 turndown. Overpressure rating of transmitter shall be 150% of maximum operating pressure. Transmitter shall have weather proof IP-67 metallic housing with durable corrosion resistant coating, integral digital display with self-indicating diagnostics, ,plug and socket type electrical connection, calibration using HART calibrator, 2/3/5 Valve non integral manifold and rack with canopy. For air and flue gas applications, DPT shall be provided for pressure measurement below range of 2000 mmwc. For corrosive, viscous, solid bearing, slurry type process fluids, suitable diaphragm seal shall be provided. Parts below seal shall be removable for cleaning. Entire volume shall be completely filled with inert liquid suitable for instruments. LVDT type transmitter is not acceptable.			
3.05.02	ULTRASONIC TYPE LEVEL TRANSMITTER, RADAR TYPE LEVEL TRANSMITTER Minimum technical requirements shall be as follows:- Microprocessor based 2 wire type, HART protocol compatible, output signal 4-20mA along with superimposed digital signal (based on HART protocol), accuracy ± 0.5% of calibrated span or minimum 5 mm, Load impedance 500 Ohm (minimum), weather proof IP-65 metallic housing with durable corrosion resistant coating, Plug in socket type electrical connection, zero & span adjustment- temper proof remote as well as local from instrument, integral digital display and self-indicating type diagnostic features, power supply 24V DC+/-10%, calibration using hand held HART calibrator, temperature compensation built in the instrument (applicable for ultrasonic type only), False signal tolerance like ignoring false echoes from internal tank/sumps & obstructions such as pipes, heating coils or agitator blades. It should be possible to calibrate the instrument without any level in the tank/sump etc. All weather canopy shall be provided for protection from direct sunlight and direct rain for open locations. In case of Guided wave radar (GWR) type level transmitters coaxial probe of SS316L shall be provided. However, Rod probe, cable probe of SS316L can be used for applications wherever coaxial probe is not suitable. External cage and other mounting accessories shall be provided where ever side mounting is required. Where ever top mounting is required, all mounting accessories, stilling well (as required) etc., shall be provided by the contractor. Four wire type transmitters can be provided for applications where 2- wire transmitter has some technical limitations, subject to employer's approval during detailed engineering stage. However, in such cases isolated 4-20 mA DC (analog) output shall be provided. Power supply required for such transmitters shall be 240V AC / 24V DC. For applications where transmitter location is not accessible, the transmitter shall have separate sensor unit and electronic unit for such applications. It shall be possible to mount the electronic unit at accessible location. Sonic frequency based transmitters can also be provided under “ultrasonic transmitters” category for powdery medium like fly ash silo level.			
3.05.03	TEMPERATURE TRANSMITTER (TT) Single input temperature transmitter shall be 2-wire loop powered directly from 4-20mA input cards of DDCMIS. Transmitter shall be fully compatible with thermocouples and RTDs being provided. It shall be capable to handle Pt-100 RTD, Thermocouple –K, R & S types (selectable through HART terminal/calibrator).Temperature compensation for T/C shall be			
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CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
	performed in the transmitter itself. In case of failure (open or burn-out) of RTD/thermocouple, transmitter shall provide low temperature output. Transmitter shall be HART compatible, have EMC compatibility as per EN 61326, weather proof IP-67 metallic housing with durable corrosion resistant coating, plug and socket type electrical connection, integral digital display with self-indicating diagnostics, operating ambient temperature of 85 deg C without display & 70 deg C with display, suitable for 2 inch pipe mounting in enclosure/rack. Composite Accuracy for RTD shall be $\leq 0.25\%$ of 0-250 deg C span, for T/C-K type $\leq 0.2\%$ of 0-600 deg C span and CJC accuracy (for thermocouples) shall be ≤ 1 deg C.			
3.05.04	APPROVED By Addl. Secy. (P&ID) dt 02.07.2019 HART HAND HELD CALIBRATOR Hand held calibrator with latest HART version shall be provided for adjustment/calibration/maintenance of the HART compatible transmitters. The hand held calibrator shall be suitable for all types of HART transmitters supplied in the package. If one type of hand held type calibrator is not suitable for communicating with all types of transmitters then separate hand held calibrator will be provided for that specific type of transmitter.			
3.06.00	Temperature Elements and accessories K type (Chromel-Alumel) thermocouple, R type (Pt- Rhodium Pt) thermocouple, Pt100 (Platinum 100) type resistance temp detectors (RTDs) shall be provided for temperature measurement depending on temperature range meeting the following minimum technical requirements:- (i) Swaged type Mineral insulated (magnesium oxide), SS316 sheathed, Duplex element, ungrounded separate junction, housing/head die cast aluminum IP65, plug in socket type electrical connection, Accuracy class 1 as per IEC-584/ ANSI-MC-96.1 for thermocouples & class A as per IEC-751/ DIN-43760 for RTDs. (ii) Reference Standards : For Thermocouple : IEC-584/ ANSI-MC-96.1 For RTD : IEC-751/ DIN-43760 For Thermowell : ASME PTC-19.3 (iii) The specifications for RTDs of winding/ bearings of motor/pump, can be as per their manufacturer standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice. However the type of RTD shall be Pt100. (iv)The specifications of temp elements for air conditioning & ventilation system / process can be as per system manufacturer's standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice. (v) Thermo well (for all process temp. elements):- Shall be one piece solid bored type of 316 SS of step-less tapered design as per ASME PTC 19.3). Solid sintered tungsten carbide material shall be used for high abrasive medium. For Air & Flue gas applications protection tube with welded cap of 316 SS or better material shall be provided. For furnace zone, impervious ceramic protecting tube of suitable material along with Incoloy supporting tubes and adjustable flanges shall be provided.			
3.07.00	APPROVED By Addl. Secy. (P&ID) dt 02.07.2019 SPECIFICATION FOR CORIOLIS FLOW TRANSMITTER Minimum technical requirements shall be as follows:- Microprocessor based, HART protocol compatible, output signal 4-20mA along with superimposed digital signal (based on HART protocol), accuracy $\pm 0.2\%$ of rate, repeatability $\pm 0.1\%$ of rate, material of wetted parts SS316, material of housing SS304L, weather proof			
NCTPP DADRI ST—II (2X490MW) & IGSTPP, JHAJJAR (3X500MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC. NO.: CS-6130/0330-109-9	SUB-SECTION-III-C CONTROL & INSTRUMENTATION	PAGE 8 OF 34

CLAUSE NO.		TECHNICAL REQUIREMENTS		एनटीपीसी NTPC																	
		APPROVED By: [Signature] Date: 11/12/2019 However, 25% spare feeder (min. 1 no.) with fuses for each rating shall be provided in each ACDB. (f) The batteries shall be heavy duty Nickel-cadmium type and shall be sized for one hour of full load operation during non-availability of AC supply / chargers. The Ni-Cd batteries shall conform to IS: 10918.																			
5.00.00		PROCESS CONNECTION PIPING The Contractor shall provide, install and test all required material for completeness of Impulse Piping System and Air Piping System as per the requirements of this Sub-Section and QA sub section requirements on as required basis for the connection of all instruments and control equipments of entire plant. Hydrostatic and Pneumatic leakage tests shall be performed on all pipes, tubing and systems and shall conform to ANSI B31.1.																			
5.01.00		IMPULSE PIPING, TUBING, FITTINGS, VALVES AND VALVE MANIFOLDS The rating of material of impulse pipes, tubes, fittings, valves and their installation thereof shall conform to the latest edition of standards as per following table: <table><tr><td>Impulse Pipes, Tubes (Material, Rating)</td><td>ANSI B31.1, ANSI B31.1a, ANSI/ISA 77.70</td></tr><tr><td>Valves (Material, Pr. Class, Size)</td><td>ASTM A182/ASTM A105 as per ASME 16.34</td></tr><tr><td>Fittings (Size, Rating, Material)</td><td>ANSI B31.1, ANSI B31.1a, ASME B16.11-2009</td></tr><tr><td>Installation Schemes</td><td>BS 6739-2009, ANSI/ISA 77.70</td></tr></table> The valve manifolds of 316 SS with pressure rating suitable for intended application shall be provided as given below: <table><tr><th>Manifold</th><th>Application/Measurement</th></tr><tr><td>2 Valve</td><td>Pressure measurements using pressure transmitters/pressure switches</td></tr><tr><td>3 Valve</td><td>Pressure measurements using differential pressure transmitter/ switches</td></tr><tr><td>5 Valve</td><td>Differential Pressure, Flow and Level Measurements</td></tr></table> All pneumatic piping, fittings, valves, air filter cum regulator, purge rotameter and other accessories required for instrument air for the various pneumatic devices/ instruments shall be provided. This will include as a minimum air supply to pneumatically operated control valves, actuators, instruments, continuous and intermittent purging requirements etc. Instrument air and Service air supply shall be provided for continuous and intermittent purging respectively for all transmitters of dirty air and flue gas applications. All transmitters, switches, Dual Input temperature transmitters etc. for FGD system and other system being provided under the contract shall be suitably grouped together and mounted inside (i) local instruments enclosures in case of open areas of the plant and (ii) In local instrument racks in case of covered areas.				Impulse Pipes, Tubes (Material, Rating)	ANSI B31.1, ANSI B31.1a, ANSI/ISA 77.70	Valves (Material, Pr. Class, Size)	ASTM A182/ASTM A105 as per ASME 16.34	Fittings (Size, Rating, Material)	ANSI B31.1, ANSI B31.1a, ASME B16.11-2009	Installation Schemes	BS 6739-2009, ANSI/ISA 77.70	Manifold	Application/Measurement	2 Valve	Pressure measurements using pressure transmitters/pressure switches	3 Valve	Pressure measurements using differential pressure transmitter/ switches	5 Valve	Differential Pressure, Flow and Level Measurements
Impulse Pipes, Tubes (Material, Rating)	ANSI B31.1, ANSI B31.1a, ANSI/ISA 77.70																				
Valves (Material, Pr. Class, Size)	ASTM A182/ASTM A105 as per ASME 16.34																				
Fittings (Size, Rating, Material)	ANSI B31.1, ANSI B31.1a, ASME B16.11-2009																				
Installation Schemes	BS 6739-2009, ANSI/ISA 77.70																				
Manifold	Application/Measurement																				
2 Valve	Pressure measurements using pressure transmitters/pressure switches																				
3 Valve	Pressure measurements using differential pressure transmitter/ switches																				
5 Valve	Differential Pressure, Flow and Level Measurements																				
6.00.00		INSTRUMENTATION CABLE, INTERNAL WIRING AND ELECTRICAL FIELD CONSTRUCTION MATERIAL (CABLE SUB-TRAYS ETC)																			
6.01.00		General requirements																			
6.01.01		APPROVED By: [Signature] Date: 11/12/2019 All cables including special cables, internal wiring and electrical field construction material shall conform to this specification, Employer approved detail engineering drawings & documents and the latest edition of the relevant standards & guidelines. The Bidder shall furnish all material and services required for the completeness of the work identified in his scope as per this specification.																			
NCTPP DADRI ST—II (2X490MW) & IGSTPP, JHAJJAR (3X500MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC. NO.: CS-6130/0330-109-9		SUB-SECTION-III-C CONTROL & INSTRUMENTATION																	
PAGE 21 OF 34																					

8.00.00 DEW POINT METER

- | | | | |
|-----|-------------------------------|---|---|
| 1. | Type | : | Direct Mounting Capacitance type with change in output proportional to moisture present. |
| 2. | Sensing Element | : | Ceramic / Aluminum Oxide sensor |
| 3. | Service | : | Dry Air |
| 4. | Range | : | -90 Deg.C to 10 Deg.C Dew Point Temperature |
| 5. | Sensor Accuracy | : | ± 2 Deg. C Dew Point |
| 6. | Repeatability | : | 0.5 Deg. C Dew Point |
| 7. | Operating Ambient Temperature | : | -40 Deg C to 50 Deg C |
| 8. | Operating Pressure | : | 0- 10 kg/ Sq. cm |
| 9. | Display | : | Combined enclosure with 5 Digit seven segments LED display. |
| 10. | Element Filter | : | 80 micron sintered stainless steel |
| 11. | Output | : | 4- 20 mA DC Loop powered |
| 12. | Power Supply | : | 24 VDC nominal |
| 13. | Enclosure class | : | IP 65 |
| 14. | Interchangeability | : | Fully Interchangeable transmitters |
| 15. | Accessories | : | Sampling system, cables, sensor holder, desiccant chambers, double compression fittings, ¾ “ Cable gland, mounting fixture etc. |



**Technical specification for
COMPRESSED AIR SYSTEM**

**2X490 MW NATIONAL CAPITAL POWER STATION
(NCPS) DADRI**

SECTION D

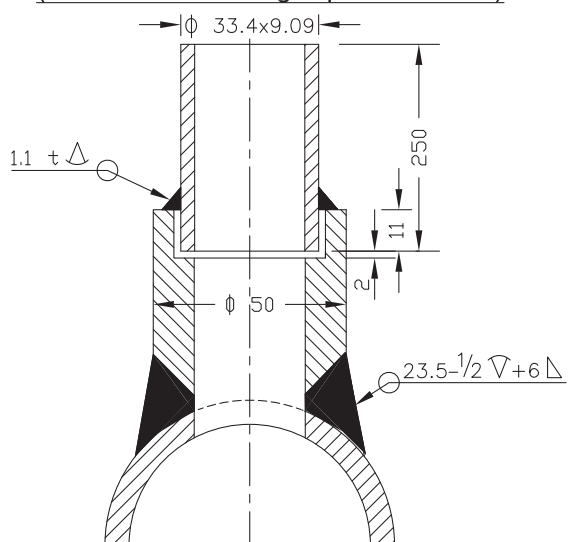
REV. NO. 00

DATE : 23.02.2018

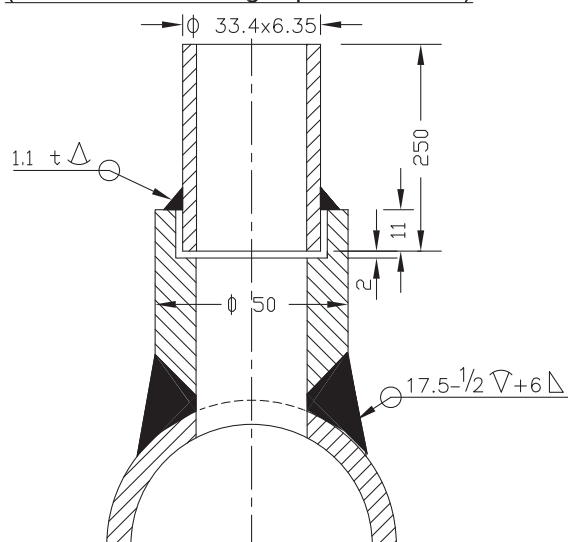
INSTRUMENT STUB DETAILS

PRESSURE MEASUREMENT

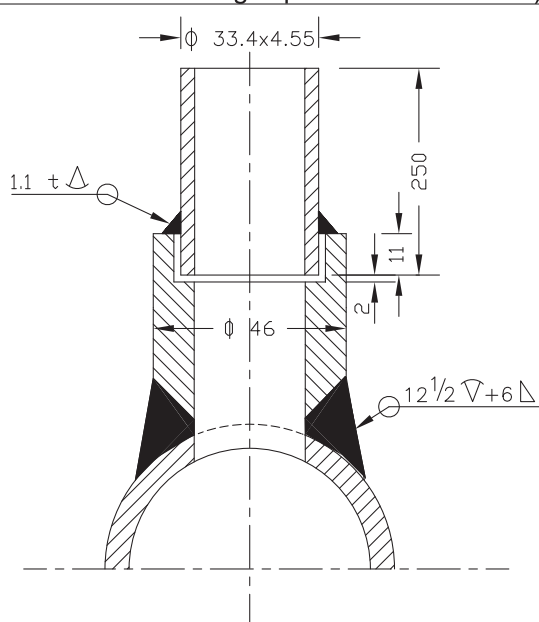
(SYSTEM PR. >40Kg/Sq Cm CL 9000)



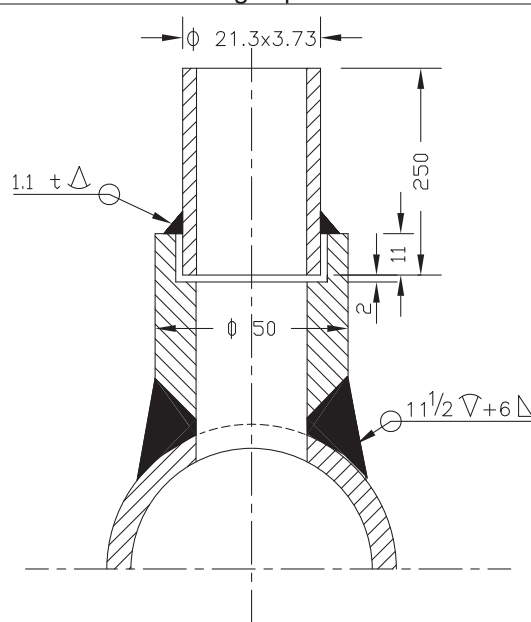
(SYSTEM PR. >40Kg/Sq Cm CL 6000)



(SYSTEM PR. <40Kg/Sq cm Nb 25 CL 3000)



(SYSTEM PR. <40Kg/Sq cm Nb 15 CL 3000)



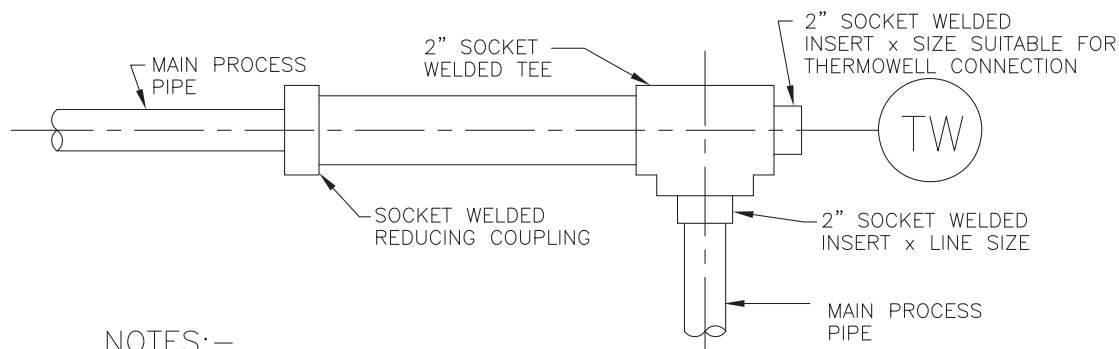
NOTES:-

1. MATERIAL OF THE BOSS AND NIPPLE SHALL BE THE SAME AS THE PIPE INTO WHICH IT IS WELDED AND CONFIRM TO ANSI B 16.11.
2. THE LENGTH OF THE NIPPLE SHOULD BE 250mm.
3. THE OTHER END OF THE NIPPLE SHALL BE SOCKET WELDED WITH 1" GLOBE VALVE OF MATERIAL AS PER ANSI B 16.1.
4. TWO ISOLATED VALVES ARE TO BE USED FOR PRESSURE = >40 Kg/Cm2.
5. EDGE HOLE MUST BE CLEAN AND SQUARE OR ROUNDED SLIGHTLY (1/64" RADIUS) FREE FROM BURRS, WIRE EDGES OR OTHER IRREGULARITIES.
6. ORIENTATION OF TAP WILL BE VARY WITH TYPE OF PROCESS FLUID AND NATURE OF RUN OF THE PIPE.
7. ACTIVITIES TO BE COMPLETED AT THE SHOP, WELD THE COUPLING (OR BOSS) ON THE PIPE AND DRILL PRESSURE CONNECTION HOLE (SAME AS I D OF NIPPLE) IN THE PIPE IN ALIGNMENT WITH HOLE IN THE COUPLING.
8. ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE STATED.

FOR TENDER PURPOSE ONLY

एन टी पी सी NTPC NTPC LIMITED (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION									
PROJECT TYPICAL THERMAL POWER PROJECT									
TITLE INSTRUMENT SOURCE CONNECTION DETAILS									
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.
A	FIRST ISSUE								
T.G. 21.08.12 SIZE A4 SCALE N.T.S. DRG. NO. 0000-999-POI-A-035 REV. NO. A									

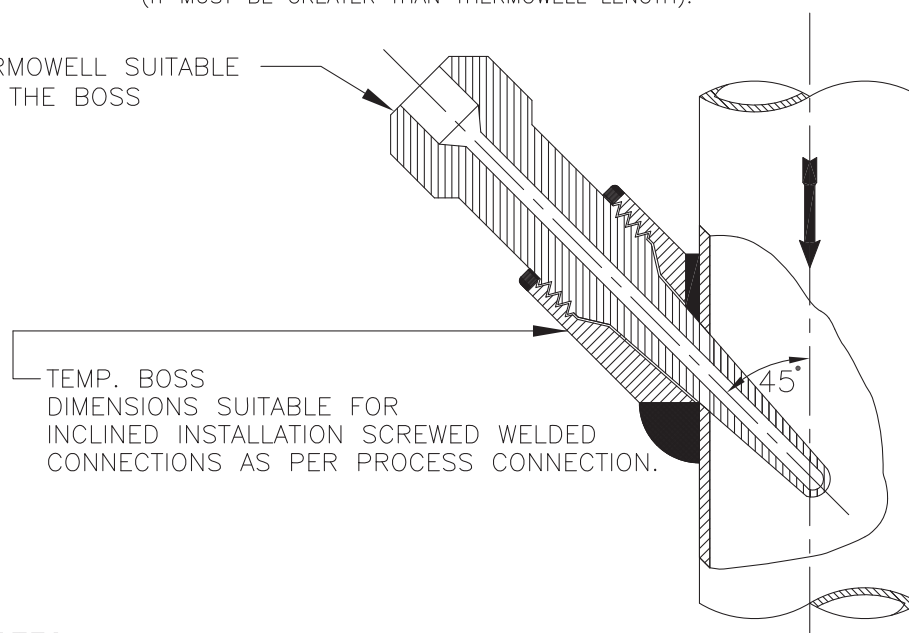
TEMP. MEASUREMENT



NOTES:—

1. THIS TYPE OF THERMOWELL INSTALLATION IS SUITABLE FOR THE PROCESS PIPE OF 2" NPS AND SMALLER.
2. FOR STEAM SERVICE THIS TYPE OF THERMOWELL INSTALLATION 90° BEND MAY BE USED ONLY IN VERTICAL PLANE.
3. THE LENGTH OF THE LARGER PIPE SECTION SHALL BE MINIMUM 150mm (IT MUST BE GREATER THAN THERMOWELL LENGTH).

THERMOWELL SUITABLE FOR THE BOSS



TEMP. BOSS
DIMENSIONS SUITABLE FOR
INCLINED INSTALLATION SCREWED WELDED
CONNECTIONS AS PER PROCESS CONNECTION.

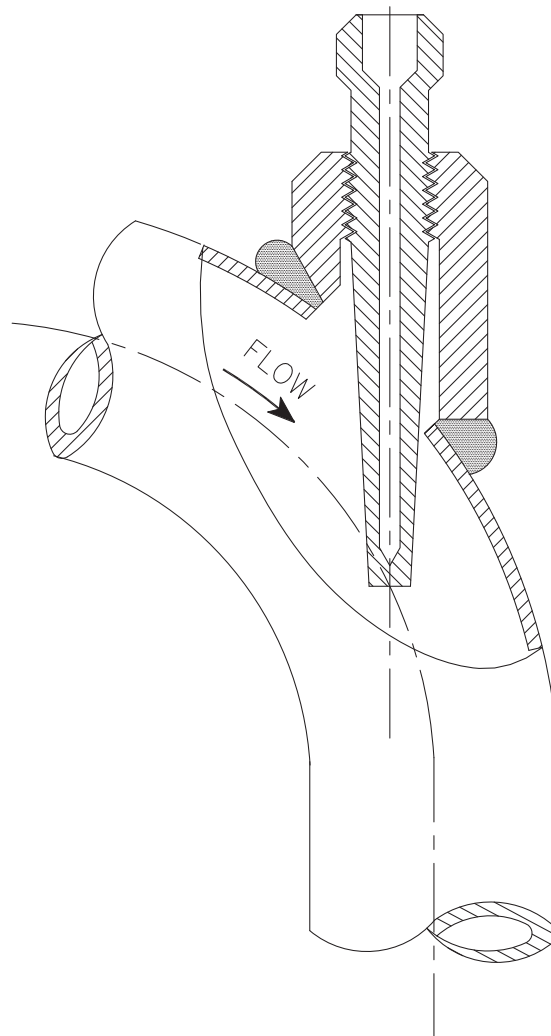
NOTES:—

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

FOR TENDER PURPOSE ONLY

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PROJECT TYPICAL THERMAL POWER PROJECT (SG PACKAGE)															
TITLE INSTRUMENT SOURCE CONNECTION DETAILS															
A	FIRST ISSUE	DRWN	DESIGN	CHKD.	M	E	C	CB	ARCH.	APPD.	DATE	SIZE	SCALE	DRG. NO.	REV. NO.
REV. NO.	DESCRIPTION											A4	N.T.S.	0000-999/102-POI-A-035	A
CLEARED Page 190 of 328										Sh-4 Of 14					

TEMP. MEASUREMENT



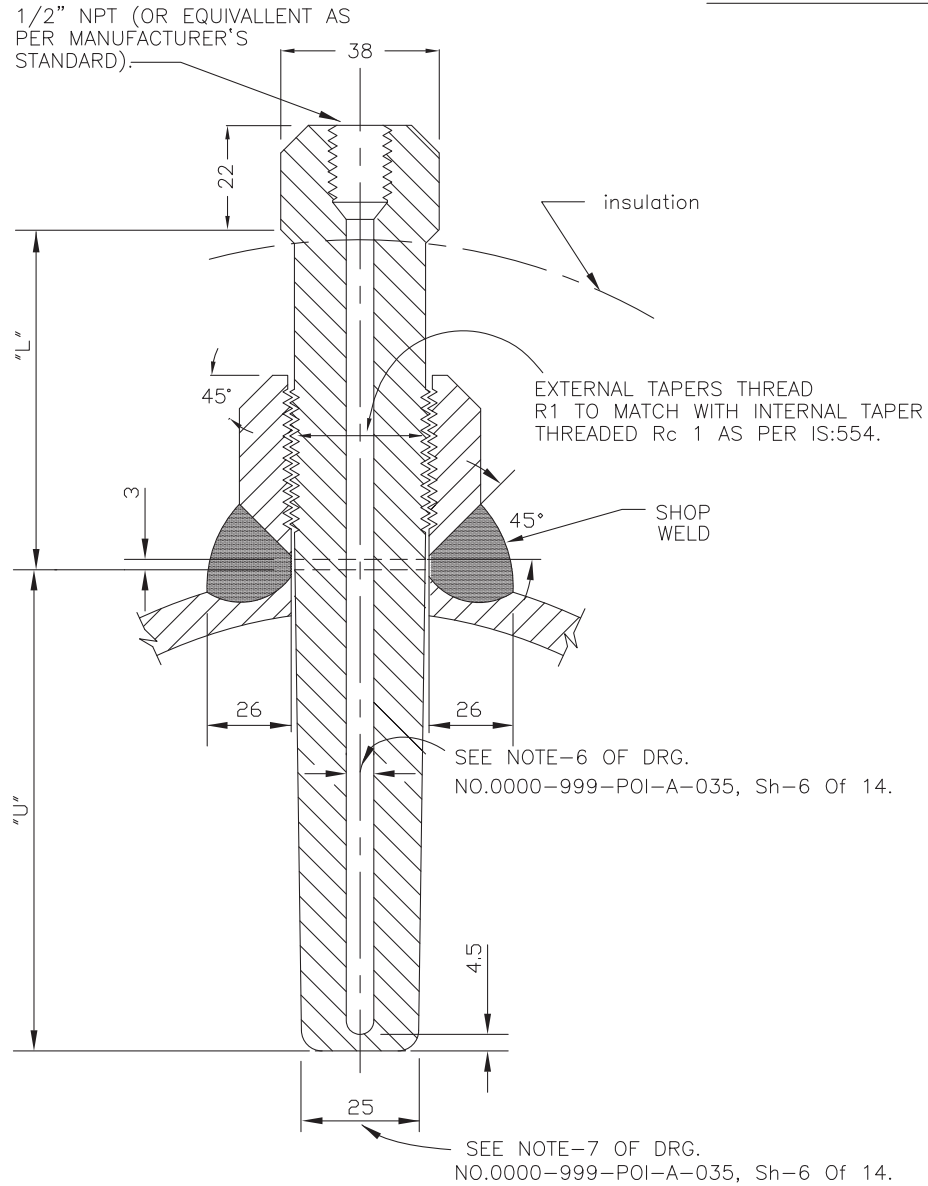
NOTES:-

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

FOR TENDER PURPOSE ONLY

एन टी पी सी NTPC NTPC LIMITED (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION																			
PROJECT										TYPICAL THERMAL POWER PROJECT									
TITLE										INSTRUMENT SOURCE CONNECTION DETAILS									
REV. NO. A DESCRIPTION DRAWN DESIGN CHKD. M E C T.G. 21.08.12										SIZE A4 SCALE N.T.S. DRG. NO. 0000-999-POI-A-035 REV. NO. A									
CLEARED Page 192 of 328										Sh-5 Of 14									

TEMP. MEASUREMENT



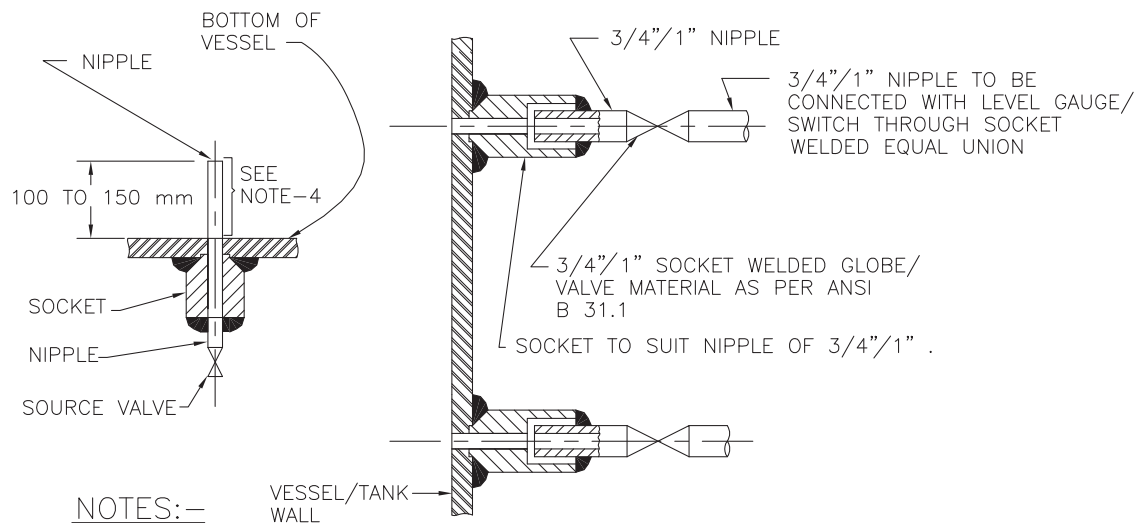
NOTES:-

1. THIS TYPE OF TEMPERATURE BOSS IS APPLICABLE FOR THE PROCESS PRESSURE/TEMPERATURE BELOW 40 Kg/Cm²(g)/400°C
2. FOR PRESSURE TIGHT JOINTS THE BOSS SHOULD HAVE INTERNAL TAPERED PIPE THREAD Rc 1 AS PER IS:554. THE LENGTH OF THREAD ENGAGEMENT SHOULD BE AS PER ABOVE STANDARD.
3. PIPES HAVING PROBABILITY OF PROLONGED VIBRATION SEAL WELDING MAY BE DONE ALL AROUND AFTER TIGHTENING THERMOWELL WITHIN THE BOSS.
4. SEE NOTES-2 TO 14 OF DRG. NO. 0000-999-POI-A-035, Sh-6 Of 14.

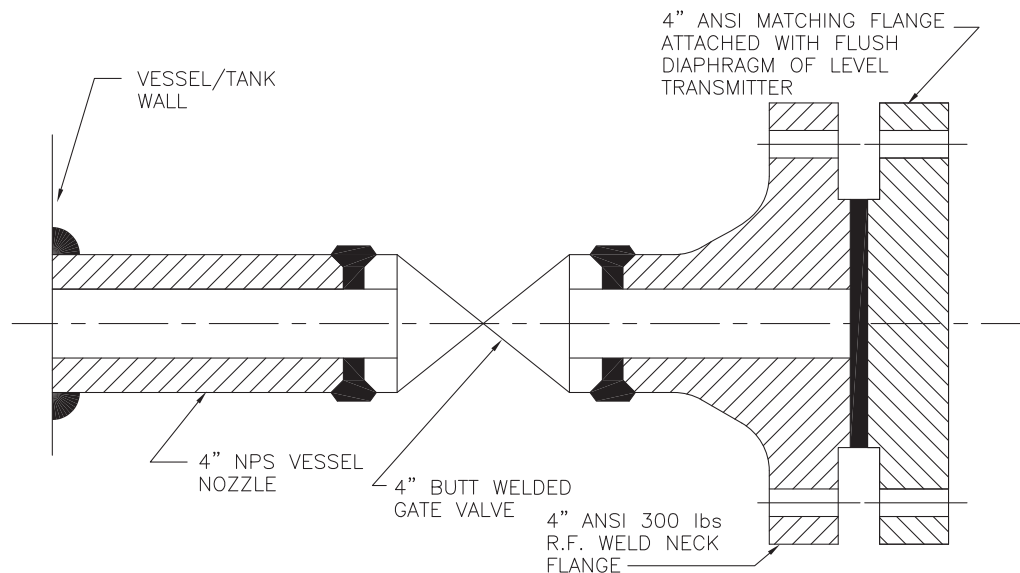
FOR TENDER PURPOSE ONLY

एन टी पी सी NTPC NTPC LIMITED (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION															
PROJECT TYPICAL THERMAL POWER PROJECT															
TITLE INSTRUMENT SOURCE CONNECTION DETAILS															
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD.	DATE	SIZE	SCALE	DRG. NO.	REV. NO.
A	FIRST ISSUE										21.06.19	A4	N.T.S.	0000-999-POI-A-035	A
Cleared										Page 192 of 328		Sh-7 Of 14			

LEVEL MEASUREMENT



1. THIS TYPE OF PROCESS CONNECTION SHALL BE USED FOR LEVEL GAUGE AND EXTERNAL CAGE TYPE FLOAT OR DISPLACER OPERATED LEVEL SWITCH.
2. FOR GAUGES 3/4" NIPPLE ALONG WITH 3/4" SW SOURCE VALVE AND FOR SWITCHES 1" NIPPLE ALONG WITH 1" SW SOURCE VALVE SHALL BE PROVIDED AS PROCESS CONNECTION.
3. SOURCE CONNECTION ON VESSEL SHOULD NOT BE LOCATED AT PLACES SUBJECTED TO INTERFACE AND TURBULENCE FROM INLETS AND OUTLETS.
4. IF LOWER CONNECTION IS TAKEN FROM BOTTOM OF THE VESSEL THEN THE NIPPLE MUST BE 100 mm TO 150 mm ABOVE THE BOTTOM OF THE VESSEL.



NOTES:-

1. THIS TYPE OF PROCESS CONNECTION SHALL BE PROVIDED FOR TANK LEVEL MEASUREMENT OF VISCOUS OR CORROSIVE LIQUID USING FLUSH DIAPHRAGM/WAFER TYPE LEVEL TRANSMITTER.
2. WELDING OF MATCHING FLANGE TO GATE VALVE SHALL BE DONE BY BIDDER.

FOR TENDER PURPOSE ONLY

एन टी पी सी NTPC NTPC LIMITED (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION																			
PROJECT										TYPICAL THERMAL POWER PROJECT									
TITLE										INSTRUMENT SOURCE CONNECTION DETAILS									
REV. NO.										REV. NO.									
DESCRIPTION										DESCRIPTION									
DRAWN										DRAWN									
DESIGN										DESIGN									
CHKD.										CHKD.									
M										M									
E										E									
C										C									
C&I										C&I									
ARCH.										ARCH.									
APPD.										APPD.									
DATE										DATE									
SIZE										SIZE									
SCALE										SCALE									
DRG. NO.										DRG. NO.									
0000-999-POI-A-035										0000-999-POI-A-035									
A										A									



**Technical specification for
COMPRESSED AIR SYSTEM**

**2X490 MW NATIONAL CAPITAL POWER STATION
(NCPS) DADRI**

SECTION D

REV. NO. 00

DATE : 23.02.2018

INSTRUMENTS CHECK LIST



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

CHECK LIST FOR FLOW SWITCH

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

Legend :

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

Note :

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



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

CHECK LIST FOR TEMPERATURE SWITCH

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	100%	APPROVED SPEC./ DATA SHEETS	P	W	V	
	TYPE						
	MODEL/TAG NO.						
	RANGE/SCALE						
	END CONNECTION						
2	DIMENSIONS CHECK	100%		P	W	V	
3	ACCURACY	100%		P	W	V	
4	SWITCHING DIFFERENTIAL	100%		P	W	V	
5	CONTACT RATING / No. OF CONTACTS	RANDOM		P	W	V	
6	MATERIAL TC FOR BULB, CAPILLARY, ARMOUR	ONE / LOT		P	V	V	
7	HV / IR	RANDOM		P	W	V	
8	DEGREE OF PROTECTION	TYPE TEST		P	V	V	
9	THERMOWELLS						
	DIMENSIONS, PROCESS CONN	100%		P	W	V	
	MATERIAL TC	ONE / LOT		P	V	V	
	HYD TEST	100%		P	W	V	
	IBR CERTIFICATE, IF APPLICABLE			P	V	V	
10	REPEATABILITY	100%		P	V	V	
11	HYSTERESIS	100%		P	V	V	
12	ACCESSORIES AS APPLICABLE	SEE NOTE-1 BELOW		P	W	V	

Legend :

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P = Perform, W = Witness, V = Verification

Note :

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



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

CHECK LIST FOR PRESSURE SWITCH

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	V	V	
	1.1 MODEL NO/TAG NO						
	1.2 RANGE						
	1.3 END CONN						
	1.4 NO. OF CONTACT						
2	CALIBRATION			P	V	V	
	2.1 REPEATABILITY						
	2.2 SET POINT ADJUSTMENT						
	2.3 DIFFERENTIAL						
3	OVER PR & LEAK TEST			P	V	V	
4	ELECT. INSULATION/HV TEST	ONE		P	V	V	
5	REVIEW OF TC FOR MATERIALS OF	FOR LOT		V	V	V	
	5.1 SENSOR						
	5.2 MOVEMENT						
	5.3 PROCESS CONNECTION						
	5.4 HOUSING						
6	REVIEW OF TC FOR DEGREE OF PROTECTION	TYPE TEST	V	V	V		
7	REVIEW OF TC OF MICROSWITCH	FOR LOT	V	V	V		

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

Note :

- Quantum of check shall be as below :
100 % - By Manufacturer
- Manufacturer to carry out ROUTINE TEST on 100 %.
- Contractor to provide compliance certificate for tests/checks verified by contractor and the same alongwith test certificates to be verified by BHEL



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

CHECK LIST FOR ANNUNCIATORS

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	TYPE/ MODEL						
	DIMENSIONS OF HARDWARE						
	MODULARITY						
	SEQUENCE						
	FACIA DETAILS						
2	FUNCTIONAL TEST	100%		P	W	V	
3	IMMUNE TO STEP VARIATIONS IN THE POWER SUPPLY	SEE NOTE-1 BELOW		P	W	V	
4	DEGREE OF PROTECTION FOR ENCLOSURE	TYPE TEST		P	W	V	
5	I/R CHECK	SEE NOTE-1 BELOW		P	W	V	
6	RESPONSE			P	W	V	

Legend :

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

Note :

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



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

CHECK LIST FOR TRANSMITTER

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECKS FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	VISUAL.						
	MODEL/TAG No						
2	PROCESS CONNECTION			P	W	V	
3	ACCURACY			P	W	V	
4	REPEATABILITY			P	W	V	
5	HYSTERESIS			P	W	V	
6	EFFECT OF TEMP VARIATION ON ACCURACY			P	W	V	
7	SPAN / ZERO ADJUSTMENT	ONE / TYPE		P	W	V	
8	EFFECT OF SUPPLY VOLTAGE VARIATION			P	W	V	
9	EFFECT OF LOADING (500 OHM METERS)			P	W	V	
10	HIGH PRESSURE TEST	SEE NOTE-1 BELOW		P	W	V	
11	BURN-IN TEST	ONE / TYPE		P	W	V	
12	DEGREE OF PROTECTION			P	W	V	
13	ACCESSORIES AS APPLICABLE	SEE NOTE-1 BELOW		V	V	V	

Legend :

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

Note :

- Quantum of check shall be as below :
100 % - By Manufacturer
- Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
- When material corelation are not available manufacturer's compliance to be provided.
- Contractor to provide compliance certificate for tests/checks verifid by contractor and submit the same alongwith test certificates to be verified by BHEL.



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

CHECK LIST FOR TEMPERATURE ELEMENT

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR TYPE	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	MODEL No./TAG No.						
	PROCESS CONNECTION						
2	STABILITY			P	W	V	
3	INSULATION RESISTANCE			P	W	V	
4	ENCLOSURE CLASS			P	W	V	
5	RESPONSE TIME			P	W	V	
7	ACCURACY			P	W	V	
8	HYDROSTATIC TEST			P	W	V	
9	ELECTRICAL CHARACTERISTIC OF SENSOR (CONTINUITY OF T/C WIRES & INSULATION RESISTANCE OF RTD LEADS w.r.t. BODY			P	W	V	
10	TEMP CURVES / CHARTS			P	V	V	
11	AMBIENT TEMP. EFFECT CHECK			P	W	V	
12	HV TEST			P	W	V	

Legend :

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

Note :

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

[illegible]

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

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



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

CHECK LIST FOR SOLENOID VALVES

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	TYPE						
	MAKE						
	MODEL No.						
2	MATERIAL (BODY. PLUNGER/TRIM)			P	W	V	
3	PORT SIZE			P	W	V	
4	CABLE CONNECTION SIZE			P	W	V	
5	ENCLOSURE CLASS			P	W	V	TYPE TEST CERTIFICATE TO BE FURNISHED BY VENDOR
6	No. OF COILS & INSULATION CLASS			P	W	V	TEST CERTIFICATE TO BE FURNISHED FOR INSULATION CLASS BY VENDOR
7	POWER SUPPLY CHECK			P	W	V	
8	IR / HV TEST			P	W	V	
9	FUCTIONAL TEST			P	W	V	

Legend :

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

Note :

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



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

CHECK LIST FOR TEMPERATURE GAUGE

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	DIAL SIZE						
	MODEL NO./TAG NO./TYPE						
	RANGE/SCALE						
	END CONNECTION						
2	CALIBRATION	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	ACCURACY						
	REPEATABILITY						
	HYSTERESIS						
3	OVER TEMP. TEST			P	W	V	
4	AMBIENT TEMP. COMPENSATION CHECK	1 OF TYPE		P	V	V	
5	REVIEW OF TC FOR MATERIALS OF	FOR LOT	APPROVED SPEC./ DATA SHEETS	V	V	V	
	SENSOR						
	MOVEMENT						
	PROCESS CONNECTION						
	THERMOWELL						
	HOUSING						
6	REVIEW OF TC FOR DEGREE OF PROTECTION	TYPE TEST		V	V	V	
7	THERMOWELL	SEE NOTE-1 BELOW	AS PER APPD DWG		V	V	
	MATERIAL TC & DIMN. CHECK						
	HYD. TEST						
	OVER RANGE TEST						

Legend :

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

Note :

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



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

CHECK LIST FOR PRESSURE & DP GAUGE

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	SENSOR TYPE						
	DIAL SIZE						
	MODEL NO/TAG NO						
	RANGE/SCALE						
	SWITCH CONTACT RATING & NOS.						
	END CONNECTION						
2	CALIBRATION			P	W	V	
	ACCURACY						
	REPEATABILITY						
	SET POINT ADJUSTMENT						
3	OVER PRESSURE & LEAK TEST	P	W	V			
4	OPERATION OF PRESSURE. RELIEF DEVICE	ONE	P	W	V		
5	REVIEW OF TC FOR	FOR LOT	V	V	V		
	MATERIALS OF SENSOR						
	MOVEMENT						
	PROCESS CONNECTION						
	HOUSING						
6	REVIEW OF TC FOR DEGREE OF PROTECTION	TYPE TEST	V	V	V		
7	ACCESSORIES AS APPLICABLE	SEE NOTE-1 BELOW	V	V	V		

Legend :

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

Note :

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



**Technical specification for
COMPRESSED AIR SYSTEM**

**2X490 MW NATIONAL CAPITAL POWER STATION
(NCPS) DADRI**

SECTION D

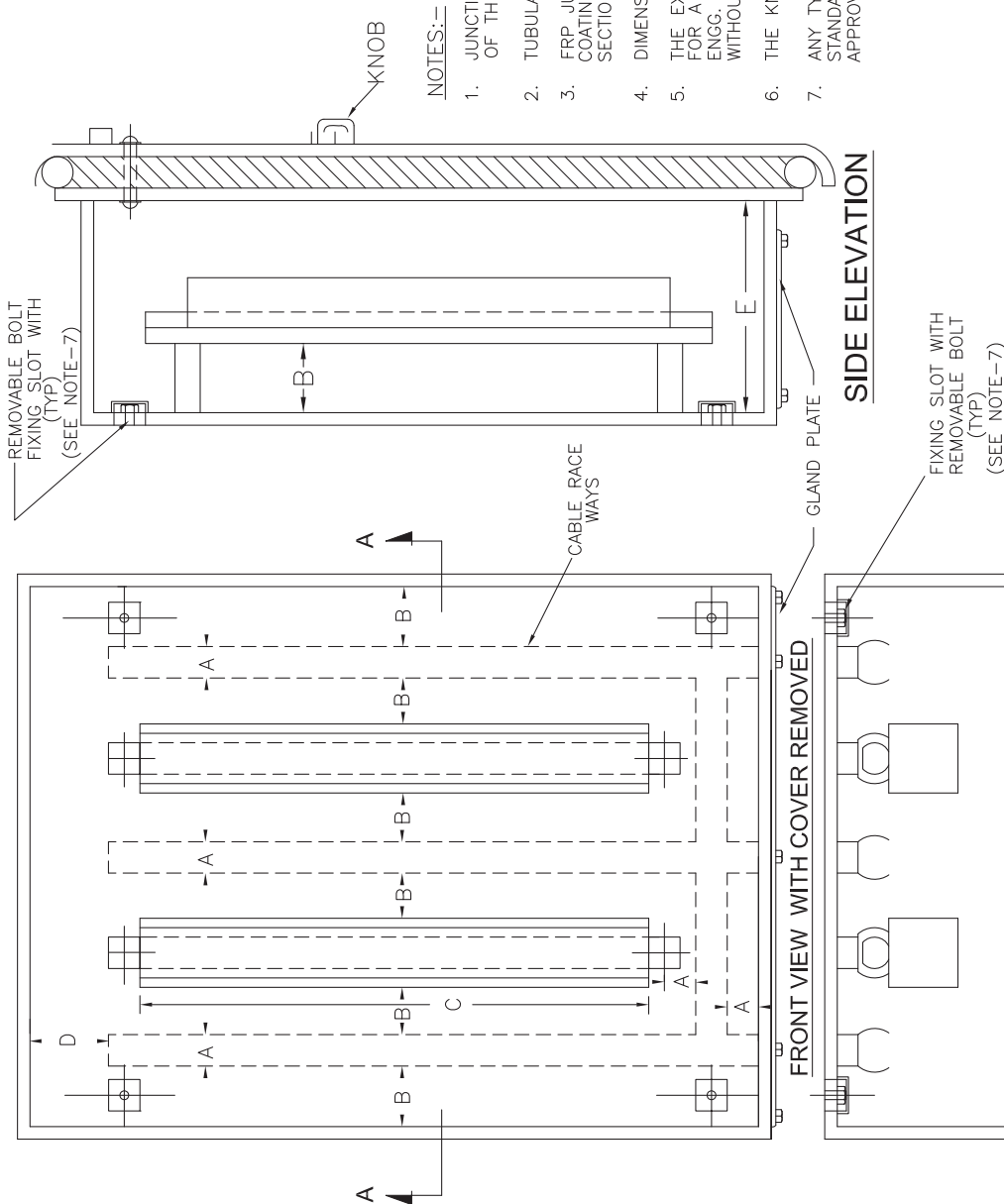
REV. NO. 00

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JB/RACKS SPECIFICATION

FIELD MOUNTED LOCAL JUNCTION BOXES

Material & thickness - Fiberglass Reinforced Polyester (FRP) of 4 mm (minimum thickness).
Terminal blocks - Rail mounted cage-clamp type suitable for conductor size upto 2.5 mm².
Other requirements – Earthing stud, Weather & dust proof IP-65, Suitable for mounting on walls, columns, structures, brackets, bolts, nuts, screws, glands required for erection shall be of SS.



- A - 75 mm
- B - 25 mm
- C - SEE NOTE-4
- D - 100 mm
- E - 150 mm

NOTES:-

- JUNCTION BOXES SHALL HAVE GLAND PLATES AT THE BOTTOM OF THE BOX ONLY.
- TUBULAR TYPE GASKETS WILL BE USED.
- FRP JUNCTION BOXES, SHALL BE PROVIDED WITH POLYETHERENE COATING. ALSO REFER SUB SECTION INST CABLE, PART-B SECTION-VI FOR DETAILS.
- DIMENSION OF 'C' SHALL BE BASED ON NO. OF TERMINAL BLOCKS.
- THE EXACT TYPE & DIMENSION OF JUNCTION BOXES TO BE USED FOR A PARTICULAR APPLICATION SHALL BE AS DECIDED DURING DETAIL ENGG. STAGE AND SHALL BE SUBJECT TO EMPLOYER'S APPROVAL WITHOUT ANY PRICE REPERCUSSION.
- THE KNOB FOR ALL THE JUNCTION BOXES SHALL BE IDENTICAL.
- ANY TYPE OF SEALED FIXING ARRANGEMENT AS PER MANUFACTURER'S STANDARD CAN ALSO BE PROVIDED SUBJECT TO EMPLOYER'S APPROVAL.

FOR TENDER PURPOSE ONLY

NTPC एन टी सी NTPC LIMITED (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION	PROJECT		TITLE	
TYPICAL THERMAL POWER PLANT		G.A. OF JUNCTION BOX		
REV.NO.	DESCRIPTION		DRAWN	DESIGN
A	FIRST ISSUE		S.K.	A.R.
B	GENERALLY REVISED		S.K.	A.R.
C	GENERALLY REVISED		JM	KS
D	GENERALLY REVISED		JM	KS
HINGE FOR THE DOOR		KNOB		SECTION-AA
REV. NO.		DATE		APPD
A4		04.05.05		04.05.05
N.T.S.		SCALE		DRG. NO.
0000-999-POI-A-017		0000-999-POI-A-017		REV. NO.
D		D		REV. NO.



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QUALITY ASSURANCE

CLAUSE NO.	एनटीपीसी NTPC TECHNICAL REQUIREMENTS					
7.03.00	TYPE TEST REQUIREMENT FOR C&I SYSTEMS					
	SI No	Item	Test requirement	Standard	Test to be specifically conducted	NTPC's approval req. On test certificate
	1	Elect. Metering instruments	As per standard (col 4)	IS-1248	No	Yes
	2	Electronic transmitter	As per standard (col 4)	BS-6447 / IEC-60770	No	Yes
	4	Pressure gauge	Degree of protection test	IS-2147	No	No
			Temp interference test	IS -3624	No	No
	5	Temperature gauge	Degree of protection test	IS-2147	No	No
	6	Pressure & DP switch	Degree of protection test	IS-2147	No	No
			As per standard (col 4)	BS 6134	No	No
	7	Level switch	Degree of protection test	IS-2147	No	No
	8	Control valves	CV Test	ISA 75.02	No	Yes
	9	Flow Nozzles & Orifice plate	Calibration	ASME PTC , BS 1042	No	Yes
	1	PLCs	All tests as	IEC-	N	Yes
NCTPP DADRI ST—II (2X490MW) & IGSTPP,JHAJJAR (3X500MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE			TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC. NO.: CS-6130/0330-109-9		SUB-SECTION-III-C CONTROL & INSTRUMENTATION	PAGE 29 OF 34

CLAUSE NO.	TECHNICAL REQUIREMENTS					एनटीपीसी NTPC
	SI No	Item	Test requirement	Standard	Test to be specifically conducted	NTPC's approval req. On test certificate
	0		per IEC-1131	601131	o	
	11	Junction Box	Degree of protection test	IS-13947	No	Yes
	12	Battery charger (Not required for inbuilt chargers)	Degree of protection test	IS-13947	No	No
			Short circuit current capability	IEC-60146-2	No	Yes
			Temp rise test without redundant fans	Approved procedure, IEC 60146-2	No	Yes
			SWC test	Approved procedure	No	Yes
			Burn-in-test	Approved procedure	No	Yes
			Efficiency	IEC-60146-2,	No	Yes
			Audible Noise Test	IEC 60146-2	No	Yes
			Fuse Clearing Capability	Approved procedure	No	Yes
			Relative harmonic content	Approved procedure	No	Yes
			ESD immunity test	IEC-61000-4-2-9(1)	No	Yes
			Radio interference	IEC 60146-2	No	Yes
			Over Load Test on	Approved procedure	No	Yes
NCTPP DADRI ST—II (2X490MW) & IGSTPP, JHAJJAR (3X500MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE			TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC. NO.: CS-6130/0330-109-9		SUB-SECTION-III-C CONTROL & INSTRUMENTATION	PAGE 30 OF 34

CLAUSE NO.	TECHNICAL REQUIREMENTS					एनटीपीसी NTPC
	SI No	Item	Test requirement	Standard	Test to be specifically conducted	NTPC's approval req. On test certificate
			Inverter & charger			
			Restart Test	IEC 60146-2	No	Yes
			Output voltage tolerance	Approved	No	Yes
			Output voltage Harmonic content	Approved procedure	No	Yes
			Insulation test	IEC 60146	No	Yes
			Load Tests	Approved procedure	No	Yes
			Preliminary light load test	IEC 60146	No	Yes
			Current division / Voltage division	IEC 60146-2	No	Yes
	13	Battery	As per standard (col 4)	IEC –623 / IS 10918 for Ni-Cd IS-1652 for Plante Lead Acid	No	Yes
	14	Voltage stabilizers	Over Load Test	Approved procedure	No	Yes
			Temp rise test without redundant fans	Approved procedure	No	Yes

NCTPP DADRI ST—II (2X490MW) & IGSTPP, JHAJJAR (3X500MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC. NO.: CS-6130/0330-109-9	SUB-SECTION-III-C CONTROL & INSTRUMENTATION	PAGE 31 OF 34
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DATE : 23.02.2018

APPLICABLE CODES & STANDARDS

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 		
	Miscellaneous IS:802 Code of practice for use of structural steel in (Relevant parts) overhead transmission line towers. IS:803 Code of practice for design, fabrication and erection of vertical mild steel cylindrically welded in storage tanks. IS:10430 Creteria for design of lined canals and liner for selection of type of lining. IS:11592 Code of practice for selection and design of belt conveyors. IS:12867 PVC handrails covers. CIRIA Design and construction of buried thin-wall pipes. Publication REFERENCE CODES AND STANDARDS FOR CONTROL AND INSTRUMENTATION The design, manufacture, inspection, testing & installation of all equipment and system covered under this specification shall conform to the latest editions of codes and standards mentioned below and all other applicable VDE, IEEE, ANSI, ASME, NEC, NEMA, ISA AND Indian Standards and their equivalents. Temperature Measurements - Instrument and apparatus for temperature measurement - ASME PTC 19.3 (1974). - Temperature measurement - Thermocouples ANSI MC 96.1 - 1982. - Temperature measurement by electrical Resistance thermometers - IS:2806. - Thermometer - element - Platinum resistance - IS:2848. Pressure Measurements - Instruments and apparatus for pressure measurement - ASME PTC 19.2 (1964). - Electronic transmitters BS:6447. - Bourdon tube pressure and vacuum gauges - IS:3624 - 1966. - Process operated switch devices (Pr. Switch) BS-6134.		
NCTPP DADRI(2X490MW) & IGSTPP JHAJJAR (3X500MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-6130/0330-109-9	GENERAL TECHNICAL REQUIREMENTS	PAGE 69 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	Flow Measurements Instruments and apparatus for flow measurements - ASME PTC 19.5 (1972) Interim supplement, Part-II. Measurement of fluid flow in closed conduits - BS-1042. Electronic Measuring Instrument & Control Hardware/ Software - Automatic null balancing electrical measuring instruments - ANSI C 39.4 (Rev. 1973): IS:9319. - Safety requirements for electrical and electronic measuring and controlling instrument - ANSI C 39.5 - 1974. - Compatibility of analog signals for electronic industrial process instruments - ISA - S 50.1 (1982) ANSI MC 12.1 - 1975. - Dynamic response testing of process control instrumentation ISA - S 26 (1968). - Surge Withstand Capability (SWC) tests - ANSI C 37.90 a/IEEE-472 or suitable class of IEC-255-4 equivalent to ANSI C37.90a/IEEE-472. - Printed circuit boards - IPC TM - 650, IEC 326 C. - General requirement and tests for printed wiring boards - IS 7405 (Part-I) 1973. - Edge socket connectors - IEC 130-11. - Requirements and methods of testing of wire wrap terminations DIN 41611 Part-2. - Dimensions of attachment plugs & receptacles - ANSI C 73 - 1973 (Supplement ANSI C 73 a - 1980). - Direct acting electrical indicating instrument - IS:1248 - 1968 (R). - Standard Digital Interface for Programmable Instrumentation - IEEE-488.2 - 1990. - Information Processing Systems - Local Area Networks - Part 2 : Logical Link Control - IEEE-802.2 - 1989. - Standard for Local Area Networks : Carrier Sense Multiple Access with Collision Detection - IEEE-802.3 - 1985. - Supplements A, B, C and E to Carrier Sense Multiple Access with Collision Detection - IEEE-802.3 - 1988.			
NCTPP DADRI(2X490MW) & IGSTPP JHAJJAR (3X500MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-6130/0330-109-9	GENERAL TECHNICAL REQUIREMENTS	PAGE 70 OF 83	

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
	16. Standard for Local Area Networks : Token - Passing Bus Access Method - IEEE-802.4 - 1985. 17. Standard for Local Area Networks : Token - Ring Access Method and Physical Layer Specification - IEEE-802.5 - 1985. 18. IEEE Guide to Software Requirements Specifications - IEEE-830 - 1984. 19. Hardware Testing of Digital Process Computers - ISA RP55.1 - 1983. 20. Electromagnetic Susceptibility of Process Control Instrumentation - SAMA PMC 33.1 - 1978. 21. Interface Between the Data Terminal Equipment and Data Circuit - Terminating Equipment Employing Serial Binary Data Interchange - EIA-232-D-1987. 22. Electromagnetic Compatibility for Industrial Process Measurement and Control Equipment, Part 3 : Radiated Electromagnetic Field Requirements - IEC 801-3-1984. Instrument Switches and Contact 1. Contact rating - AC services NEMA ICS 2 - 1978 (with revision through May 1983), Part - 2-125, A6000. 2. Contact rating - DC services NEMA ICS 2-1978 Part-2 125, N600. Enclosures 1. Type of Enclosures - NEMA ICS Part - 6 - 1978 (with Rev. 1 4/80) through 110.22 (Type 4 to 13). 2. Racks, panels and associated equipment - EIA : RS - 310 C- 1983 (ANSI C 83.9 - 1972). 3. Protection class for Enclosures, cabinets, control panels & desks - IS:2147 - 1962. Apparatus, enclosures and installation practices in hazardous area 1. Classification of hazardous area - NFPA 70 - 1984, Article 500. 2. Electrical Instruments in hazardous dust location - ISA - 512.11, 1973. 3. Intrinsically safe apparatus - NFPA 493 1978. 4. Purged and pressurised enclosure for electrical equipment in hazardous location - NFPA 496-1982. 5. Enclosures for Industrial Controls and Systems - NEMA IS 1.1 - 1977.			
NCTPP DADRI(2X490MW) & IGSTPP JHAJJAR (3X500MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-6130/0330-109-9	GENERAL TECHNICAL REQUIREMENTS	PAGE 71 OF 83	

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 		
	Sampling System 1. Stainless steel material of tubing and valves for sampling system - ASTMA 296-82, Grade 7 P 316. 2. Submerged helical coil heat exchangers for sample coolers ASTM D11 92-1977. 3. Water and steam in power cycle - ASME PTC 19.11. 4. Standard methods of sampling system - ASTM D 1066-99. Annunciators 1. Specifications and guides for the use of general purpose annunciators - ISA S 19.1, 1979. 2. Surge withstand capability tests - ANSI C 37.90a - 1989/IEEE-472 or suitable class of IEC 255-4 equivalent to ANSI C37.90a 1989/IEEE-472 3. Damp heat cycling test - IS:2106 4. Specification for Electromagnetic Susceptibility - SAMA DMC 33, 1/78 Protections 1. Relays and relay system associated with electric power apparatus. ANSI C 37.90, 1 - 1989. 2. General requirements & tests for switching devices for control and auxiliary circuits including contactor relays - IS:6875 (Part-I) - 1973. 3. Turbine water damage prevention - ASME TDP-1-1980. 4. Boiler safety interlocks - NFPA 85 - 2011 or latest version. UPS System 1. Practices and requirements for semi-conductor power rectifiers - ANSI C 34.2, 1973. 2. Relays and relays system associated with electrical power apparatus - ANSI C 3.90 - 1983. 3. Surge withstand capability test - ANSI C 37.90 1 -1989. 4. Performance testing of UPS - IEC 146. 5. Stationary cells & Batteries Lead Acid type (with tubular positive plates) specification IS-1651-1991.		
NCTPP DADRI(2X490MW) & IGSTPP JHAJJAR (3X500MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-6130/0330-109-9	GENERAL TECHNICAL REQUIREMENTS	PAGE 72 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 		
	6. Recommended practice for sizing large lead storage batteries for generating stations & sub-stations - IEEE-485-1985. 7. Printed Circuit Board - IPC TM 650, IEC 326C. 8. General Requirements & tests for printed wiring boards, IS:7405 (Part-I) 1973. Control Valves 1. Control valve sizing - Compressible & Incompressible fluids - ISA S 75.01-1985. 2. Face to face dimensions of control valves - ANSI B 16.00 - 1973. 3. ISA Hand Book of Control Valves - (ISBN : B: 1047-087664-234-2). 4. Codes for pressure piping - ANSI B 31.1 5. Control Valve leak class - ISA RP 39.6 Process Connection & Piping 1. Codes for pressure piping "power piping" - ANSI B 31.1. 2. Seamless carbon steel pipe ASTM - A - 106. 3. Forged & Rolled Alloy steel pipe flanges, forged fittings and valves and parts - ASTM - A - 182. 4. Material for socket welded fittings - ASTM - A - 105. 5. Seamless ferritic alloy steep pipe - ASTM - A - 335. 6. Pipe fittings of wrought carbon steel and alloy steel - ASTM - A - 234. 7. Composition bronze of ounce metal castings - ASTM - B - 62. 8. Seamless Copper tube, bright annealed - ASTM - B - 168. 9. Seamless copper tube - ASTM - B - 75. 10. Dimension of fittings - ANSI - B - 16.11. 11. Valves flanged and butt welding ends - ANSI - B - 16.34. Instrument Tubing 1. Seamless carbon steel pipe - ASTM - A 106. 2. Material of socketweld fittings - ASTM - A105. 3. Dimensions of fittings - ANSI - B - 16.11.		
NCTPP DADRI(2X490MW) & IGSTPP JHAJJAR (3X500MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-6130/0330-109-9	GENERAL TECHNICAL REQUIREMENTS	PAGE 73 OF 83



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SIGNAL EXCHANGE LIST FORMAT



**Technical specification for
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KKS PHILOSOPHY

**KKS NUMBERING PHILOSOPHY**

For identifying (tagging) an instrument / equipment in Power plant KKS numbering scheme is used. The purpose is to assign a unique number to every equipment in the power plant. For C&I equipment unique number are to be provided up to the signal level so that a unique number Input / Output exist in DCS for every signal.

Normally KKS number is a 10 digit alpha-numeric code and is typically split into the following:

X	X	X	A	A	Y	Y	B	B	B
---	---	---	---	---	---	---	---	---	---

First three digits indicate the Sub-System. The Code for the major system are given as per **Annexure-1**.

Fourth and Fifth digits are the **Numerical Keys at System Code Level** and used to distinguish between main systems having same Alpha Codes.

Sixth and Seventh digits are the **Equipment / Apparatus / Measuring Circuit Code**. The code of various Equipment / Apparatus / Measuring Circuit is shown in **Annexure-2**

Eight, Nine and tenth digits are the **Numerical Keys at Equipment / Apparatus / Measuring Circuit Code** and used to distinguish between various instruments in the same sub-group. Numerical keys at System / Equipment / Apparatus / Measuring Circuit is shown in **Annexure-3**.

**ANNEXURE-1****List of System / Sub-System Codes used in Power Plant:**

- 1) Compressed air system : QEA, QEB, QEC, QED

ANNEXURE-2**Standard Equipment Codes:**

AA	Valves including drives, also hand operated
AB	Seclusions, Lock, Gates, Doors
AC	Heat Exchanger
AE	Turning, Driving, Lifting equipment
AF	Continuous conveyors, Feeders
AG	Generator Units
AH	Heating and Cooling Units
AK	Pressing and Packaging equipment
AM	Mixer, Stirrer
AN	Blower, Air Pumps / Fans, Compressor Units
AP	Pump Units
AT	Purification, Drying, Filter
AV	Combustion Equipment e.g. grates

Standard Apparatus Codes:

BB	Vessels and Tank
BF	Foundation
BG	Boiler Heating Surfaces
BN	Injector, Ejector
BP	Flow and throughput limitation equipment (Orifice)
BQ	Holders, Carrying Equipment, Support
BR	Piping, Ducts, Chutes, Compensator
BS	Sound Absorber
BU	Insulations, Sheatings

Standard Measuring Circuits Codes:

CD	Density
CE	Electrical Quantities
CF	Flow, throughput
CG	Distance, Length, Position
CK	Time
CL	Level



CM	Humidity
CQ	Analysis (SWAS)
CS	Speed, Velocity, Frequency
CT	Temperature
CY	Vibration, Expansion

ANNEXURE-3

Numerical Keys

A) Numerical Keys at System Code Level

- i) Use 10, 20, 30... To distinguish between main systems having same Alpha Codes. Examples:
 - a) Main Steam (Left) and Main Steam (Right)
 - b) BFP – A/B/C
 - c) ID Fan – A/B, FD Fan A/B, AH – A/B
- ii) For branch off from main system path having code say 10, keep the same alpha code and use 11, 12, 13 etc. Similarly for other branch off from main system path having code say 20, keep the same alpha code and use 21, 22, 23 etc and shall carry on further in the same way.
- iii) If the branch off from main system / sub system path is used for some other system, where different alpha codes can be applied, then in that case the said branch line will be designated by the alpha codes of the system to which it is providing the input.

B) Numerical keys at Equipment Code level:

There are three numerical keys available for each type of equipment code. Following has been agreed upon considering present practice, better flexibility and ease in sorting.

i) Valves and Dampers --- Equipment Code – AA

		<u>N1</u>	<u>N2 N3</u>
Motorised (<i>on/off duty</i>)	-	0	01 to 50
Motorised (<i>inching duty</i>)	-	0	51 to 99
Pneumatic (Control)	-	1	01 to 50
Motorised (<i>thyrestor Control</i>)	-	1	51 to 99
Sol. Operated	-	2	01 to 99
(Open / Close duty (Valves, NRVs, Gate)			
Hydraulic	-	3	01 to 99



NRV (Without actuation)	-	4	01 to 99
Manual	-	5	01 to 99
Manual	-	6	01 to 99
Relief & Safety Valves	-	7	01 to 99
Reserve	-	8	01 to 99
Reserve	-	9	01 to 99

ii) **Field Instruments**

Field Transmitters & Analog Signals	-	0	01 to 99
Field Switches & Binary Signals	-	1	00 to 99
PG Test Point	-	4	00 to 99
Gauges	-	5	00 to 99
Automatic Turbine Tester (ATT)-HWR	-	2	00 to 99
(Reserved for protection Signals used by Hardwar)			

Example of Numerical Key Usage:

In line with the philosophy adopted for Valves / Dampers /instruments etc. pumps and fans in the main systems (having different system code) can be numbered as AP/N100 and as AP/N101, 102, Where system code is same.

	2 X 490 MW NCTPPP, DADRI, STAGE-II COMPRESSED AIR SYSTEM	SPECIFICATION No: PE-TS-436-555-A001	
		VOLUME: II B	
		SECTION : D	
		REV. 00	DATE: 19.03.18
		SHEET: 1 OF 1	

SECTION: D

STANDARD TECHNICAL SPECIFICATIONS

	TECHNICAL SPECIFICATION COMPRESSED AIR SYSTEM	SPECIFICATION NO.PE-SS-EPC-555-A-001	
		VOLUME II B	
		SECTION D	SUB-SECTION A8
		REV. 0	
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1.

GENERAL

1.1

This specification covers the design, manufacture, testing at Manufacturer's works, delivery to site, handling at site, installation, commissioning and carrying out acceptance tests and final painting at site of various equipment of the compressed air system, as specified hereinafter.

2.

SYSTEM DESCRIPTION

2.1

The compressed air system shall consist of instrument air compressors & air drying plant (ADP), plant air compressors, air receivers, control panels inter connecting compressed air piping, cooling water piping, instrumentation and control.

2.2

The compressors shall be arranged such that all the plant air compressors shall supply air to the upstream (header of instrumentation air of each ADP through an isolation and a non-return valve so that in the event of failure of instrument air compressor, the instrument are ensured at all time continuously.

3.

DESIGN CRITERIA

3.1

The instrument air compressor will be designed to meet the instrument air requirements of all the equipments /plants/systems as specified elsewhere in the specification (excluding the compressed air requirement of Ash Handling Plant).

3.2

The Plant/Service air compressor will be designed to meet the plant/service air requirements of all the equipments / plants / systems as specified elsewhere in the specification (excluding the plant air requirement of Ash Handling Plant) or capacity be identical as that of the instrument air compressors whichever is higher.

3.3

Void.

3.4

Each compressor will be designed to deliver the nominal capacity at the required delivery pressure.

3.5

The compressors' capacity will be designed for 45⁰ C DBT and 75% RH

3.6

For Instrument Air, Delivery pressure will be 8.0 Kg/cm² (g) at ADP outlet.

3.7

For Plant / Service Air, Delivery pressure will be 8.5 Kg/cm² (g) at Compressor outlet.

3.8

Air compressors will be designed for continuous operation with high efficiency to satisfy the performance requirement.

3.9

The continuous motor rating (at 50⁰ C ambient) will be at least ten percent (15%) above the maximum load demand of the driven equipment under the entire operating range. When the driver is not directly coupled to the compressor, due consideration will be made for losses in power transmission, in addition to the above margin.

3.10

Velocity of air in the air piping shall be limited from 6 to 9 m/sec.

3.11

Velocity of water flow shall be limited to 2.5 m/sec and for gravity flow the same shall be limited to 1.5 m/sec.

3.12

For calculating friction loss in piping system: WILLIAM & HAZEN formula shall be used with C value as 100.

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3.13	Noise level of compressors not to exceed 90 dBA to a reference of 0.0002 microbar when measured at a distance of 1.5 m above the floor in elevation and at a distance of 1 m horizontally from the nearest surface of compressor.		
3.14	Compressors to be designed for Continuous, Load-Unload and On-Off mode operation.		
3.15	Satisfactory operation in parallel shall be ensured without any uneven load sharing, undue vibration, noise etc.		
4.	OIL FREE MULTISTAGE SCREW TYPE COMPRESSORS		
4.1	AIR COMPRESSOR SHALL COMPLY WITH THE FOLLOWING REQUIREMENTS.		
4.1.1	Design / Construction		
	i) Compression chamber Wall thickness to withstand maximum design pressure.		
	ii) Casing with a large inlet port for fast filling and low air velocity.		
	iii) To provide suitable arrangement for cleaning of the cooling water jackets during maintenance of compressor.		
	iv) Dynamically balanced, one piece Rotors with a symmetric profile, to keep leakage losses to a minimum and ensure high efficiency.		
	v) Rotor shaft mounted, oil lubricated, highly precise timing gear shall be designed to counteract the axial forces incurred in compression.		
	vi) Life of Oil lubricated anti-friction type bearing be at least 8000 running hours.		
	vii) Shaft Seals of floating restrictive ring type design.		
	viii) The shaft seal rings and retainers shall be free for radial self-adjustment on the rotor shafts.		
	ix) Minimum design service factor for the integral, oil lubricated type, step-up Gear Box shall be of 1.5.		
	x) To provide safety valves on low pressure and high pressure stages.		
	xi) A direct driven positive displacement type oil pump connection to the main drive shaft is preferred. Alternatively a separate motor driven oil pump be provided.		
	xii) The lubrication system to include oil pump, oil filter, oil cooler and oil tank / sump.		
	xiii) Cooling shall be by closed circuit Demineralised water.		
	xiv) Compressor shall be directly coupled with constant speed squirrel cage induction motor conforming to the technical specification attached elsewhere.		
4.1.2	Material of construction		
	The materials of various components shall conform to the applicable BIS / BS / ASTM / DIN standard or any other reputed standards.		
	i) Compressor chamber: Cast iron coated with corrosion resistant material.		
	ii) Rotors: Forged carbon steel coated with corrosion resistant material		

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	iii) Timing Gear: Low, Alloy Steel.
	iv) Inlet throttle valve & Housing: Aluminium
	v) Shaft Seals: High, Alloy Steel.
	vi) Safety valves: Brass
	vii) Water separator: Cast Iron
	viii) Non-return valves: Stainless steel spring loaded type.
	ix) Blow off valve: Stainless steel.
	x) Unloading Cylinder header: Aluminium
	xi) Tube of Blow off cooler / oil cooler: SS 304
	xii) Outer casing of coolers: Carbon Steel
	xiii) Gear box: Cast Iron
	xiv) Gears: Alloy Steel.
	However, Material of Construction of components of Screw Compressor of reputed manufacturer shall also be acceptable subject to BHEL/Customer's approval.
4.1.3 A	Accessories Each compressor skid to include Suction filter, silencer, intercooler & After cooler with moisture separators, automatic drain traps, instruments, control panel Base plate, coupling guard. Foundation bolt, nuts, anti vibration pads, Eye bolts and operation and maintenance tools.
4.1.4	Control Philosophy i. Each compressor be operatable under continuous, auto, "Load-Unload" or "On - Off" mode (i.e.) "Dual control modes". ii. Any of the compressors shall be selectable at control panel to operate either for Base duty (Auto Load-Unload) or Standby duty (Auto On-Off) operation. iii. In "Base duty" mode, whenever air supply from compressors exceeds the demand, control system shall: a) Operate the load-unload circuit at a predetermined set pressure. b) Throttle the inlet valve. c) Open the blow off valve. Unloaded compressors to run in idling mode and when system pressure drops due to more demand, the load-unload circuit shall operate again to bring the compressor to 100% load after closing the blow-off valve. iv. In "Stand-by" duty the compressor shall automatically assist base load compressors during periods of peak air demand. When air pressure in the system reaches a pre-set lower limit, compressor shall be started to unloaded condition. After a suitable time delay, the compressor shall be fully loaded. v. When the pressure in the system rises to pre-set high value, the compressor shall be unloaded and shall run in idling mode for a specific period, (set by a timer), the compressor may be loaded to; full load in case of drop in system

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pressure or compressor may be stopped in case the system pressure does not drop and compressor continues to idle for more than a pre-set time.

vi.

The pressure and duration of time to be set shall be adjustable at site from the panel.

vii.

Further all inter locks for safe and proper operation of the compressors shall be provided by the Bidder.

viii.

All pressure and temperature conditions used for tripping the compressor shall be provided with pre-trip annunciation in the control panel.

ix.

Independent switches shall be used for alarms (annunciations) and tripping or interlock as far as possible.

x.

An electrically operated automatic valve shall be provided on cooling water supply line of each compressor which will automatically shut off the cooling water supply, in case compressor is not running for more than set time duration. Suitable interlock shall also be provided for opening the valve before starting of the compressor.

4.2

Intake Filter and Silencer

Intake Air Filter and Silencer shall be comply with the following requirements:

4.2.1

Performance

i.

Filtering efficiency minimum 99% down to 10 microns.

ii.

Maximum pressure drop across filter at design flow rate in new condition be 250 mm of water column.

iii.

Design Airflow rate corresponding to compressor airflow.

4.2.2

Quantity: One per compressor

4.2.3

Design air data

i.

Dust concentration:30 mg / M³

ii.

Particle size in microns: Up to 10 microns

4.2.4

Type/Design: Heavy duty type

4.2.5

Construction

i.

To provide densely packed, replaceable type paper as filtering media.

ii.

Filter to be designed to have sound suppressing characteristics.

iii.

Preferably Filter and silencer be combined type.

iv.

Filter to take suction from outside not from compressor room.

4.3

Inter Cooler & After Cooler

Inter cooler and After cooler shall comply with the following requirements:

4.3.1

Performance

i.

Outlet temperature of air from intercooler to suit the equipment offered.

ii.

Outlet temperature of air After cooler to be limited to 10 Deg.C of inlet cooling water temperature.

4.3.2

Type: Shell and tube type

4.3.3

Construction

i.

Design code: TEMA class “C” or equivalent.

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ii.

With removable tube bundle type.

iii.

With internal baffling.

iv.

Design pressure in airside: 2 Kg / Cm² more than air inlet pressure.

v.

Design pressure in waterside: Not less than shut off head of DM cooling water pump.

4.3.4

Material

i.

Tube

:

Admiralty brass or Aluminium brass or SS 304.

ii.

Shell

:

SA 285 Gr.C or equivalent

iii.

Tube sheet:

SA 285 Gr.C or equivalent

iv.

B affle

:

Carbon steel

v.

Flanges

:

Steel IS 2862.

4.3.5

Accessories

i.

To provide necessary vent & drain connections.

ii.

Moisture separation units with level gauge.

iii.

Automatic drain trap stations with bypass & isolating valves for moisture separators.

iv.

Safety valves

v.

Lifting eye bolts, tools & tackles if any.

4.3.6

Additional Data

After coolers are not to be fitted with instrument air compressors if bidder offers "Heat of c ompression" type air drying plants and the s ame s hall be provided at down stream of ADP.

5.

RECIPROCATING OIL FREE COMPRESSOR

5.1

Each of the Compressors shall comprise but not be limited to the following:

5.1.1

LP an d HP c ylinders as req uired to mee t the compressor ra ting, inte rcoolers, automatic drain trap station, relief valves and other accessories.

5.1.2

Drive machinery including drive motor and accessories.

5.1.3

Frame lubrication system, complete with protective devices and instruments.

5.1.4

After cooler and moisture separator both complete with automatic trap station, relief valves and other accessories and instruments .

5.1.5

Air intake filter and silencer unit

5.1.6

Set of local instruments as applicable

5.1.7

Set of cooling water control valves.

5.1.8

Set of foundation bolts, nuts etc. for compressors, motors, after coolers, suction filters etc.

5.1.9

Control panel comprising of all relays, contactors, solenoid valves, pressure switches, instruments, pneumatic impulse air tubing annunciation window selector switches etc.

5.1.10

Flow indicator of jacket cooling water after the inter and after coolers

5.1.11

Relief valves o n the ins trument and service a ir h eaders and also after the interconnection header between SA and IA headers.

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5.1.12

Instruments like pressure / temperature gauges and switches as required for the following:-

i. Pressure switches

a) Compressor lube oil pressure low alarm

b) Compressor lube oil pressure very low trip

c) To load the compressor

d) To unload the compressor

e) To start the compressor

f) To stop the compressor

g) Low water pressure alarm on common water inlet heater of the Compressor.

h) Very low water pressure trip on common water inlet heater of the Compressor.

ii. Temperature switches

a) Air after after-cooler high alarm

b) Air after after-cooler very high trip

c) Compressor cylinder water outlet temperature high alarm

d) Compressor cylinder water outlet temperature very high trip.

iii. Pressure gauges

a) After compressor inter-cooler

b) After compressor after-cooler

c) At water inlet common header of the compressors

iv. Temperature gauges

a) After cooler water outlet

b) After cooler air outlet

c) Inter cooler water inlet

d) Inter cooler air outlet

e) After air compressor cylinder jacket

5.1.13

Flow indicator of jacket cooling water after the inter and after coolers

5.1.14

Relief valves on the after coolers, inter coolers, instrument and service air headers and also after the inter connection headers between SA & IA headers, moisture separators etc.

5.1.15

Counter flanges, bolts, nuts and gaskets at all equipment/piping terminating points.

5.1.16

Base plate/plates, support plates, anchor bolts and nuts, inserts, lifting lugs, eye bolts, etc. as required.

5.1.17

Set of special tools and tackles including tools boxes.

5.1.18

Cleaning, protection and painting

5.1.19

Initial fill of lubricating oil for compressors and filtering media for all filters.

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5.2 CONSTRUCTION FEATURES

5.2.1 Air Compressors

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- i. Each compressor shall be multi stage, reciprocating, water cooled type. Compressor cylinder shall be closed grained cast iron conforming to IS:210 FG 260 or equivalent. The cylinder shall be provided with renewable liners or recording allowance as per API-015, 1974. The crankshaft and connecting rods shall be of forged steel conforming to IS:1875 or equivalent and statically and dynamically balanced. The service air compressors shall be lubricated / non lubricated type (as required in the data sheet A) whereas the instrument air compressors shall be non lubricated type and the air delivered by these instrument air compressors shall be completely free of any oil, grease and other impurities. To ensure, this the piston rings shall be of Teflon and no lubricating oil shall be used in the cylinder. Special care shall be taken to prevent any oil from finding its way into the cylinders from the crank case.
- ii. The piston rod packing shall also be of oil less self lubricating type. Any oil adhering to the piston rod shall be wiped off by suitable water rings. Suitable collar may also be fixed in the piston rod so that any trickling oil flow can be stopped from movement towards the cylinder.
- iii. The intake filters with built in silencers shall be of dry reusable type located at the air intake connection to low pressure cylinder to remove any carried solid particles in air.
- iv. Crank case shall be of rugged construction and shall have openings for access to all crank case machinery. A level indicator shall be provided for all crank case oil sump.
- v. Each compressor shall be driven preferably by direct coupled electric motors or otherwise through 'V' belt drives. The drive shall be provided with a safety guard.
- vi. Flywheels shall be provided, if required, and shall be of a adequate size to smoothen the effect of fluctuation of turning moment load during crank revolution.
- vii. Compressor valves shall have large effective areas permitting low velocities. In case of non lubricating type compressors, valves disc. Shall be either of stainless steel to AISI 316 or 15% chrome steel heat treated, tempered and ground. The valve seats and guards shall be case hardened and valve springs shall be of stainless steel. Self lubricating valve guides and wear strips shall be used for noiseless operation and long life. The tenderer shall offer his standard materials of construction for the valve for lubricated type of compressor.
- viii. To shut off cooling water flow through intercooler, compressor jacket and after coolers, operate lockable type gate valve (lockable in open position) shall be provided. These valves are to be shut off manually when required.
- ix. The crankshaft bearings shall be of antifriction type. A crankshaft driven positive displacement pump shall draw lubricating oil from the crankcase sump through a strained and shall provide for forced lubrication to all the bearings.
- x. The compressor lube oil pressure shall be built up within a predetermined time (adjusted by a timer) failing which the compressor shall automatically trip.
- xi. Provision shall be made for lubricating the parts where ever necessary to ensure smooth operation and freedom from undue wear.
- xii. Gear boxes and oil bath shall be provided with filling and drain plug of adequate size and shall also be provided with visual level indicators. Provision shall be made for efficient lubrication of all bearings, including ball and roller bearings by the use of separate grease cups, self sealing nipples of oil baths. No using of

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ball and roller bearings shall be packed at the time of assembly. Necessary provisions shall be made for preventing dust ingress into lubricated parts. A drawing showing all lubricant points and recommended lubrications to be used shall be supplied. The first fill of oil lubricant of correct grade shall be provided.

xiii. All lubrication systems fittings on all equipment supplied shall wherever possible be standardised. The grease nipples shall be of button head type or approved equal and shall conform to IS:4009.

xiv. The power ratings of the driver shall be selected such that the minimum margin of 15% is available over the power requirement to deliver rated capacity at rated pressure. When the drive is not directly coupled to the compressor, due account should be made for losses in power transmission in addition to the above margin. In case belt driven compressors, 5% belt loss should be considered over and above 15% spare margin in selecting the driven motor.

5.2.2 Inter Cooler, After Cooler and Moisture Separator

i. The intercooler shall be provided between the low and high pressure stages of the compressor. The after coolers and moisture separator shall be located between the compressor discharge and air receiver. Volume bottles shall be provided at LP cylinder discharge end and HP cylinder suction and discharge ends to take care of the pulsation or air flow. Both intercooler and after cooler shall be water cooled complete with standard accessories, such as safety valves moisture separator and automatic drain trap, bypass arrangement for automatic drain trap. The equipment shall be complete with the instrument mentioned elsewhere in this specification included in the scope of work. The inter cooler and after cooler shall be designed with adequate margin in heat transfer area. For design purpose a cleanliness factor of 0.85 shall be used in both cases.

ii. The after cooler shall be designed such that the temperature of air leaving is not more than 80 deg. C above the cooling water inlet temperature.

iii. Following material of construction shall be used.

a) Shell: ASTM A-285 Gr. C or approved / Equal

b) Tubes: Copper as per BS-378 or admiralty brass to ASTM B-111 type B.

c) Moisture separator: Galvanised, to prevent corrosion Internal.

iv. The lower portion of moisture separator shall be provided with the gauge glass. Pressure drop in intercooler, after-cooler & moisture separator, shall be kept to a minimum. Pressure parts shall be designed as per IS:2825 or as per ASME section VIII Div. 1 Design of coolers shall be as per TEMA class C.

v. Both intercooler and after cooler shall preferably be standardised in regard to tube material, tube outside diameter & tube length.

5.2.3 Oil Separator

i. In case compressed air is to be fed from the lubricated compressors to the pneumatic/control valves, then it would be desirable that the air is made oil free before it is fed to the pneumatic valves bypassing it through an air separator. (Please refer to data sheet A).

ii. The oil separator shall be constructed from carbon steel in accordance with pressure vessel codes like ASME Section VIII Div. 1 or IS 2525. The design pressure of this same shall be indicated in Data Sheet A. The oil separator shall be able to remove the oil in the condensed form by impingement on a cartridge of synthetic wool to a degree as specified in Data Sheet A.

iii. The design of the oil separator shall be such as to facilitate easy removal of the synthetic wool cartridge for cleaning. A drain valve shall also be provided.

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APPROVED By Anil Kumar Singh on 13.07.2018, Rev. 01, 2018	iv. The frequency at which the oil separator is to be drained and the time after which the synthetic wool should be either washed with a solvent or replaced shall be clearly indicated. 5.3 Control and Interlock Equipment 5.3.1 Compressor Capacity Control i. Control system for each compressor shall be to maintain receiver pressure within the specified limits by "Load/unload Control" or "on-off control" (i.e. dual control as per data sheet 'A' which are briefly described below:- ii. The loading/unloading of the compressor is to be actuated through pressure switches located on the outlet header of each compressor. The compressor(s), in this mode of control would run continuously at constant speed but would be loaded and unloaded in steps of 100, 50% and 0% by closing and opening of the respective suction valves. This is to be achieved by means of a selector switch, having two position viz "Auto" and "Mechanical". iii. In the auto position the control will be through electro pneumatic means i.e. pressure switches while in the mechanical position, the control shall be through adjustable spring loaded mechanical governors. iv. Normally the selector switch for control for all the compressors will be in the 'Auto' position and the mechanical position is only a standby arrangement. v. Another selector switch is to be provided for selecting the duty of the compressor viz. 'Main' or 'Standby' Duty. Depending upon the position selected in this selector switch, the compressor will run as a main compressor or be a standby. vi. In the ON-OFF mode of capacity control the compressor will always be loaded except during starting. The compressor is started automatically when the discharge header pressure falls below the set value by the pressure switch. The compressor is stopped when the discharge header pressure reaches upper set limit on another pressure switch. The first start of compressor will however, be manual. In the event of tripping of compressor on fault or manually, the compressor will not start automatically until the fault is reset and started manually. 5.3.2 COMPRESSOR PROTECTION The control panel shall house an audio visual alarm system for each compressor in order to ensure safe operation of the compressors and to bring their abnormal operation to the notice of the operator. The items to be annunciated for IA & SA compressors shall include but not be limited to the following:- a) Receiver pressure high alarm b) Receiver pressure very high trip c) Receiver pressure low alarm d) Compressor lube oil pressure low alarm e) Compressor lube oil pressure very low trip f) Air temperature after aftercooler high alarm g) Air temperature after after-cooler very high trip h) Compressor cylinder water outlet temperature high alarm i) Compressor cylinder water outlet temperature very high trip.		
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	6. AIR RECEIVERS Air receivers shall comply with the following requirements.		

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6.1.1	Design		
	i.	Design pressure & temperature : 10 Kg/cm ² & 50 Deg.C.	
	ii.	Outdoor located, vertical cylindrical vessel.	
	iii.	Design code : ASME Sec. VIII Div 1 or IS:2825 & IS 7938.	
	iv.	Welded Construction : Longitudinal seam in adjacent sections shall not be in same line.	
	v.	To provide gasketted inspection manhole of minimum 500 diameter.	
		Opening shall not pierce any seam & shall be as far as possible away from any welded seam.	
6.1.2	Fabrication		
	i.	Welding as per relevant codes.	
	ii.	Filler material to have composition & structure as that of material welded.	
	iii.	Welding electrodes to be approved by Owner.	
	iv.	Electrodes to be dried before use.	
6.1.3	Accessories		
	i.	To provide Relief valves to suit compressor capacity and set pressure of the same at least 10% above working pressure.	
	ii.	The spring in relief valve shall not reset for any pressure more than 10% above or below the design set pressure.	
	iii.	Drain connection with automatic trap stations.	
6.1.4	Material		
		Shell End plates & flanges --- IS:2002 or Equivalent.	
7.	AIR DRYING PLANTS		
		Air Drying plants shall comply with the following requirements:	
7.1	Performance Requirements		
7.1.1	Normal flow rate:	To match compressor capacity.	
7.1.2		To be designed for continuous duty for dew point of outlet air at minus (-) 40 Deg.C at atmospheric pressure.	
7.1.3		Quality of dry outlet air to conform to Instrument society of American standard S7.3 "Quality Standard for Instrument Air".	
7.1.4		ADP to be placed upstream of the air receiver.	
7.2	Quantity		
7.2.1		One ADP for each air compressor.	
7.3	Type / Design		
7.3.1		"Heat of Compression type ADP" either "Conventional Type" or "Rotary Drum type".	
7.3.2		Drying by absorption method.	

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7.4	Construction of Conventional heat of Compression type ADP
7.4.1	Reactivation shall be by “Heat of Compression” method without any air purge loss. Hot unsaturated compressed air shall be used for regeneration of exhausted dessicant in case of “Heat of compression type ADP”.
7.4.2	With two adsorber tower per ADP for conventional type (One for drying while the other is under regeneration / standby modes).
7.4.3	Design drying cycle: 8 Hours.
7.4.4	Design regeneration cycle: Less than 8 hours including cooling period.
7.4.5	Indoor located.
7.4.6	With (minimum) 3 steps de-pressurisation.
7.4.7	To provide automatic tower change over control with provision for manual take over.
7.4.8	All pressure vessels to be designed as per IS:2825 or equivalent code.
7.4.9	All vessels to include required manholes / hand holes.
7.4.10	All hot vessels & pipelines to be insulated to restrict the outside temperature within 60 Deg.C with mineral wool (or equivalent), GI wire netting and aluminium cladding / over.
7.4.11	Quantity of dessicant to be calculated taking into account residual moisture content at the end of regeneration cycle. Design calculation with curves shall be submitted for approval of Owner.
7.4.12	Absorption capacity and density to be considered for silica gel shall not be more than 10% and 550 Kg/M ³ respectively. In case of activated alumina the same shall be 8% (max) and 900 Kg/M ³ (max.) respectively.
7.4.13	Minimum 20% of dessicant depth shall be provided as free board in adsorber vessels.
7.4.14	Adsorber vessels to be provided with suitable number of inspection / sight windows of peresplex for observation of adsorbent condition.
7.4.15	Dessicant filling and removal connection shall be provided.
7.4.16	Non-lubricated two way three way / four way valves ball valves with pneumatic actuators be provided.
7.4.17	In case of Heat of compression type adsorbers shall be sized so that even when the compressor is operating at 50 % capacity, complete regeneration shall be achieved within the cycle time.
7.4.18	Complete ADP equipments shall be preferably mounted on a skid.
7.4.19	Required sample connections in piping be provided for sampling of air at desired locations.
7.5	Accessories
7.5.1	Prefilters and After filters: 2x100% with automatic drain trap filter arrangement & with ceramic candle type elements.
7.5.2	Electric Heaters : 2x100% with thermostatic control for heater & facility for easy replacement of element.
7.5.3	To provide suitable solenoid valves for de-pressurisation and re-pressurisation of towers.
7.6	Material
7.6.1	Absorber vessels & its internals: MS Vessels as per IS; 2062 & Internals SS 304

	TECHNICAL SPECIFICATION COMPRESSED AIR SYSTEM	SPECIFICATION NO.PE-SS-EPC-555-A-001	
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		SECTION D	SUB-SECTION A8
		REV. 0	
		SHEET 13 OF 14	
7.6.2	Regeneration air cooler shell tube(if applicable): SA-285 Gr.C or equivalent		
7.6.3	Blower casing: carbon steel		
7.6.4	Blower blades & shaft:	Stainless steel	
7.6.5	Relief valves:	Brass or SS	
7.6.6	Tube of heat exchangers and Dehumidifier:	Aluminium brass or SS	
7.6.7	Shell & tube sheet for the above:	SA 285 Gr.C.	
7.6.8	Baffle: Carbon steel		
7.6.9	Dessicant: Silica gel / Activated Aluminium or as per manufacture's standard.		
7.7	Control philosophy		
7.7.1	Sequential operation o f the a dsorber to wers be controlled automatically with a provision for manual take over.		
7.7.2	Automatic operation of adsorber to wer u nder d rying, operation of the other tower under regeneration, c hange o ver of to wers, starting a nd s topping of blowers, slow depressurisation & re pressurisation of to wers etc. shall be timer controlled. During the process, in case, operation is taken over manually from the panel through push button or selector switch, the sequential operation shall start with the manual initiation for each of the steps.		
8.	INTER CONNECTING PIPING, FITTING AND VALVES		
	Inter c onnecting p iping, fittings a nd v alves s hall confirm to the follow ing requirements.		

	TECHNICAL SPECIFICATION COMPRESSED AIR SYSTEM	SPECIFICATION NO. PE-SS-EPC-555-A-001	
		VOLUME II B	
		SECTION D	SUB-SECTION A8
		REV. 0	
		SHEET 14 OF 14	
8.1	All interconnecting compressed air piping shall conform to IS: 1239 (Heavy Grade) or IS: 3589 Gr. 410 and galvanised as per IS : 4736.		
8.2	Fittings for a ir piping shall be conforming to IS: 1239/IS:1879 and Grade equivalent that of parent pipe Grade.		
8.3	Compressed air piping from air c ompressor to after c ooler and other lines handling hot air will be suitably insulated so as to restrict surface temperature to 60deg.C. The pipe joints will be screwed coupling type for sizes upto 50 NB and above 50 NB the same will be flanged.		
8.4	All cooling water piping will be M.S. conforming to IS: 1239 (Part-I) (Heavy Grade).		
8.5	For A ir line Ball V alves with St ainless Steel in ternals with T eflon s eat shall be provided. Ball valves upto 50 NB shall be of Forged Carbon Steel Body with screwed connections. Ball valves above 50 N B shall be o f Ca st Car bon Stee l Body with flanged connections.		
8.6	The check valves shall conform to IS: 3412.		
8.7	For water line Gate valves shall be p rovided. For size 50 NB an d smaller carrying water the same shall conform to IS:778 with gun metal body and trim and for above 50 NB with carbon steel body and internals.		
9.	INSTRUMENTATION (GENERAL)		
9.1	Detailed specification for the Ins trumentation s hall be r eferred in the c ontrol an d instrumentation section of this volume.		
9.2	The bidder shall include instruments / controls to facilitate safe, reliable and efficient operation for the system offered. The instrumentation control system offered by the bidder shall be subjected to approval of the Employer during detailed engineering.		
9.3	All Instrumentation and Control equipments required for Compressed air system such as prim ary and s econdary ins truments, control p anels / c abinets, cable etc. s hall meet the requirements specified in control and instrumentation section of the Volume.		
9.4	The protection and interlock system shall be subject to the approval of the Employer.		
9.5	All p ressure an d tempe rature c onditions used for tr ipping t he c ompressor s hall e provided with pre-trip annunciation in the control panel.		
9.6	Following general philosophy shall be followed regarding instrumentation.		
9.6.1	Pressure Indicators / Vacuum gauge: i. At inlet outlet of each compression stage (air line). ii. At inlet and outlet of cooling water header. iii. At inlet and outlet of (air line) each heat exchangers of compressors & air drying plant (in air side). iv. At inlet and outlet of each adsorber vessel. v. At each air receiver and at outlet header of compressor & air drying plant. vi. At inlet of each of the filters of compressors assembly and ADP system.		

	TECHNICAL SPECIFICATION COMPRESSED AIR SYSTEM	SPECIFICATION NO. PE-SS-EPC-555-A-001	
		VOLUME II B	
		SECTION D	SUB-SECTION A8
		REV. 0	
		SHEET 15 OF 14	
9.6.2	Pressure Switches (Individual for each function).		
	i. At inlet/outlet of each compressor stage of the compressor (for annunciation / interlock).		
	ii. At each air receiver for:		
	a) High/Low pressure alarm, for start/stop control.		
	b) For load/unload control.		
	c) At common discharge outlet of compressor & air drying plant (for alarm)		
	iii. At discharge of each compressor.		
9.6.3	Temperature Indicators		
	i. At inlet and outlet of each heat exchangers / coolers of compressor and air-drying plant in the lube oil, air & cooling water circuits.		
	ii. At inlet and outlet of electric heaters & exhaust (atmosphere) of regeneration air (for open through type ADP).		
	iii. At inlet and outlet of each adsorber vessel.		
	iv. At common discharge outlet of compressor & ADP.		
9.6.4	Temperature Switches / Temperature Controllers		
	i. At inlet and outlet of each heat exchangers / coolers of compressor and air drying plant in the air & cooling water and lube oil circuits for low & high alarms, trip & interlock.		
	ii. At outlet of electric heaters & exhaust of regeneration air (open through type ADP) for alarm & interlock.		
	iii. At discharge of each compressors (before air receiver).		
	iv. At common discharge outlet of air compressors & air-drying plant.		
10.	NOTE: In case of any ambiguity in this standard specification (Section -D) with the scope specified in Section-C, in that case Section-C shall be followed.		

	2 X 490 MW NCTPPP, DADRI, STAGE-II COMPRESSED AIR SYSTEM	SPECIFICATION NO. PE-TS-436-555-A001	
		VOLUME : II B	
		SECTION : E / ANNEXURE-I	
		REV 00	DATE: 19.03.18
		SHEET: 1 OF 1	

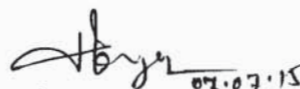
ANNEXURE-I **LIST OF MAKES OF SUB-VENDOR ITEMS**



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	
			Shakot	Noida	Twin Tower type	
2	AIR DRYING PLANT (REFRIGERANT TYPE)	I	ACIL	BELGIUM		
			MELLCON	Delhi		
			DELAIR	Gurgaon		
			SUMMITS	Coimbtore		
			Shakot	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) 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
			Jindal	Ghaziabad/Hissar	upto 350NB	
			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	


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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: GUN 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.	


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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	Jullundhar		
			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		


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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		
			KBL	Kondhapuri		
7	Butterfly Valve	II	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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CAS SUB-VENDOR LIST.xls

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)	Parvel		
			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		

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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 Techtrol 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		

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SL No	Item	QP / Insp.Cat	Proposed Subvendor	Place of Manufacturer	Technical Limit	Remarks
			Michell Instruments	UK		
			XENTAUR	USA		
			Shaw	UK		
20	Flow Meter / Rota Meter	III	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	Parvel		
			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		


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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		
			CHEENA 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	Ni/Cd 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	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		

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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		

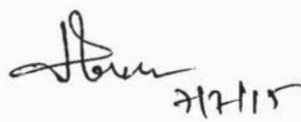
NOTES:

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.

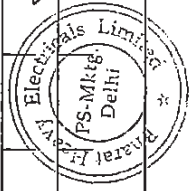
2) INSP CAT II : FOR THOSE ITEMS THE QUALITY PLANS ARE APPROVED BY CUSTOMER. HOWEVER NO PHYSICAL INSPECTION WILL BE DONE BY BHEL / CUSTOMER. THE FINAL ACCEPTANCE BY BHEL / CUSTOMER SHALL BE ON THE BASIS OF REVIEW OF DOCUMENTS AS PER QP.

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)

SR NO	ITEM	QP /INS- PN CAT *	QP NO.	QP SUB- MISSION APPL SCHEDULE	PROPOSED SUB SUPPLIER	PLACE	SS APPL STATUS / CAT	SS DETAIL SUB- SCHED ULE	SC APPL SCHED ULE	REMARKS
13	SCREENED CABLES	1			DELTON	FARIDABA D	A			
		1			THERMO CABLES	HYDERABA D	A			
		1			CORDS	BHIWADI /KAHARANI	A			
		1			POLYCAB	DAMAN	A			
		1			INCAB	PUNE	A			
		1			ELKAY TEELINKS	FARIDABA D	A			
		1			KEJ	BHIWADI	A			
		1			CMI	FARIDABA D	DR			
		1			RELANCE ENGRS LTD	BANGALOR E	DR*			
14	AUXILIARY CONTROL PANEL				REFER SEPARATE LIST					
15	LT MOTORS (Refer Note 1)	1			KEC	BANGALOR E/HUBLI	A			(HUBLI UPTO 90 KW ,RQP)For Flame Proof also
		1			NGEF	HUBLI	A			UP TO 15 KW ONLY.
		1			CGL	ALMEDNA GAR	A			RQP,For Flame Proof also
		1			MARATHON ELEC. INDIA LTD	KOLKATA	A			RQP,For Flame Proof also
		1			JYOTI	VADODARA	A			
		1			BBL	MUMBAI	A			RQP upto 160 KW only,For Flame Proof also
		1			LAXMI HYDRAULIC PVT. LTD	SHOLAPUR	A			upto 120 KW
		1			ABB	FARIDABA D/BANGAL ORE	A			RQP, Faridabad upto 55 KW Bangalore above 55



Signature

ENGINEERING DIV / QAI

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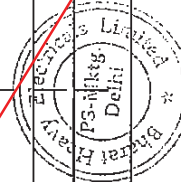
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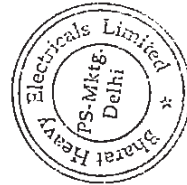
SR NO	ITEM	QP /INS -PN CAT	QP NO.	QP SUB-IP MISSION APPL SCHEDULE	PROPOSED SUB SUPPLIER	PLACE	SS APPL STATUS / CAT	SS DETAIL SUB- SCHED ULE	SC APPL SCHED ULE	REMARKS
15	LT MOTORS (Refer Note 1)	I			SIEMENS	MUMBAI	A			RQP
16	ELECTRICAL ACTUATOR(WITH GEAR BOX ALSO)	II	QVI-Q-078		HAROLD BECK	GERMANY	A			
		II			DREHMO	GERMANY	A			
		II			AUMA	GERMANY	A			
		II			ROTORK	CHENNAI/B ANGALORE	A			
		II			ROTORK	UK	A			
		II			NIPPON GEAR	JAPAN	A			
		II			LIMITORQUE	USA	A			
		II			LIMITORQUE	FARIDABA D	A			
		II			AUMA INDIA	BANGLORE	A			
17	CABLE TRAY & ACCESSORIES				REFER SEPARATE LIST					
18	FLEXIBLE CABLE TRAY SUPPORT				REFER SEPARATE LIST					
19	CABLE GLANDS				REFER SEPARATE LIST					
20	CABLE LUGS				REFER SEPARATE LIST					
21	GEARED MOTOR	III			KIRLOSKAR ELEC LTD	HUBLI/BAN GALORE	A			
		III			NEW ALLENBERY WORKS	KOLKATTA	A			
		III			SHANTI GEARS LTD	COIMBATO RE	A			
		III			POWER BUILD	VV NAGAR	A			
		III			LAXMI HYDRAULIC PVT. LTD	SHOLAPUR	A			



SR NO	ITEM	QP /INS- PN CAT	QP NO.	QP SUB- MISSION SCHEDULE	PROPOSED SUB SUPPLIER	PLACE	SS APPL STATUS / CAT	SS DETAIL SUB- SCHED ULE	SC APPL SCHED ULE	REMARKS
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.Note1 : a) Acceptance of Motor less than 30 KW is based on COC of the manufacturer and the contractor confirming as follows: It is hereby confirmed that the above mentioned motor /motors was/ were manufactured taking care of NTPC specific requirements regarding ambient temp. voltage and frequency variation, hot starts, pull out torque, starting KVA/KW, temp. rise, distance between centre of stud and gland plate and tested in accordance with approved drawing /data sheets b) 30 KW and above Acceptance of Motor rating between 30 KW 50 KW is based on NTPC review of Routine Test inspection report as per IS 325 witnessed by main contractor along with COC of the manufacturer and the contractor confirming as follows: It is hereby confirmed that the above mentioned motor /motors was/ were manufactured taking care of NTPC specific requirements regarding ambient temp., voltage and frequency variation, hot starts, pull out torque, starting KVA/KW, temp. rise, distance between centre of stud and gland plate, space heater and tested in accordance with approved drawing /data sheets.Above 50 KW up to 200 KW NTPC inspection as per approved QP Note 2: Misc Items like name plate ,wire marker,clamps and pads for thermocouple adaptor,union,cross,socket and plug ,pneumatic fittings tubes shall be as per BHEL system

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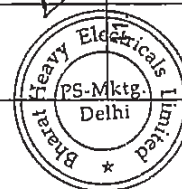
ANNEXURE-I

PROJECT: NORTH KARANPURA STPP (3X660 MW)		LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB- SUPPLIER APPROVAL					NTPC DOC NO	
PACKAGE: EPC PACKAGE		SUB SYSTEM: CIVIL WORKS					REV. NO.	
MAIN SUPPLIER: BHEL							DATE	
CONTRACT NO.: CS-4410-001-2							16.12.2013	
SR. NO.	ITEM	QAP / INSP. CAT	QAP NO.	PROPOSED SUB SUPPLIER	PLACE OF MANUFACTURING	APPROVAL STATUS / CATEGORY	REMARKS	
	PREPAINTED COIL COATED STEEL SYSTEM			INTERARCH	Noida	N		
				LLOYD INSULATION	-	N		
				MG INDUSTRIES	FARIDABAD	N		
				ARM STRONG	NEW DELHI	N		
				BERGER	-	N		
9.	PAIN	III	-	SHALIMAR PAINTS	-	N		
				JENSON AND NICHOLSON	-	N		
				KANSAL NEROLAC	-	N		
				AKZO NOBEL	-	N		
				ASIAN PAINTS	-	N		
10.	COLOUR COATED SHEET (FOR COIL)	I	-	UNION STEEL	KOREA	A		
				DONGBU STEEL	KOREA	A		
				BHUSHAN STEEL AND STRIPS LTD.	RAIGAD	A		
				ESSAR STEEL LTD	PUNE	A		
				NATIONAL STEEL AND AGRO	DHAR	A		
				JSW STEEL COATED PRODUCTS LTD	KAMLESHWAR	A	Formerly JSW ISPAT Steel Ltd	
				BHUSHAN STEEL LTD.	SAHIBABAD	A		
				JSW LTD	THANE	A		
				TATA BLUESCOPE STEEL LTD	JAMSHEDPUR	A	*AL-ZN COIL FOR CLADDING	
	PROFILERS FOR DECKING SHEETS	I		UNIMET PROFILES LIMITED	DHARUHERA	A		
				MULTICOLOUR STEEL INDIA LIMITED	GURGAON	A		
				ISOLLOYD	SOLAN	A		
				NATIONAL STEEL AND	DHAR	A		



APPENDIX B
PAGE 19 OF 29

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**SUB-VENDOR LIST FOR GAS SYSTEM-C&I
2X490 MW NATIONAL CAPITAL POWER STATION
(NCPS) DADRI**

Sl No	Package Code	Package Name	Supplier Name	Tech Limit
1	145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	DRESSER INDUSTRIES INC.	
2	145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	Barksdale GmbH, Germany	
3	145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	SWITZER PROCESS INSTRUMENTS PVT. LTD.	
4	145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	PRECISION MASS PRODUCTS PVT. LTD.	
5	145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	INDFOS INDUSTRIES LIMITED	
6	145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	GENERAL INSTRUMENTS CONSORTIUM	
7	145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	SOR INC.	
8	145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	INDFOS (INDIA) LIMITED	
9	145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	Kaustubha Udyog,	
10	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	H.GURU INDUSTRIES	
11	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	BOSE PANDA INSTRUMENTS PVT.LTD.	
12	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	A.N. INSTRUMENTS PVT. LTD.	
13	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	PRECISION MASS PRODUCTS PVT. LTD.	
14	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	Baumer Technologies India Pvt. Ltd.	
15	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	H.GURU INSTRUMENTS (SOUTH INDIA) P. LTD	
16	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	FORBES MARSHALL (HYD) LTD.	
17	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	GAUGE BOURDON INDIA PVT. LTD.	
18	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	
19	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	Nesstech Instruments Private Limited	
20	145-10000-A	TEMPERATURE GAUGE	FORBES MARSHALL (HYD) LTD.	
21	145-10000-A	TEMPERATURE GAUGE	GOA INSTRUMENTS INDUSTRIES PVT.LTD.,	
22	145-10000-A	TEMPERATURE GAUGE	H.GURU INSTRUMENTS (SOUTH INDIA) P. LTD	
23	145-10000-A	TEMPERATURE GAUGE	GAUGE BOURDON INDIA PVT. LTD.	
24	145-10000-A	TEMPERATURE GAUGE	H.GURU INDUSTRIES	
25	145-10000-A	TEMPERATURE GAUGE	GOA THERMOSTATIC INSTRUMENTS PVT.LTD.	
26	145-10000-A	TEMPERATURE GAUGE	A.N. INSTRUMENTS PVT. LTD.	
27	145-10000-A	TEMPERATURE GAUGE	Baumer Technologies India Pvt. Ltd.	
28	145-10000-A	TEMPERATURE GAUGE	PRECISION MASS PRODUCTS PVT. LTD.	
29	145-11000-A	LEVEL GAUGE	BLISS ANAND PVT. LTD.	

30	145-11000-A	LEVEL GAUGE	TOSHIWAL BROTHERS PVT.LTD.	MAKE:NIVO CONTROLS
31	145-11000-A	LEVEL GAUGE	SIGMA INSTRUMENTS CO.	
32	145-12000-A	FLOW ELEMENT	MICRO PRECISION PRODUCTS PVT. LTD.	
33	145-12000-A	FLOW ELEMENT	TM TECNOMATIC SPA	
34	145-12000-A	FLOW ELEMENT	STAR-MECH CONTROLS (I) PVT.LTD.	
35	145-12000-A	FLOW ELEMENT	INSTRUMENTATION LTD.	
36	145-13000-A	TEMP. ELEMENT	DETRIVE INSTRUMENTATION & ELECTRONICS LTD.	
37	145-13000-A	TEMP. ELEMENT	Thermal Instrument India Pvt. Ltd.	
38	145-13000-A	TEMP. ELEMENT	Tempsens Instrument (I) Pvt Ltd	
39	145-13000-A	TEMP. ELEMENT	PYRO ELECTRIC INSTRUMENTS GOA PVT.LTD.	
40	145-13000-A	TEMP. ELEMENT	TECHNO INSTRUMENTS	
41	145-13000-A	TEMP. ELEMENT	Baumer Technologies India Pvt. Ltd.	
42	145-13000-A	TEMP. ELEMENT	TM TECNOMATIC SPA	
43	145-13000-A	TEMP. ELEMENT	TOSHIWAL INDUSTRIES PVT. LTD.,	
44	145-13000-A	TEMP. ELEMENT	GOA INSTRUMENTS INDUSTRIES PVT.LTD.,	
45	145-13000-A	TEMP. ELEMENT	GAUGE BOURDON INDIA PVT. LTD.	
46	145-13000-A	TEMP. ELEMENT	Nesstech Instruments Private Limited	
47	145-13000-A	TEMP. ELEMENT	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	
48	145-14000-A	TRANSMITTERS	ABB LIMITED	PRESSURE TRANSMITTER, DP TRANSMITTER and TEMP TRANSMITTER
49	145-14000-A	TRANSMITTERS	Pune Techrol Pvt. Ltd.	Only for capacitance Type Level Transmitter
50	145-14000-A	TRANSMITTERS	V. AUTOMAT & INSTRUMENTS (P) LTD.	a)DISPLACEMENT TYPE TRANSMITTERS. b)PRESSURE AND DP TRANSMITTERS
51	145-14000-A	TRANSMITTERS	Moore Industries International Inc.	
52	145-14000-A	TRANSMITTERS	PANAM ENGINEERS	For Pressure and Diff. Pressure transmitter
53	145-14000-A	TRANSMITTERS	TOSHIWAL INDUSTRIES PVT. LTD.,	
54	145-14000-A	TRANSMITTERS	Endress + Hauser (India) Pvt. Ltd.,	
55	145-14000-A	TRANSMITTERS	YOKOGAWA INDIA LIMITED,	
56	145-14000-A	TRANSMITTERS	SBEM PVT. LTD.	FOR CAPACITANCE TYPE.
57	145-14000-A	TRANSMITTERS	SIEMENS LIMITED	
58	145-14000-A	TRANSMITTERS	EMERSON PROCESS MANAGEMENT (INDIA) PVT.LTD.	
59	145-14000-A	TRANSMITTERS	SMART INSTRUMENTS LTD, BRAZIL	LD-301 & T-301 TRANSMITTER FROM M/S SMART EQUIPMENTS BRAZIL.
60	145-14000-A	TRANSMITTERS	NIVO CONTROLS PVT. LTD.	For Capacitance type only
61	145-14000-A	TRANSMITTERS	Honeywell Automation India Limited	
62	145-25000-A	JUNCTION BOX	Shrenik & Company,	

63	145-25000-A	JUNCTION BOX	SUCHITRA INDUSTRIES		
64	145-25000-A	JUNCTION BOX	FLEXPRO ELECTRICALS PVT. LTD.		Metal type junction box only
65	145-25000-A	JUNCTION BOX	K.S.INSTRUMENTS PVT.LTD.		
66	145-25000-A	JUNCTION BOX	AJmera INDUSTRIAL & ENGINEERING WORKS		
67	145-32000-A	INSTRUMENTS TUBE FITTINGS	VIKAS INDUSTRIAL PRODUCTS		
68	145-32000-A	INSTRUMENTS TUBE FITTINGS	Fluid Controls Pvt. Ltd.		
69	145-32000-A	INSTRUMENTS TUBE FITTINGS	AURA INCORPORATED		
70	145-32000-A	INSTRUMENTS TUBE FITTINGS	PRECISION ENGINEERING INDUSTRIES		
71	145-38000-A	INSTRUMENTS PIPE FITTINGS	VIKAS INDUSTRIAL PRODUCTS		
72	145-38000-A	INSTRUMENTS PIPE FITTINGS	Fluid Controls Pvt. Ltd.		
73	145-38000-A	INSTRUMENTS PIPE FITTINGS	PRECISION ENGINEERING INDUSTRIES		
74	145-38000-A	INSTRUMENTS PIPE FITTINGS	AURA INCORPORATED		
75	145-42000-A	UL TRASONIC FLOW METERS	CHEMTROLS INDUSTRIES PVT. LTD.		For Flexim Fluxus non-invasive ultrasonic flowmeter only;
76	145-42000-A	UL TRASONIC FLOW METERS	Rockwin Flowmeter India Pvt. Ltd.		
77	145-42000-A	UL TRASONIC FLOW METERS	FLASH FORGE PVT LTD		
78	145-42000-A	UL TRASONIC FLOW METERS	NIVUS GMBH		
79	145-45000-A	INSTRUMENT FITTINGS	Perfect Instrumentation Control (India) Pvt. Ltd.		
80	145-45000-A	INSTRUMENT FITTINGS	Arya Crafts & Engineering Pvt. Ltd.		
81	145-45000-A	INSTRUMENT FITTINGS	Comfit & Valve Pvt. Ltd.		
82	145-45000-A	INSTRUMENT FITTINGS	HP VALVES & FITTINGS INDIA PVT. LTD.		
83	145-45000-A	INSTRUMENT FITTINGS	AURA INCORPORATED		
84	145-45000-A	INSTRUMENT FITTINGS	PRECISION ENGINEERING INDUSTRIES		
85	145-45000-A	INSTRUMENT FITTINGS	FLUIDFIT ENGINEERS PVT. LTD.		
86	145-45000-A	INSTRUMENT FITTINGS	VIKAS INDUSTRIAL PRODUCTS		
87	145-45000-A	INSTRUMENT FITTINGS	Fluid Controls Pvt. Ltd.		
88	145-45000-A	INSTRUMENT FITTINGS	PANAM ENGINEERS		
89	145-47000-A	ELECTROMAGNETIC FLOW METER	Electronet Equipments Pvt Ltd.		
90	145-47000-A	ELECTROMAGNETIC FLOW METER	Adept Fluidyne Pvt. Ltd.		
91	145-47000-A	ELECTROMAGNETIC FLOW METER	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,		
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NOTES: i) The above sub-vendor list is tentative & for reference only. However Sub-Vendor List is subject to BHEL/ end user approval without any commercial/ delivery implication. ii) New Sub-Vendor if proposed by Vendor during contract stage shall be subject to BHEL/ end user approval without any commercial/ delivery implication.					
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2 X 490 MW NCTPPP, DADRI, STAGE-II

COMPRESSED AIR SYSTEM

SPECIFICATION NO. PE-TS-436-555-A001

VOLUME : II B

SECTION : E / ANNEXURE-III

REV 00

DATE: 19.03.18

SHEET: 1 OF 1

ANNEXURE-III

PAINTING & COLOUR SCHEME

	2 X 490 MW NCTPPP, DADRI, STAGE-II COMPRESSED AIR SYSTEM	SPECIFICATION NO. PE-TS-436-555-A001	
		VOLUME : II B	
		SECTION : E / ANNEXURE-IV	
		REV 00	DATE: 19.03.18
		SHEET: 1 OF 1	

ANNEXURE-IV **LIST OF TOOLS & TACKLES**

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES	एनटीपीसी NTPC
3.00.00	COMPRESSED AIR SYSTEM a) Two (2) numbers (1 working+ 1 standby) oil free, rotary screw type air compressors for Instrument air and service air applications for FGD and ZLD plant (if provided) each of adequate capacity & adequate pressure, with their motor drives and other accessories as per equipment sizing criteria mentioned in Part A, Sub-section 'Salient design data' of technical specification. However, minimum capacity of each air compressor shall be 15Nm³/min at discharge pressure of 8.5 Kg/cm² (g). b) Two (2) numbers (1 working+ 1 standby) Air Drying Plants (one for each air compressor) of adequate capacity with all interconnecting piping, valves, fittings, etc. c) Two number Air Receiver each of capacity 2 m³ (normal) at the discharge of each Air compressor. d) One number Air Receiver of capacity 2m³(normal) for ZLD plant if ZLD plant is far away from compressor location. g) Monorail with Chain pulley block of minimum 2 tons or 125% of heaviest parts of equipment to be lifted whichever is more. h) Complete instruments, control system with panels as required for compressed air system. i) Complete compressed air and piping network for service air and instrument air application in FGD and ZLD system (if provided). Separate piping network for Service Air and Instrument Air shall be provided. j) Supply of Mandatory spares as specified. k) Any additional items required to make the system complete.	
4.00.00	General i. All associated Civil & structural work for air conditioning and Ventilation system and compressed air system. ii. Set of commissioning spares as may be required during erection and commissioning. iii. One (1) set Special tools and tackles required for maintenance of all the Mechanical, Electrical and C & I equipment under the scope of bidder. iv. All steel / cast iron inserts, plates, bolts, nuts, sleeves, metallic-fasteners etc. to be grouted in concrete work and used to hold/ support the equipment/piping / ducting being supplied and erected under this specifications. v. Any additional items required to make the system complete. vi. Initial charge of all lubricants and grease, etc. Further, all consumables required for PG tests shall also be in Bidder's scope of supply. Grouting, dressing and final finishing of all foundations of various equipment, etc.	
NCTPP, DADRI(2X490MW) IGSTPP JHAJJAR (3X500MW) FLUE GAS DESULPHURISATION (FGD)SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.: CS-6130/0330-109-9	SUB SECTION-III-A2 AIR CONDITIONING, VENTILATION SYSTEM & COMPRESSED AIR SYSTEM Page 3 of 4



2 X 490 MW NCTPPP, DADRI, STAGE-II
COMPRESSED AIR SYSTEM

SPECIFICATION NO. PE-TS-436-555-A001

VOLUME : II B

SECTION : E / ANNEXURE-V

REV 00

DATE: 19.03.18

SHEET: 1 OF 1

ANNEXURE-V

DM WATER ANALYSIS

CLAUSE NO.	PROJECT INFORMATION			एनटीपीसी NTPC																		
	Table-4 ANALYSIS OF DM WATER <table><tr><th>Sl.No.</th><th>Characteristics</th><th>Value</th></tr><tr><td>1.</td><td>Silica (Max.)</td><td>0.02 ppm as SiO2</td></tr><tr><td>2.</td><td>Iron as Fe</td><td>Nil</td></tr><tr><td>3.</td><td>Total hardness</td><td>Nil</td></tr><tr><td>4.</td><td>pH value</td><td>6.8 to 7.2</td></tr><tr><td>5.</td><td>Conductivity</td><td>Not more than 0.1 µs/cm</td></tr></table>				Sl.No.	Characteristics	Value	1.	Silica (Max.)	0.02 ppm as SiO2	2.	Iron as Fe	Nil	3.	Total hardness	Nil	4.	pH value	6.8 to 7.2	5.	Conductivity	Not more than 0.1 µs/cm
Sl.No.	Characteristics	Value																				
1.	Silica (Max.)	0.02 ppm as SiO2																				
2.	Iron as Fe	Nil																				
3.	Total hardness	Nil																				
4.	pH value	6.8 to 7.2																				
5.	Conductivity	Not more than 0.1 µs/cm																				
NCTPP,DADRI ST-II (2X490 MW) & IGSTPP,JHAJJAR(3X500MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO CS-6130/0330-109-9	SUB-SECTION-IIB PROJECT INFORMATION	PAGE 28 OF 32																		

	2 X 490 MW NCTPPP, DADRI, STAGE-II COMPRESSED AIR SYSTEM	SPECIFICATION NO. PE-TS-436-555-A001	
		VOLUME : II B	
		SECTION : E / ANNEXURE-VI	
		REV 00	DATE: 19.03.18
		SHEET: 1 OF 1	

ANNEXURE-VI **DRAWINGS / DOCUMENTS SUBMISSION** **PROCEDURE**

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS (Annexure-VI)																																																																					
	<table border="1"> <thead> <tr> <th>S.No</th><th>Description of Drgs/Docs</th><th>No of Prints</th><th>No of ROMs/DVDs/Portable Hard Disk</th><th>CD</th></tr> </thead> <tbody> <tr> <td rowspan="8">1</td><td>Drawings, Data sheets, Design calculations, Purchase specifications and other documents</td><td></td><td></td><td></td></tr> <tr> <td>First submission and submission with major changes</td><td></td><td></td><td></td></tr> <tr> <td>▪ Layout (A0&A1 sizes)</td><td>4</td><td>-</td><td></td></tr> <tr> <td>▪ Other Drawings/Documents (A0&A1 sizes)</td><td>2</td><td>-</td><td></td></tr> <tr> <td>▪ P&ID (All sizes)</td><td>4</td><td>-</td><td></td></tr> <tr> <td>a) Final drawings/documents (Directly to site)</td><td>6</td><td>2</td><td></td></tr> <tr> <td>b) "As Built" Drawing/Documents (Directly to site)</td><td>6</td><td>2</td><td></td></tr> <tr> <td>c) Analysis reports of Equipments / piping /structures components/system employing software packages as detailed in the specifications.</td><td>2</td><td>2</td><td></td></tr> <tr> <td>2</td><td>Erection Manual (Directly to site)</td><td>4 sets</td><td>2</td><td></td></tr> <tr> <td rowspan="2">3</td><td>Operation & Maintenance manual i) First Submission</td><td>1 set</td><td>--</td><td></td></tr> <tr> <td>ii) Final Submission (Directly to site)</td><td>4 sets</td><td>2</td><td></td></tr> <tr> <td rowspan="2">4</td><td>Plant Hand Book i) First Submission</td><td>1</td><td>1</td><td></td></tr> <tr> <td>Commissioning and Performance Test Procedure manual i) First Submission</td><td>1 set</td><td>--</td><td></td></tr> <tr> <td>5</td><td>ii) Final Submission (Directly to site)</td><td>4 sets</td><td>2</td><td></td></tr> </tbody> </table>				S.No	Description of Drgs/Docs	No of Prints	No of ROMs/DVDs/Portable Hard Disk	CD	1	Drawings, Data sheets, Design calculations, Purchase specifications and other documents				First submission and submission with major changes				▪ Layout (A0&A1 sizes)	4	-		▪ Other Drawings/Documents (A0&A1 sizes)	2	-		▪ P&ID (All sizes)	4	-		a) Final drawings/documents (Directly to site)	6	2		b) "As Built" Drawing/Documents (Directly to site)	6	2		c) Analysis reports of Equipments / piping /structures components/system employing software packages as detailed in the specifications.	2	2		2	Erection Manual (Directly to site)	4 sets	2		3	Operation & Maintenance manual i) First Submission	1 set	--		ii) Final Submission (Directly to site)	4 sets	2		4	Plant Hand Book i) First Submission	1	1		Commissioning and Performance Test Procedure manual i) First Submission	1 set	--		5	ii) Final Submission (Directly to site)	4 sets	2	
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				PAGE 81 OF 83																																																																		

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS (Annexure-VI)			एनटीपीसी NTPC																																																												
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		VOLUME : II B	
		SECTION : E / ANNEXURE-VII	
		REV 00	DATE: 19.03.18
		SHEET: 1 OF 1	

ANNEXURE-VII INSPECTION AND TESTING

	TITLE	PE-TS-436-555-A001	
		REV	00
INSPECTION AND TESTING		SHEET	1 OF 2
1.00.00	INSPECTION AND TESTING		
1.01.00	Inspection and Tests during Manufacture.		
1.01.01	The method and techniques to be used by the Bidder for the control of quality during manufacture of all plant and equipment shall be agreed with the Owner.		
1.01.02	The Owner's general requirements with respect to quality control and the required shop tests are set out elsewhere in this specification.		
1.01.03	Before any item of plant or equipment leaves its place of manufacture the Owner shall be given the option of witnessing inspections and tests for compliance with the specification and related standards.		
1.01.04	Advance notice shall be given to the Owner as agreed in the Contract, prior to the stage of manufacture being reached, and the piece of plant must be held at this stage until the Owner has inspected the piece, or has advised in writing that inspection is waived. If having consulted the Owner and given reasonable notice in writing of the date on which the piece of plant will be available for inspection, the Owner does not attend the Bidder may proceed with manufacture having forwarded to the Owner duly certified copies of his own inspection and test results.		
	The owner's representative shall have at all reasonable times access to bidder's or his sub-vendor's premises and shall have power to inspect/ examine materials and workmanship or equipment under manufacture.		
	The Bidder shall forthwith forward to the engineer duly certified copies of the Test Certificates in six copies (one to the Purchaser and five to the Consulting Engineer) for approval. Further nine (9) copies of Shop Test Certificates shall be bound with Instruction Manuals referred to elsewhere.		
	For electrical equipment, routine tests as per relevant IS spec are to be carried out on all equipment. Type tests are also to be carried out on selected equipment as detailed in the specs of concerned electrical equipment.		
1.01.05	Under no circumstances any repair or welding of castings be carried out without the consent of the Engineer. Proof of the effectiveness of each repair by radiographic and/or other non-destructive testing technique, shall be provided to the Engineer.		
1.01.06	All the individual and assembled rotating parts shall be statically and dynamically balanced in the works. Where accurate alignment is necessary for component parts of machinery normally assembled on site, the Bidder shall allow for trial assembly prior to despatch from place of manufacture.		
1.01.07	All materials used for the manufacture of equipment covered under this specification shall be of tested quality. Relevant test certificates shall be made available to the Purchaser. The certificates shall include tests for mechanical properties and chemical analysis of representative material. Equipment or parts coming under any statutory Regulations shall be certified by a Competent Authority under the regulations in the specified format.		

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	TITLE	PE-TS-427-555-A001	
		REV	00
INSPECTION AND TESTING			
		SHEET	2 OF 2
1.01.08	All pressure parts connected to pumping main shall be subjected to hydraulic testing at a pressure of 150% of shut-off head for a period not less than one hour. Other parts shall be tested for one and half times the maximum operating pressure, for a period not less than one hour.		
1.01.09	All necessary non-destructive examinations shall be performed to meet the applicable code requirements.		
1.01.10	All welding procedures adopted for performing welding work shall be qualified in accordance with the requirements of Section-IX of ASME code or IBR as applicable. All welded joints for pressure parts shall be tested by liquid penetrant examination according to the method outlined in ASME Boiler and Pressure Vessel code. Radiography, magnetic particle examination magnuflux and ultrasonic testing shall be employed wherever necessary/ recommended by the applicable code. At least 10% of all major but welding joints shall be radiographed unless otherwise stipulated. Statutory payments in respect of IBR approvals including inspection shall be made by the bidder. Bidder's scope shall include to preparation of all necessary documents, co-ordination and follow-up for above approval. Owner shall only forward assistance/endorsement of documents /design /drawings /reports/records to be submitted for approval as stipulated/ required by Statutory Authorities till registration of the unit and clearance for commercial operation.		
1.02.00	Performance Tests at Site		
1.02.01	The full requirements for testing the system shall be agreed between the Owner and the Bidder prior to Award of Contract. The completely erected System shall be tested by the Bidder on site under normal operating conditions. The Bidder shall also ensure the correct performance of the System under abnormal conditions, i.e. the correct working of the various emergency and safety devices, interlocks, etc.		
1.02.02	The Bidder shall provide complete details of his normal procedures for testing, for the quality of erection and for the performance of the erected plant. These tests shall include site pressure test on all erected pipe work to demonstrate the quality of the piping and the adequacy of joints made at site.		
1.02.03	The Bidder shall furnish the quality procedures to be adopted for assuring quality from the receipt of material at site, during storage, erection, pre-commissioning to tests on completion and commissioning of the complete system/equipment.		
1.03.00	For details of specific tests required on individual equipment refer to respective section of this specification. All Statutory testing / clearance is in Bidder's scope including payment of all fees, etc. as required		

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ANNEXURE-III

		Project : _____		Stage : _____		LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB-SUPPLIER APPROVAL					DOC. NO.:	
		Package Supplier Contractor No. : _____									REV. NO.:	
											DATE : _____	
						SUB-SYSTEM :					PAGE : _____ OF _____	
S. N.	Item	QP/ Insp. Cat.	QP No.	QP Sub. Schedule	QP approval schedule	Proposed sub-supplier	Place	Sub-suppliers approval status / category	Sub-supplier Details on schedule	Remarks		

LEGENDS
SYSTEM SUPPLIER/SUB-SUPPLIER APPROVAL STATUS CATEGORY (SHALL BE FILLED BY NTPC)
A – For these items proposed vendor is acceptable to NTPC. To be indicated with letter “A” in the list alongwith the condition of approval, if any.
DR – For these items “Detailed required” for NTPC review. To be identified with letter “DR” in the list.
NOTED – For these items vendors are approved by Main Supplier and accepted by NTPC without specific vendor approval from NTPC. To be identified with “NOTED.”
QP/INSPN CATEGORY:
CAT-I : For these items the Quality Plans are approved by NTPC and the final acceptance will be on physical inspection witness by NTPC.
CAT-II : For these items the Quality Plans approved by NTPC. However no physical inspection shall be done by NTPC. The final acceptance by NTPC shall be on the basis review of documents as per approved QP.
CAT-III : For these items Main Supplier approves the Quality Plans. The final acceptance by NTPC shall be on the basis certificate of conformance by the main supplier.
UNITS/WORKS : Place of manufacturing Place of Main Supplier of multi units/works.

FORMAT NO.: QS-01-QAI-P-1/F3-R0 1/1 Engg. Div. / QA&I

NCTPP DADRI(2X490MW) & IGSTPP JHAJJAR (3X500MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC.NO.:CS-6130/0330-109-9	GENERAL TECHNICAL REQUIREMENT	PAGE 78 OF 83
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	2 X 490 MW NCTPPP, DADRI, STAGE-II COMPRESSED AIR SYSTEM	SPECIFICATION NO. PE-TS-436-555-A001	
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		SECTION : E / ANNEXURE-VIII	
		REV 00	DATE: 19.03.18

ANNEXURE-VIII

MASTER DRAWING LIST WITH SCHEDULE OF SUBMISSION

MDL FOR CAS PACKAGE FOR 2 X 490 MW NCTPPP, DADRI, STAGE-II

PROJECT	SURATGARH STPS	PACKAGE-COMPRESSED AIR SYSTEM	NOA DATE	"G" NAME OF BOI	"H" SCHEDULED SUBMISSION (NO. OF WEEKS FROM LOA DATE/SCH PO DATE)(*)	"I" SCH_SUB_DATE (DD-MON-YYYY)	"J" SCH_APPL_DATE (DD-MON-YYYY)
"A" S NO	"B" VENDOR_DRG_NO.	"D" DRAWING TITLE	"E" PURPOSE				
1	PE-V0-436-555-A001	QUALITY PLAN OF AIR COMPRESSOR FOR FGD COMPRESSED AIR SYSTEM	A-CUST	CAS	2		
2	PE-V0-436-555-A002	QUALITY PLAN OF AIR DRYING PLANT FOR FGD COMPRESSED AIR SYSTEM	A-CUST	CAS	2		
3	PE-V0-436-555-A003	QUALITY PLAN OF AIR RECEIVER FOR FGD COMPRESSED AIR SYSTEM	A-CUST	CAS	3		
4	PE-V0-436-555-A004	QUALITY PLAN OF MOTOR FOR FGD COMPRESSED AIR SYSTEM	A-CUST	CAS	3		
5	PE-V0-436-555-A005	TDS OF AIR COMPRESSOR FOR FGD COMPRESSED AIR SYSTEM	A-CUST	CAS	2		
6	PE-V0-436-555-A006	TDS OF AIR DRYING PLANT FOR FGD COMPRESSED AIR SYSTEM	A-CUST	CAS	2		
7	PE-V0-436-555-A007	TDS & CHARACTERISTIC CURVES OF MOTOR FOR FGD COMPRESSED AIR SYSTEM	A-CUST	CAS	3		
8	PE-V0-436-555-A008	TDS & GA OF VALVES FOR FGD COMPRESSED AIR SYSTEM	I-CUST	CAS	5		
9	PE-V0-436-555-A009	TDS OF PIPES & FITTINGS FOR FGD COMPRESSED AIR SYSTEM	I-CUST	CAS	5		
10	PE-V0-436-555-A010	TDS OF INSTRUMENTS FOR FGD COMPRESSED AIR SYSTEM	I-CUST	CAS	5		
11	PE-V0-436-555-A011	GA DRAWING OF AIR COMPRESSOR FOR FGD COMPRESSED AIR SYSTEM	I-CUST	CAS	3		
12	PE-V0-436-555-A012	GA DRAWING OF AIR DRYER FOR FGD COMPRESSED AIR SYSTEM	I-CUST	CAS	3		
13	PE-V0-436-555-A013	GA DRAWING OF MOTOR FOR FGD COMPRESSED AIR SYSTEM	I-CUST	CAS	3		
14	PE-V0-436-555-A014	GA DRAWING OF AIR RECEIVER FOR FGD COMPRESSED AIR SYSTEM	I-CUST	CAS	3		
15	PE-V0-436-555-A015	COMPRESSOR HOUSE LAYOUT	A-CUST	CAS	4		
16	PE-V0-436-555-A016	P & I DIAGRAM OF AIR COMPRESSOR FOR FGD COMPRESSED AIR SYSTEM	I-CUST	CAS	2		
17	PE-V0-436-555-A017	P&I DIAGRAM OF AIR DRYER FOR FGD COMPRESSED AIR SYSTEM	I-CUST	CAS	2		
18	PE-V0-436-555-A018	P&I DIAGRAM OF FGD COMPRESSED AIR SYSTEM WITHIN COMPRESSOR HOUSE	A-CUST	CAS	3		
19	PE-V0-436-555-A019	OPERATION & CONTROL PHILOSOPHY OF FGD COMPRESSED AIR SYSTEM	A-CUST	CAS	6		
20	PE-V0-436-555-A020	ELECTRICAL & INTERNAL WIRING DIAGRAM FOR COMPRESSOR PANEL FOR FGD COMPRESSED AIR SYSTEM.	I-CUST	CAS	2		
21	PE-V0-436-555-A021	ELECTRICAL FEEDER LIST FOR FGD COMPRESSED AIR SYSTEM	I-G-P	CAS	3		
22	PE-V0-436-555-A022	CONTROL CABLE SCHEDULE FOR FGD COMPRESSED AIR SYSTEM	I-G-P	CAS	6		
23	PE-V0-436-555-A023	PG TEST PROCEDURE FOR FGD COMPRESSED AIR SYSTEM	I-CUST	CAS	7		
24	PE-V0-436-555-A024	O&M MANUAL-FGD COMP AIR SYSTEM	I-CUST	CAS	12		
25	PE-V0-436-555-A024A	ERECTION MANUAL-FGD COMP AIR SYSTEM	I-CUST	CAS	12		
26	PE-V0-436-555-A024B	COMMISSIONING MANUAL-FGD COMP AIR SYSTEM	I-CUST	CAS	12		
27	PE-V0-436-555-A025	QUALITY PLAN OF INSTRUMENTS FOR FGD COMPRESSED AIR SYSTEM	I-CUST	CAS	6		
28	PE-V0-436-555-A027	QUALITY PLAN OF BROUGHT OUT ITEMS (BOI) FOR FGD COMPRESSED AIR SYSTEM	I-CUST	CAS	6		
29	PE-V0-436-555-A029	SUB-VENDOR LIST WITH INSPECTION CATEGORISATION PLAN FOR FGD COMPRESSED AIR SYSTEM	A-CUST	CAS	1		
30	PE-V0-436-555-I003	I/O LIST OF PLC FOR FGD COMPRESSED AIR SYSTEM	A-CUST	CAS	6		



2 X 490 MW NCTPPP, DADRI, STAGE-II

COMPRESSED AIR SYSTEM

SPECIFICATION NO. PE-TS-436-555-A001

VOLUME : II B

SECTION : E / ANNEXURE-IX

REV 00

DATE: 19.03.18

SHEET : 1 OF 1

ANNEXURE-IX

FORMAT FOR PREPERATION OF ERECTION MANUAL AND OPERATION & MAINTENANCE MANUAL

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एन टी पी सी NTPC
8.03.02	scope of the bidder civil calculation sheets including structural analysis and design alongwith output results. xxvii) Underground facilities, levelling, sanitary, land scaping drawings. xxviii) Geotechnical investigation and site survey reports (if and as applicable). xxix) Model study reports wherever applicable. xxx) Functional & guarantee test procedures and test reports. xxxi) Documentation in respect of Quality Assurance System, and Documentation in respect of Commissioning, as listed out elsewhere in this specification. xxxii) Maintenance schedule for Absorber & auxiliaries clearly indicating interval, duration if shutdown required, manhours required and tools & tackles required for maintenance. The Contractor's while submitting the above documents/ drawings for approval/ reference as the case may be, shall mark on each copy of submission the reference letter alongwith the date vide which the submissions are made.			
	INSTRUCTION MANUALS The Contractor shall make first submission of instruction manual for all the equipments covered under the Contract as per agreed engineering information schedule. The Instruction manuals shall contain full details required for erection, commissioning, operation and maintenance of each equipment. The manual shall be specifically compiled for this project. After finalisation and approval of the Employer the Instruction Manuals shall be submitted as indicated in Annexure-IV. The Contract shall not be considered to be completed for purposes of taking over until the final Instructions manuals have been supplied to the Employer. The Instruction Manuals shall comprise of the following. A) ERECTION MANUALS The erection manuals shall be submitted atleast three (3) months prior to the commencement of erection activities of particular equipment/system. The erection manual should contain the following as a minimum. a) Erection strategy. b) Sequence of erection.			
NCTPP DADRI(2X490MW) & IGSTPP JHAJJAR (3X500MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-6130/0330-109-9	GENERAL TECHNICAL REQUIREMENTS	PAGE 9 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	c) Erection instructions. d) Critical checks and permissible deviation/tolerances. e) List of tool, tackles, heavy equipments like cranes, dozers, etc. f) Bill of Materials g) Procedure for erection and General Safety procedures to followed during erection/installation. h) Procedure for initial checking after erection. i) Procedure for testing and acceptance norms. j) Procedure / Check list for pre-commissioning activities. k) Procedure / Check list for commissioning of the system. l) Safety precautions to be followed in electrical supply distribution during erection. B) OPERATION & MAINTENANCE MANUALS a) The manual shall be a two rim PVC bound stiff sided binder able to withstand constant usage or where a thicker type is required it shall have locking steel pins, the size of the manual shall not be larger than international size A3. The cover shall be printed with the Project Name, Services covered and Volume / Book number Each section of the manual shall be divided by a stiff divider of the same size as the holder. The dividers shall clearly state the section number and title. All written instructions within the manual not provided by the manufacturers shall be typewritten with a margin on the left hand side. b) The arrangement and contents of O & M manuals shall be as follows: 1) Chapter 1 - Plant Description: To contain the following sections specific to the equipment/system supplied (a) Description of operating principle of equipment / system with schematic drawing / layouts.			
NCTPP DADRI(2X490MW) & IGSTPP JHAJJAR (3X500MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-6130/0330-109-9	GENERAL TECHNICAL REQUIREMENTS	PAGE 10 OF 83

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	(b) Functional description of associated accessories / controls. Control interlock protection write up. (c) Integrated operation of the equipment alongwith the intended system. (This is to be given by the supplier of the Main equipment by taking into account the operating instruction given by the associated suppliers). (d) Exploded view of the main equipment, associated accessories and auxiliaries with description. Schematic drawing of the equipment alongwith its accessories and auxiliaries. (e) Design data against which the plant performance will be compared. (f) Master list of equipments, Technical specification of the equipment/ system and approved data sheets. (g) Identification system adopted for the various components, (it will be of a simple process linked tagging system). (h) Master list of drawings (as built drawing - Drawings to be enclosed in a separate volume). 2) <u>Chapter 2.0 - Plant Operation</u>: To contain the following sections specific to the equipment supplied (a) Protection logics provided for the equipment alongwith brief philosophy behind the logic, Drawings etc. (b) Limiting values of all protection settings. (c) Various settings of annunciation/interlocks provided. (d) Startup and shut down procedure for equipment alongwith the associated systems in step mode. (e) Do's and Don'ts related to operation of the equipment. (f) Safety precautions to be take during normal operation. Emergency instruction on total power failure condition/lubrication failure/any other conditions. (g) Parameters to be monitored with normal value and limiting values. (h) Equipment isolating procedures.		
NCTPP DADRI(2X490MW) & IGSTPP JHAJJAR (3X500MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-6130/0330-109-9	GENERAL TECHNICAL REQUIREMENTS PAGE 11 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 		
	(i) Trouble shooting with causes and remedial measures. (j) Routine testing procedure to ascertain healthiness of the safety devices alongwith schedule of testing. (k) Routine Operational Checks, Recommended Logs and Records (l) Change over schedule if more than one auxiliary for the same purpose is given. (m) Preservation procedure on long shut down. (n) System/plant commissioning procedure. 3) <u>Chapter 3.0 - Plant Maintenance</u>- To contain the following sections specific to the equipment supplied. (a) Exploded view of each of the equipments. Drawings alongwith bill of materials including name, code no. & population. (b) Exploded view of the spare parts and critical components with dimensional drawings (In case of Electronic cards, the circuit diagram to be given) and spare parts catalogue for each equipment. (c) List of Special T/ P required for Overhauling /Trouble shooting including special testing equipment required for calibration etc. (d) Stepwise dismantling and assembly procedure clearly specifying the tools to be used, checks to be made, records to be maintained etc. Clearance to be maintained etc. (e) Preventive Maintenance schedules linked with running hours/calendar period alongwith checks to be carried out. (f) Overhauling schedules linked with running hours/calendar period alongwith checks to be done. (g) Long term maintenance schedules (h) Consumables list alongwith the estimated quantity required during normal running and during maintenance like Preventive Maintenance and Overhauling. (i) List of lubricants with their Indian equivalent, Lubrication Schedule including charts showing lubrication checking, testing and replacement procedure to be carried daily, weekly, monthly & at		
NCTPP DADRI(2X490MW) & IGSTPP JHAJJAR (3X500MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-6130/0330-109-9	GENERAL TECHNICAL REQUIREMENTS	PAGE 12 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एन टी पी सी NTPC
	longer intervals to ensure trouble free operation and quantity required for complete replacement. (j) Tolerance for fitment of various components. (k) Details of sub vendors with their part no. in case of bought out items. (l) List of spare parts with their Part No, total population, life expediency & their interchangeability with already supplied spares to NTPC. (m) List of mandatory and recommended spare list along with manufacturing drawings, material specification & quality plan for fast moving consumable spares. (n) Lead time required for ordering of spares from the equipment supplier, instructions for storage and preservation of spares. (o) General information on the equipment such as modification carried out in the equipment from its inception, equipment population in the country / foreign country and list of utilities where similar equipments have been supplied.			
8.03.03	After finalization and approval of the Employer, the O & M Manuals shall be submitted as indicated in Annexure-VI. The Contract shall not be considered to be completed for purposes of taking over until the final Instructions manuals (both erection and O & M manuals have been supplied to the Employer.			
	If after the commissioning and initial operation of the plant, the instruction manuals (Erection and /or O &M manuals) require modifications/additions/changes, the same shall be incorporated and the updated final instruction manuals shall be submitted by the Contractor to the Employer for records and number of copies shall be as mentioned in Annexure-VI.			
8.03.03	PLANT HANDBOOK AND PROJECT COMPLETION REPORT			
8.03.03.01	PLANT HANDBOOK			
	The Contractor shall submit to the Employer a preliminary plant hand book preferably in A-4 size sheets which shall contain the design and performance data of various plants, equipments and systems covering the complete project including i) Design and performance data. ii) Process & Instrumentation diagrams. iii) Single line diagrams.			
NCTPP DADRI(2X490MW) & IGSTPP JHAJJAR (3X500MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-6130/0330-109-9	GENERAL TECHNICAL REQUIREMENTS	PAGE 13 OF 83

Format for Operation & Maintenance Manual

Project name :

Project number :

Package Name :

PO reference :

Document number :

Revision number :

Sl.no. & Sections	Description	Tick (√)if included in Manual			Remarks
		Yes	No	Not Applicable	
1.	Cover page				
1.1	Project Name				
1.2	Customer/consultant Name				
1.3	Name of Package				
1.4	Supplier details with phone, FAX ,email address , Emergency Contact number				
1.5	Name and sign of prepared by , checked by & approved by				
1.6	Revision history with approval Details				
2.0	Index				
2.1	showing the sections & related page nos All the pages should be numbered section wise				
3.0	Description of Plant/System				
3.1	Description /write up of operating principle of system equipment/ associated sub-systems & accessories/controls system , operating conditions, performance parameters under normal , start up and special cases				
3.2	Equipment list and basic parameter with Tag numbers				
3.3	Data sheets approved by Customer/for information and catalogues provided by original manufacturer				
3.4	Associated other packages and Interface /terminal points				
3.5	P&ID & Process Diagrams				
3.6	GA Layout drawings, As-built drawings , Actual photograph of items/system (Drawings of A2 & bigger sizes are to be attached in the last)				
3.7	Single line/wiring diagrams				
3.8	Control philosophy /control write-ups				

4.0	Commissioning Activities (if not covered in separate document i.e. erection manual, commissioning manual)				
4.1	Pre-Commissioning Checks				
4.2	handling of items at site				
4.3	Storage at site				
4.4	Unpacking & Installation procedure				
5.0	Operation Guidelines for plant personal/user/operator				
5.1	Interlock & Protection logic along with the limiting values of protection settings for the equipment along with brief philosophy behind the logic, drawings etc. to be provided.				
5.2	Start up, normal operation and shut down procedure for equipments along with the associated systems in step by step mode. Valve sequence chart, step list, interlocks etc. with Equipment isolating procedures to be mentioned.				
5.3	Do's & Don't of the equipments.				
5.4	Safety precautions to be taken during normal operation. Safety symbols, Emergency instructions on total power failure condition/lubrication failure/any other condition				
5.5	Parameters to be monitored with normal values and limiting values				
5.6	Trouble shooting with causes and remedial measures				
5.7	Routine operational checks, recommended logs & records				
5.8	Changeover schedule if more than one auxiliary for the same purpose is given				
5.9	Painting requirement and schedule				
5.10	Inspection, repair , Testing and calibration procedures				
6.0	Maintenance guidelines for plant personal				
6.1	List of Special Tools and Tackles required for Overhaul/Trouble shooting including special testing equipment required for calibration etc.				
6.2	Stepwise dismantling and re-assembly procedure clearly specifying the tools to be used, checks to be made, records to be maintained, clearances etc. to be mentioned. Tolerances for fitment of various components to be given.				

6.3	Preventive Maintenance & Overhauling schedules linked with running hours/calendar period along with checks to be given				
6.4	Long term maintenance schedules especially for structural, foundations etc.				
6.5	Consumable list along with the estimated quantity required during commissioning, normal running and during maintenance like Preventive Maintenances and Overhaul. Storage/handling requirement of consumables/self-life.				
6.6	List of lubricants with their Indian equivalent, Lubrication Schedule, Quantity required for each equipment for complete replacement is to be given				
6.7	List of vendors & Sub-vendors with their latest addresses, service centres ,Telephone Nos., Fax Nos., Mobile Nos., e-mail IDs etc.				
6.8	List of mandatory and recommended spare parts list				
6.9	Tentative Lead time required for ordering of spares from the equipment supplier				
6.10	Guarantee and warranty clauses				
7.0	Statutory and other specific requirements considerations.				
8.0	List of reference documents				
9.0	Binding as per requirement				

	2 X 490 MW NCTPPP, DADRI, STAGE-II COMPRESSED AIR SYSTEM	SPECIFICATION NO. PE-TS-436-555-A001	
		VOLUME : II B	
		SECTION : E / ANNEXURE-X	
		REV 00	DATE: 19.03.18
		SHEET: 1 OF 1	

ANNEXURE-X **SITE STORAGE AND PRESERVATION**

CONTENT

- 1 SCOPE OF THE DOCUMENT
- 2 PURPOSE OF STORAGE & PRESERVATION
- 3 MEASURES TO BE TAKEN FOR STORAGE AND PRESERVATION
 - a) GENERAL STORAGE REQUIREMENTS
 - b) GENERAL PRESERVATION REQUIREMENTS
 - c) GENERAL INSPECTION REQUIREMENTS
- 4 TYPE OF STORAGE FOR VARIOUS EQUIPMENT
5. CONCLUSION
6. STACKING ARRANGEMENT FOR PLATES AND STRUCTURAL STEEL

1. SCOPE OF THE DOCUMENT

This guideline is prepared in intent to provide proper site storage and preservation of the Mechanical, Electrical and C & I items / equipment supplied under various bought out packages/items. This storage procedure shall be followed at different power plant sites by concerned agency for storage and preservation from the date of equipment received at site until the same are erected and handed over to the customer.

2. PURPOSE OF STORAGE & PRESERVATION

Many of the items may be required to be kept in stores for long period. It shall therefore be essential that proper methods of storage and preservation be applied so that items do not deteriorate, loose some of their properties and become unusable due to atmospheric conditions and biological elements.

3. MEASURES TO BE TAKEN FOR STORAGE, HANDLING & PRESERVATION

a) GENERAL STORAGE REQUIREMENTS

1. To the extent feasible, materials should be stored near the point of erection. The storage areas should have adequate unloading and handling facilities with adequate passage space for movement of material handling equipment such as cranes, fork lift trucks, etc. The storage of materials shall be properly planned to minimise time loss during retrieval of items required for erection.
2. The outdoor storage areas as well as semi-closed stores shall be provided with adequate drainage facilities to prevent water logging. Adequacy of these facilities shall be checked prior to monsoon.
3. The storage sheds shall be built in conformity with fire safety requirements. The stores shall be provided with adequate lights and fire extinguishers. 'No smoking' signs shall be placed at strategic locations. Safety precautions shall be strictly enforced.
4. Adequate lighting facility shall be provided in storage areas and storage sheds and security personnel positioned to ensure enforcement of security measures to prevent theft and loss of materials.
5. Adequate number of competent stores personnel and security staff shall be deployed to efficiently store and maintain the equipment / material.
7. The equipment shall be stored in an orderly manner, preserving their identification slips, tags and instruction booklets, etc., required during erection. The storage of materials shall be equipment-wise. Loose parts shall be stored in sheds on racks,

preserving the identification marks and tags in good condition. The group codes shall be displayed on the racks

6. At no time shall any materials be stored directly on ground. All materials shall be stored minimum 200 mm above the ground preferably on wooden sleepers

b) GENERAL PRESERVATION REQUIREMENTS

1. All special measures to prevent corrosion shall be taken like keeping material in dry condition, avoiding the equipment coming in contact with corrosive fluid like water, acid etc.
2. Materials which carry protective coating shall not be wrapped in paper, cloth, etc., as these are liable to absorb and retain moisture. The material shall be inspected and in case of signs of wear or damages to protective coating, that portion shall be cleaned with approved solution and coated with an approved protective paint. Complete record of all such observations and protective measures taken shall be maintained.
3. Generally equipment supplied at site are properly greased or rust protective oil is applied on machined/ fabricated components. However periodic inspection shall be carried out to ensure that protection offered is intact.
4. While handling the equipment, no dragging on the ground is permitted. Avoid using wire rope for lifting coated components. Use polyester slings (if possible) otherwise protective material (e.g. clothes, wood block etc.) should be used while handling the components with rope / slings
5. For Equipment supplied with finished paint, touch paint shall be done in case any surface paint gets peeled off during handling. Otherwise such surfaces shall necessarily be wrapped with polythene to avoid any corrosion. Further for equipment wherein finish coat is to be applied at site, site to ensure that equipment is received with primer coat applied.
6. It shall be ensured by periodic inspection that plastic inserts are intact in tapped holes, wherever applicable.
7. Pipes shall be blown with air periodically and it shall be ensured that there is no obstruction.
8. Silica gel or approved equivalent moisture absorbing material in small cotton bags shall be placed and tied at various points on the equipment, wherever necessary.
9. Heavy rotating parts in assembled conditions shall be periodically rotated to prevent corrosion/jamming due to prolonged storage.

10. All the electrical equipment such as motors, generators, etc. shall be tested for insulation resistance at least once in three months and a record of such measured insulation values shall be maintained.
11. Following preservatives/preservation methods can be used depending upon type of equipment
 - a. Rust preventive fluid (RPF)
 - b. Rust protective paints
 - c. Tarpaulin covers, in case of outdoor storage
 - d. De-oxy aluminate for weld-ments

c) GENERAL INSPECTION REQUIREMENTS

1. Period inspection of materials with specific reference to –
 - Ingress of moisture and corrosion damages.
 - Damage to protective coating.
 - Open ends in pipes, vessels and equipment -
 - In case any open ends are noticed, same shall be capped.
2. Any damages to equipment / materials.
 - In case of any damages, these shall be promptly notified and in all cases, the repairs / rectification shall be carried out.
 - Any items found damaged or not suitable as per project requirements shall be removed from site. If required to store temporarily, they shall be clearly marked and stored separately to prevent any inadvertent use.

4. TYPE OF STORAGE FOR VARIOUS EQUIPMENT

The types of storage are broadly classified under the following heads:

i **Closed storage with dry and dust free atmosphere. (C)**

The closed shed can be constructed by using cold-rolled / tubular components for structure and corrugated asbestos sheets / galvanised iron sheets for roofing. Brick walls / asbestos sheets can be used to cover all the sides. The floor of the shed can be finished with plain cement concrete suitably glazed. The shed shall be provided with proper ventilation and illumination.



ii **Semi-closed storage. (S)**

The semi closed shed can be constructed by using cold-rolled / tubular components for structure and corrugated / asbestos sheets for roofing. The floor shall be brick paved. If required a small portion of sides can be covered to protect components from rainwater splashing onto the components.





iii Open storage (O)

The open yard shall be levelled, well consolidated to achieve raised ground with the provision of feeder roads for crane approach along with access roads running all sides. One part of the open yard shall be stone pitched, levelled and consolidated with raised ground suitable for storing / stacking heavier and critical components with due space to handle them by cranes etc . Adequate number of sleepers, concrete block etc. to be provided to make raised platforms to stack critical materials.

A separate yard to be identified as “scrap yard” slightly away from main open yard to store wooden/steel scraps, which are to be disposed off. This is required to avoid mix up with regular components as well as to avoid fire hazard.

Some of the components, which are having both machined & un-machined surfaces and are bulky, shall be stored in open storage area on a raised ground and suitably covered with water proof / fire retardant tarpaulin.



The equipment listed below shall be stored and inspected as per requirement mentioned in the table below.

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
Raw material /mechanical items like pipes, plates, structure sections etc.)				
1.	Steel pipes (lined/unlined)	S	Damage , paint, corrosion, rubber lining peeling	Provide end cap
2.	MS Plates	S	Damage, paint, corrosion	
3.	SS Plates	S	Damage	
4.	Non-metallic pipes	S	Damage, cracks	Provide end cap
5.	Stainless steel pipes	S	Damage ,	Provide end cap
6.	MS sections, beams	S	Damage, paint, corrosion	
7.	Cable trays	S	Damage, condition of preservations	
8.	Insulation sheets	S	Damage	
9.	Insulation	C	Damage, packing	
10.	Hangers Rods	S	Damage, paint, packing	
11.	Tubes	S	Damage, paint , packing	Provide end cap
12.	Hume pipes	O	Damage	
13.	Castings	O	Damage, paint, corrosion	
Fabricated mechanical items (pressure vessels, tanks etc.)				
14.	Pressure vessels (unlined)	O	Damage, paint, corrosion,	Covered nozzles
15.	Atmospheric storage tanks (unlined)	O	Damage, paint, corrosion	Covered nozzles

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
16.	Pressure vessels (lined)	S	Damage, paint, corrosion, rubber lining	
17.	Atmospheric storage tanks(lined)	S	Damage, paint, corrosion, rubber lining	
18.	Support structures	O	Damage , paint, corrosion	
19.	Flanges	C	Damage , paint, corrosion	
20.	Fabricated pipes	S	Damage , paint, corrosion	Provide end cap
21.	Vessels internals	C	Damage , paint, corrosion ,packing	
22.	Grills	S	Damage , paint, corrosion	
23.	Angles	S	Damage , paint, corrosion	
24.	Bridge mechanism/clarifier mechanism	O	Damage , paint, corrosion	
25.	Cranes, rails	S	Damage , paint, corrosion	
26.	Stair cases	O	Damage , paint, corrosion	
27.	Ladders/handrails	O	Damage , paint, corrosion	
28.	Fabricated ducts	S	Damage , paint, corrosion	
29.	Isolation Gates	O	Damage , paint, corrosion	
30.	Fabricated boxes/panels	S	Damage , paint, corrosion	
Mechanical components like valves, fittings, cables glands, spares etc.)				
31.	Valves	S	Damage , packing	

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
32.	Fittings	S	Damage , packing	Provide end cap
33.	Cable glands	C	Damage , packing	
34.	Tools & tackles	C	Damage , packing	
35.	Nut , bolts, washers,	C	Damage , packing	
36.	Gasket & Packings	C	Damage , packing	
37.	Copper tubes	C	Damage , packing, corrosion	Provide end cap
38.	SS tubing	C	Damage , packing	Provide end cap
Rotating assemblies (pumps, blowers, stirrers, fans, compressors etc.)				
39.	Pumps	S	Damage , packing, corrosion	Shaft rotation
40.	Blowers/Compressors	S	Damage , packing, corrosion	Shaft rotation
41.	Agitators/stirrers/radial launders	C	Damage , packing, corrosion	Shaft rotation
42.	Rollers for chlorine tonner mounting	C	Damage , packing, corrosion	
43.	Centrifuge	S	Damage , packing,	
44.	Gear box	C	Damage , packing, corrosion	
45.	Bearings	C	Damage , packing, corrosion	
46.	Fans	S	Damage , packing, corrosion	
47.	Dosing skids	S	Damage , packing, corrosion	
48.	Pump assemblies	S	Damage , packing, corrosion	
49.	Air washers(INTERNALS)	S	Damage , packing	
50.	Air conditioners (split)	C	Damage , packing	

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
51.	Elevators(CONTAINERIZED)	O	Damage , packing, corrosion	
52.	Chillers/VA machines	S	Damage , packing	
53.	Air handling Unit/Package unit	S	Damage , packing	
54.	Chlorinators & Evaporators	C	Damage , packing	
55.	Ejectors	C	Damage , packing	
56.	Electrolyser	C	Damage , packing	
Miscellaneous items like chain pulley blocks, hoists etc.				
57.	Chain pulley blocks	S	Damage, Packing	
58.	Electric hoists	S	Damage, Packing	
59.	Fire extinguishers	C	Damage, expiry date	
60.	Fork Lift Truck	S	Damage, Packing	
61.	Hydraulic Mobile Crane	O	Damage, Packing	
62.	Mobile Pick Up & Carry Crane	O	Damage, Packing	
63.	Motor boats	O	Damage, Packing	
64.	Safety showers	S	Damage, Packing	
65.	Diffusers/dampers	S	Damage, Packing	
Chemicals and consumables (acid, alkali, paints, oils, reagents and special chemicals)				
66.	Hydro Chloric Acid (HCl)	Store in canes/ storage tank in dyke area	Date of production/ leakage/fumes	hazardous chemical
67.	Sulphuric acid (H ₂ SO ₄)	Store in canes/ storage tank in dyke area	Date of production/ leakage/fumes	hazardous chemical

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
68.	Sodium hydroxide (NaOH)	Store in canes/ storage tank in dyke area	Date of production/ leakage/ fumes/ breather	hazardous chemical ,breather to be checked for air ingress
69.	Sodium hypo chlorite	To be stored under shed	Date of production/ leakage/ fumes	hazardous chemical ,self-life normally 15-30 days after which strength of chemical decays
70.	Ammonia	S	Date of production/ leakage/ fumes	Store in closed storage tanks, hazardous chemical
71.	CW treatment chemicals	S	Date of production , Self-life	Store in closed canes
72.	RO/UF cleaning chemicals	S	Date of production , Self-life	Store in closed canes
73.	Lime	C	Damage to packing , seepage	Prevent moisture, rain
74.	Alum bricks	C	Damage to packing	Prevent moisture, rain
75.	Poly electrolyte	S		Store in closed storage tanks
76.	Laboratory chemicals(powder)	C	Damage, Packing self-life	
77.	Laboratory chemicals(liquid)	C	Damage, Packing self-life	
78.	Lubrication oils	C	Leakage	
79.	Paints	S	Leakage ,air tightness	
80.	Sand	O	Damage of packing	No hooks
81.	Salt (NaCl)	C	Damage of packing, water ingress	Prevent moisture, rain
82.	Anthracite	S	Damage of packing	
83.	Activated carbon	S	Damage of packing	

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
84.	Thermal insulation	S	Damage of packing	
85.	Cement	C	Damage of packing	Prevent moisture, rain
86.	Gravels	O	Damage of packing	
87.	ION exchange resins	C	Damage , packing	Refer manufacturer guidelines
88.	RO membranes	C	Damage , packing	Refer manufacturer guidelines
89.	UF membranes	C	Damage , packing	Refer manufacturer guidelines
90.	Cleaning chemicals	C	Damage , packing	Refer manufacturer guidelines
91.	Chemicals for analysers/calibration	C	Damage , packing	Refer manufacturer guidelines
Electrical and C & I items (motors, cables etc.)				
92.	Motors	C	Damage , packing	
93.	Cable drums	O	Damage	
94.	Control Panel /control desk, UPS ,JB	S	Damage, Packing	
95.	Instruments(gauges/analysers)	C	Damage	
Special items		As per Manufacturer's item, like Hydrogen cylinders, Ozonator, Analyser, Chlorine dioxide generators etc.		

5. CONCLUSION

Concerned storage agency at site should make sure that loss in equipment performance and wear & tear are minimised through proper storage and preservation. The above are broad guidelines and cover major equipment / materials. However specific storage practices shall be followed as per manufacturer recommendation. All the necessary measures even in addition to the ones mentioned above, if found necessary, should be taken to achieve the objective.

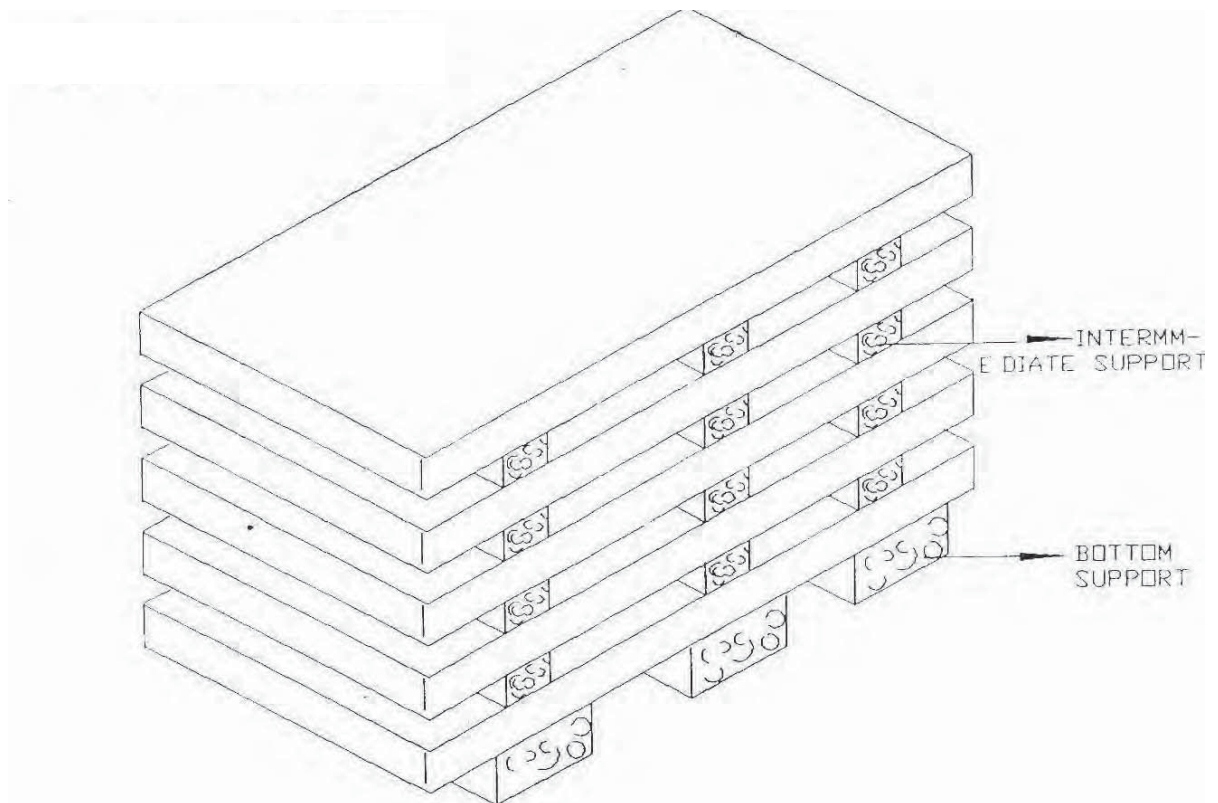


Figure – 1 – PLATE STACKING ARRANGEMENT

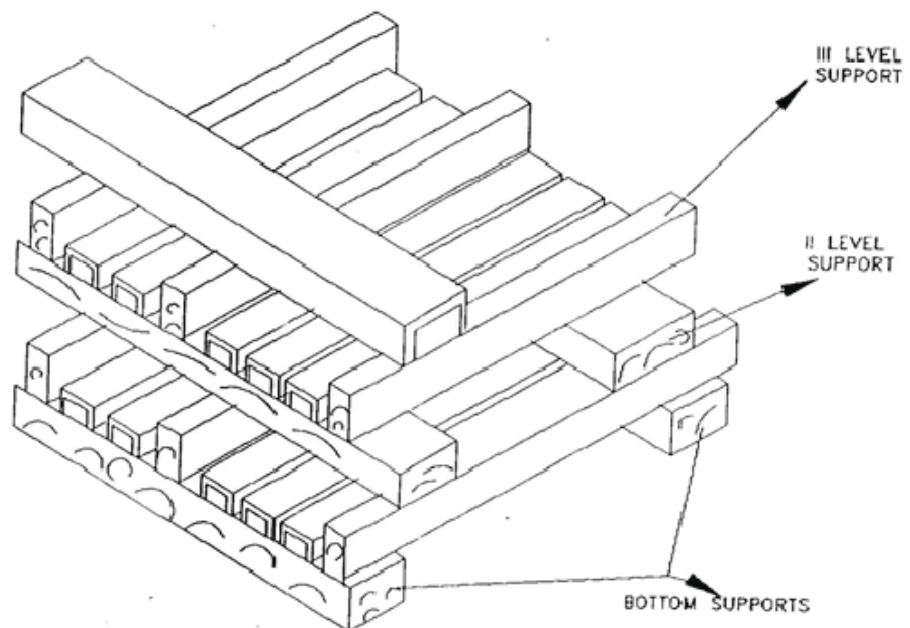


Figure – 2 – STRUCTURAL STEEL STACKING ARRANGEMENT

	2 X 490 MW NCTPPP, DADRI, STAGE-II COMPRESSED AIR SYSTEM	SPECIFICATION No: PE-TS-436-555-A001	
		VOLUME : II B	
		SECTION : E / ANNEXURE-XI	
		REV 00	DATE: 19.03.18
		SHEET: 1 OF 2	

ANNEXURE-XI

PACKING PROCEDURE

	2 X 490 MW NCTPPP, DADRI, STAGE-II COMPRESSED AIR SYSTEM	SPECIFICATION No: PE-TS-436-555-A001	
		VOLUME : II B	
		SECTION : E / ANNEXURE-XI	
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Packing, Dispatch, Handling & Transportation

- a. All equipment, pipes, valves, instruments, etc. shall be suitably packed for protection against mechanical damages and climatic conditions during transit and storage. Packing and weather proofing shall be subject to approval of the BHEL / his Customer. This approval shall be general and may not be required every time for an article to be dispatched. However, the BHEL reserves the right to examine the packing for any particular consignment at supplier's/ manufacturer's works before dispatch.
- b. The supplier shall be entirely responsible for the insurance, shipment, handling and transportation of all plant & equipment, construction tools, labourers and materials including unloading at destination, transportation to site, off-loading, storing and protection at site till erection.
- c. The equipment shall not be dispatched by the Bidder from the place of manufacture to the site until the dispatch instructions are issued by the BHEL.

	2 X 490 MW NCTPPP, DADRI, STAGE-II COMPRESSED AIR SYSTEM	SPECIFICATION No: PE-TS-436-555-A001	
		VOLUME : II B	
		SECTION : E / ANNEXURE-XII	
		REV 00	DATE: 19.03.18
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ANNEXURE-XII

LIST OF COMMISSIONING SPARES

LIST OF COMMISSIONING SPARES (Required for Commissioning of Compressed Air System)
Break up price for COMMISSIONING SPARES

[illegible]

NOTE -

1. The items indicated in the above list are minimum. Any other spares if required shall be included by bidder in the above list.
 2. Any part even though not mentioned in list furnished but required at later date shall be supplied free of cost to BHEL.
3. Bidder to note that the items indicated in the above list shall be provided prior to commissioning of the Compressed air System. If these commissioning spares are already part of compressor / dryer skid. Same need not be considered again.

2 X 490 MW NCTPPP, DADRI, STAGE-II

TECHNICAL SPECIFICATION

FOR

COMPRESSED AIR SYSTEM

VOLUME-III

(TECHNICAL SCHEDULES)



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



2 X 490 MW NCTPPP, DADRI, STAGE-II

COMPRESSED AIR SYSTEM

SPECIFICATION NO. PE-TS-436-555-A001

VOLUME : III

SECTION : 1

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SECTION: 1

**LIST OF DOCUMENTS TO BE SUBMITTED
WITH BID**

**2 X 490 MW NCTPPP, DADRI, STAGE-II****COMPRESSED AIR SYSTEM**

SPEC. NO.: PE-TS-436-555-A001

VOLUME: III

SECTION: 1

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CHECK LIST TO BE SUBMITTED BY BIDDER ALONG WITH THE BID

SI No.	Item Description	Yes/No
1	Schedules to be submitted dully filled up with bidder's signature and stamp. 1) Technical Deviation Schedule, if any. 2) Guaranteed Power Consumption For Air Compressor System 3) Compliance and Confirmation certificate 4) No Deviation Certificate	
2	Resolution to pre-bid clarifications, if any, duly stamped and signed by the bidder enclosed with the bid	
3	Un-priced bid- clearly indicating 'QUOTED' and 'NOT-QUOTED' against each item.	
4	'Compressor House Layout - (Volume III - Section-8) of technical specification' duly stamped and signed by bidder to be enclosed with the bid.	
5	Electrical load List (Volume III - section-5) of technical specification duly filled, stamped and signed by bidder to be enclosed with the bid	
6	Supporting Documents meeting PQR requirements (if Applicable)	

Please note that all the schedules shall be submitted even though they may not be applicable. Under such circumstances it shall be clearly mentioned across such schedules that these are not applicable.(e.g. in case of there are no technical deviation, it shall be mentioned in the deviation schedule that 'THERE ARE NO DEVIATIONES TO THE TECHNICAL SPECIFICATION').

Name: _____

Signature: _____

Designation: _____

Company: _____

Date: _____

Bidder Stamp

	2 X 490 MW NCTPPP, DADRI, STAGE-II COMPRESSED AIR SYSTEM	SPECIFICATION NO. PE-TS-436-555-A001	
		VOLUME : III	
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VOLUME-III
SECTION 2
COMPLIANCE CUM CONFIRMATION CERTIFICATE



2 X 490 MW NCTPPP, DADRI, STAGE-II

COMPRESSED AIR SYSTEM

SPEC. NO.: PE-TS-436-555-A001

VOLUME: III

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COMPLIANCE CUM CONFIRMATION CERTIFICATE

The bidder shall confirm compliance with following by signing/ stamping this compliance certificate (every sheet) and furnish same with the offer.

- a) The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusions other than those mentioned under "exclusion" and those resolved as per 'Schedule of Deviations', if applicable, with regard to same.
- b) There are no other deviations w.r.t. specifications other than those furnished in the 'Schedule of Deviations'. Any other deviation, stated or implied, taken elsewhere in the offer stands withdrawn unless specifically brought out in the 'Schedule of Deviations'.
- c) Bidder shall submit QP in the event of order based on the guidelines given in the specification & QP enclosed therein. QP will be subject to BHEL/ CUSTOMER approval & customer hold points for inspection/ testing shall be marked in the QP at the contract stage. Inspection/ testing shall be witnessed as per same apart from review of various test certificates/ Inspection records etc. This shall be within the contracted price with no extra implications to BHEL after award of the contract.

- d) All drawings/ data-sheets/ calculations etc. submitted along with the offer shall be considered for reference only, same shall be subject to BHEL/ CUSTOMER approval in the event of order.

- e) The offered materials shall be either equivalent or superior to those specified in the specification & shall meet the specified/ intended duty requirements. In case the material specified in the specifications is not compatible for intended duty requirements then same shall be resolved by the bidder with BHEL during the pre - bid discussions, otherwise BHEL/ Customer's decision shall be binding on the bidder whenever the deficiency is pointed out.

For components where materials are not specified, same shall be suitable for intended duty, all materials shall be subject to approval in the event of order.

- f) The commissioning spares shall be supplied on 'As Required Basis' & prices for same included in the base price itself.
- g) All sub vendors shall be subject to BHEL/ CUSTOMER approval in the event of order.
- h) Guarantee for plant/equipment as applicable, shall be as per relevant clause of GCC /SCC /Other Commercial Terms & Conditions.
- i) In the event of order, all the material required for completing the job at site shall be supplied by the bidder within the ordered price even if the same are additional to approved billing break up, approved drawing or approved Bill of quantities. This clause will apply in case during site commissioning additional requirements emerges due to customer and/ or consultant's comments. No extra claims shall be put on this account.
- j) 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.



2 X 490 MW NCTPPP, DADRI, STAGE-II

COMPRESSED AIR SYSTEM

SPEC. NO.: PE-TS-436-555-A001

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- k) As built drawings shall be submitted as and when required during the project execution.
- l) The bidder has not tempered with this compliance cum confirmation certificate and if at any stage any tempering in the signed copy of this document is noticed then same shall be treated as breach of contract and suitable actions shall be taken against the bidder.

SIGNATURE: _____

NAME : _____

DESIGNATION: _____

COMPANY: _____

DATE: _____

COMPANY SEAL

	2 X 490 MW NCTPPP, DADRI, STAGE-II COMPRESSED AIR SYSTEM	SPECIFICATION No: PE-TS-436-555-A001	
		VOLUME: III	
		SECTION : 3	
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VOLUME: III
SECTION: 3
PRE-BID CLARIFICATION SCHEDULE



**2 X 490 MW NCTPPP, DADRI, STAGE-II
COMPRESSED AIR SYSTEM**

SPECIFICATION NO. PE-TS-436-555-A001

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PRE-BID CLARIFICATION SCHEDULE

S.No.	Section/Clause/ Page No.	Statement of the referred clause	Clarification required

The bidder hereby certifies that above mentioned are the only clarifications required on the technical specification for the subject package.

SIGNATURE: _____

NAME : _____

DESIGNATION: _____

COMPANY: _____

DATE: _____

COMPANY SEAL



2 X 490 MW NCTPPP, DADRI, STAGE-II

COMPRESSED AIR SYSTEM

SPECIFICATION NO. PE-TS-436-555-A001

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**VOLUME-III
SECTION 4
SCHEDULE OF TECHNICAL DEVIATION**

DEVIATION SHEET (COST OF WITHDRAWAL)									
 PROJECT:- 2 X 490 MW NCTPPP, DADRI, STAGE-II									
PACKAGE:- COMPRESSED AIR SYSTEM									
TENDER ENQUIRY REFERENCE:-									
NAME OF VENDOR:-									
SL NO	VOULME/ SECTION	PAGE NO.	CLAUSE NO.	TECHNICAL SPECIFICATION/ TENDER DOCUMENT	COMPLETE DESCRIPTION OF DEVIATION	COST OF WITHDRAWL OF DEVIATION	REFERENCE OF PRICE SCHEDULE ON WHICH COST OF WITHDRAWL OF DEVIATION IS APPLICABLE	NATURE OF COST OF WITHDRAWL OF DEVIATION (POSITIVE/ NEGATIVE)	REASON FOR QUOTING DEVIATION
TECHNICAL DEVIATIONS									
COMMERCIAL DEVIATIONS									
PARTICULARS OF BIDDERS/ AUTHORISED REPRESENTATIVE									
NAME				DESIGNATIONS			SIGN & DATE		
NOTES:									
1. For self manufactured items of bidder, cost of withdrawl of deviation will be applicable on the basic price (i.e. excluding taxes, duties & freight) only.									
2. For directly dispatchable items, cost of withdrawl of deviation will be applicable on the basic price including taxes, duties & freight.									
3. All the bidders have to list out all their Technical & Commercial Deviations (if any) in detail in the above format.									
4. Any deviation not mentioned above and shown separately or found hidden in offer, will not be taken cognizance of.									
5. Bidder shall submit duly filled unpriced copy of above format indicating "quoted" in "cost of withdrawl of deviation" column of the schedule above along with their Techno-commercial offer, wherever applicable.									
6. Bidder shall furnish price copy of above format along with price bid.									
7. The final decision of acceptance/ rejection of the deviations quoted by the bidder shall be at discretion of the Purchaser.									
8. Bidders to note that any deviation (technical/commercial) not listed in above and asked after Part-I opening shall not be considered.									
9. For deviations w.r.t. Payment terms, Liquidated damages, Firm prices and submission of E1/ E2 forms before claiming 10% payment, if a bidder chooses not to give any cost of withdrawl of deviation loading as per Annexure-VIII of GCC will apply. For any other deviation mentioned in un-priced copy of this format submitted with Part-I bid but not mentioned in priced copy of this format submitted with Priced bid, the cost of withdrawl of deviation shall be taken as NIL.									
10. Any deviation mentioned in priced copy of this format, but not mentioned in the un-priced copy, shall not be accepted.									
11. All techno-commercial terms and conditions of NIT shall be deemed to have been accepted by the bidder, other than those listed in unpriced copy of this format.									
12. Cost of withdrawl is to be given seperately for each deviation. In no event bidder should club cost of withdrawl of more than one deviation else cost of withdrawl of such deviations which have been clubbed together shall be considered as NIL.									
13. In case nature of cost of withdrawl (positive/negative) is not specified it shall be assumed as positive.									
14. In case of discrepancy in the nature of impact (positive/ negative), positive will be considered for evaluation and negative for ordering.									



2 X 490 MW NCTPPP, DADRI, STAGE-II
COMPRESSED AIR SYSTEM

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VOLUME-III
SECTION 5
ELECTRICAL LOAD DATA



2 X 490 MW NCTPPP, DADRI, STAGE-II
COMPRESSED AIR SYSTEM

SPECIFICATION NO. PE-TS-436-555-A001

VOLUME : III

SECTION : 6

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VOLUME-III
SECTION 6
O&M SPARES FOR CAS



PROJECT:- 2 X 490 MW NCTPPP, DADRI, STAGE-II

O & M SPARES FOR COMPRESSED AIR SYSTEM

1.0	Oil free Screw Air Compressor	
a	Complete HP Stage with HP element and bearing	1 No.
b	Complete LP stage with LP element and bearing	1 No.
c	Motor Bearings	2 Sets
d	LP stage Pinion	1 No.
e	HP stage Pinion	1 No.
f	Air Oil Filter Kit	4 Nos.
g	After cooler Safety Valve	1 No.
h	Inter Cooler Safety Valve	1 No.
i	Oil Pump kit	2 Nos.
j	After cooler drain valve kit	1 No.
k	Inter cooler drain valve kit	1 No.
l	Drain/moisture trap	1 No.
m	O' Rings	8 Nos.
n	Moisture separators for Aftercooler	2 Nos.
o	Moisture separators for Intercooler	2 Nos.
2.0 (A)	AIR DRYING PLANT FOR IA SYSTEM (Twin tower Type) (As applicable)	
a	Pre filter element(Ceramic candle or as applicable)	2 sets
b	After filter element(Ceramic candle or as applicable)	2 sets
c	Heater element(if applicable)	1 sets
d	Blower bearing(if applicable)	1 sets
e	Blower motor bearing(if applicable)	2 sets
f	Valves & Valve Actuators (pneumatic/hydraulic)	2 sets
g	Heater coil for temperature stabilization (for HOC type)(as applicable)	2 sets
2.0 (B)	AIR DRYING PLANT FOR IA SYSTEM (Rotating Drum Type) (As applicable)	
a	Air dryer rotor	2 Nos.
b	Air dryer complete gear box assembly	1 No.
3.0	Valves and Valves with actuator	2 Nos. of each type / rating / size
4.0	Air receiver drain/moisture trap	1 No.
5.0	MEASURING INSTRUMENTS	
a	Instruments within compressor house including the instruments within skid.	10% or 1 No. of each type and model, whichever is more
6.0	Compressor Microprocessor / PLC Panel	1 no.
7.0	Compressor motor	1 no.



2X490 MW NATIONAL CAPITAL POWER STATION

COMPRESSED AIR SYSTEM

SPECIFICATION No: PE-TS-436-555-A001

VOLUME: III

SECTION-7

REV. 00

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**VOLUME-III
SECTION - 7
ANNUAL MAINTENANCE CONTRACT SERVICES**

	2X490 MW NATIONAL CAPITAL POWER STATION COMPRESSED AIR SYSTEM	SPECIFICATION No: PE-TS-436-555-A001	
		VOLUME: III	
		SECTION-7	
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ANNUAL MAINTENANCE CONTRACT SERVICES

The bidder scope also covers the Annual maintenance contract (AMC) for Preventive / Breakdown maintenance for a period of three (3) years from the date of successful handover of Compressed air system to end customer.

Bidder to note that, bidder shall use only genuine parts as per frequencies mentioned in O&M Manual. Any damage or malfunction caused by the use of unauthentic parts or unqualified personnel shall be responsibility of bidder and as a consequence of above bidder is required to replenish the unauthorised part and abridge the qualified person without any commercial implication to BHEL.

AMC scope also covers all regular maintenance by certified and trained service engineers and / or supply of genuine parts and lubricants as per the original manufacturer recommendations in a pro-active manner.

1.0 Scope of Work:

The scope of work includes:

1. To carry out Preventive Maintenance checks as per mentioned schedule provided by bidder ensuring min. one routine visit per quarter, to attend Air compressors, its motor, Air dryer and all its accessories.
2. In case of breakdown, bidder shall depute qualified Service manpower and rectify the same with in strict time frame, not exceeding 48 hours.
3. Spares and consumables required for preventive AMC shall be in the scope of bidder. However, any spare required under breakdown condition will be provided to Bidder's service provider by BHEL on the written request basis from the list of O&M Spares as provided by bidder (Refer Vol-III, Section-6). Any specific item not available in BHEL inventory, shall be provided by Bidder on mutual settlement of related commercial issues.
4. Supply of various maintenance kits based on equipment running hours for Compressor including motor and Air Dryer based on equipment running hours as specified in the O&M Manual for the equipment is in scope of bidder. This shall also include onetime replacement of air dryer resin prior to the completion of AMC contract. BHEL shall operate equipment ensuring equal wear and tear. Maintenance kit shall be provided based on equipment actual running hours clocked during the operation.

2.0 Detail description of Equipment: -

SL. NO.	EQUIPMENT	MAKE & MODEL	Qty.
1	AIR COMPRESSOR WITH MOTOR (15 Nm ³ /min. @ 8.5 kg/cm ² (g))	As per Bidder	2 nos. (1W+ 1S)
2	AIR DRYER (15 Nm ³ /min. @ 8.5 kg/cm ² (g))	As per Bidder	2 nos. (1W+ 1S)

3.0 General Checklist for Air compressor:-

The checklists are intended for general description of work to be carried out. They are not intended to cover all minute details. The work shall be executed in accordance with Manufacturer's O&M Manuals and modern techniques. Preventive Maintenance checks includes but not limited to as specified below:

MAINTENANCE OF SCREW COMPRESSOR

- Carry out external cleaning of equipment.
- Check the oil level in the tank if low top-up with oil.
- Change the lube oil & lube oil filter element.
- Check the tightness of foundation bolt & take corrective action, if applicable.

	2X490 MW NATIONAL CAPITAL POWER STATION COMPRESSED AIR SYSTEM	SPECIFICATION No: PE-TS-436-555-A001	
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- Check the coupling gear installed between compressor and motor if found damaged then replace and realignment to be done.
- Check & clean the air breather in oil tank.
- Clean the inlet air filter element and replacement on need basis.
- Checking / cleaning of all heat exchangers (including hydro testing).
- Checks the leakage in oil line, water line and airline if found then rectify the same.
- Cleaning of cooling water inlet line strainer, back flushing of air and oil cooler, air purging oil scavenging & connecting tube, Cleaning & servicing of moisture separator installed at compressor outlet, cleaning & replacement of all moisture & dust separating filter elements as prescribed by manufacturer.
- Assisting for inspection / repair / servicing during expert visit as per instructions.
- Overhauling of compressor unit as per schedule and requirement. Overhauling to be carried out as per manufacturer recommendation.
- Bidder has to maintain the records of operation, maintenance and overhauling activities with dates. Reports needs to be circulated every month.
- End customer observations and necessary corrections need to be carried out as per requirement. Equipment should be operated at normal vibration levels as per ISO norms. Any deviation in vibration levels should be addressed immediately and corrections to be done on priority.
- Take trial run for smooth operation.
- Equipment external and internal cleaning to be done at regular interval.
- Equipment painting to be done during every overhauling.
- Alignment corrections and mounting pads replacement to be carried out as per requirement.
- Motor decoupling and coupling to be carried out as per requirement
- Replacement of air-end and its accessories and any other components needs replacement is in bidder's scope.
- Spill over oil / water / grease / cotton waste / etc in surrounding area and floor to be cleaned as per the instructions of end customer.
- Check for Electrical connections intact.
- Check for compressor control panel as per manufacturer recommendation.
- Any other maintenance as recommended by manufacturer.

MAINTENANCE OF AIR DRIER

- Carry out external cleaning of equipment.
- Clean the suction filter/ moisture strainer.
- Check the tightness of foundation bolts & take corrective action if required.
- Assisting for inspection / repair / servicing during expert visit as per instructions.

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- Filling / refilling of desiccant as per requirement.
- Check change over valve & replace if required.
- Check for any leakages in pipeline & replace if required.
- Take trial run for smooth operation.
- Equipment external and internal cleaning to be done at regular interval.
- Equipment painting to be done during every overhauling.
- Spill over oil / water / grease / cotton waste / etc in surrounding area and floor to be cleaned as per the instructions of end customer.
- Any other maintenance as recommended by manufacturer.

4.0 Tools and tackles

Tools and tackles required for handling the component will be provided to the Bidder (successful bidder) on the written request basis. Bidder shall not claim any delay or compensation due to unavailability of these items, if any. In such cases bidder need to arrange the required tools and tackles at his own cost.

However, bidder to furnish one set of all such tools & tackles under “Special tools & tackles” for maintenance purpose within the quoted price, specified elsewhere in specification.

5.0 Measuring Instruments and commissioning Spare

Measuring Instruments like Vibration meter, multi-meter, clamp-on meter, noise meter will be provided to the Bidder on the written request basis. Bidder shall not claim any delay or compensation due to unavailability of these items, if any. In such cases Bidder need to arrange the required instruments at his own cost.

However, bidder to furnish one set of all such measuring instruments and commissioning spares under commissioning spares for maintenance purpose within the quoted price, specified elsewhere in specification.

6.0 Bidder is to arrange all the safety gears like helmets, air plugs, safety shoes etc during the maintenance.

7.0 In case of breakdown, Bidder is to depute service manpower within 48 hrs. without fail.

8.0 For Breakdown Maintenance, Bidder is to service and operate the compressor with satisfactory operating parameters within a week (6 working days) of reporting.

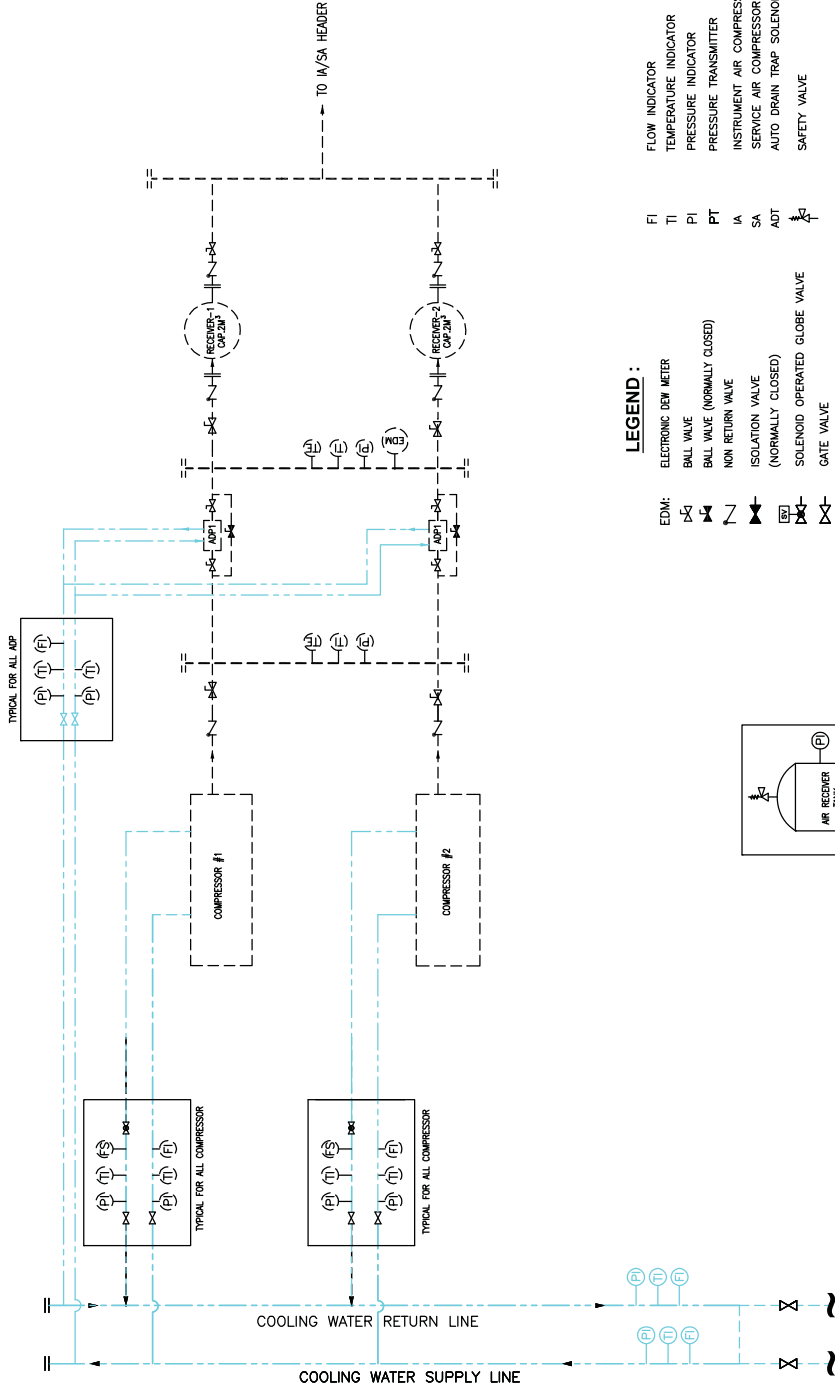
9.0 Bidder is to submit the Servicing Report (SR) of completed Breakdown Maintenance.

10.0 If any damage to the equipment and its accessories due to improper maintenance by bidder shall be recovered from the bidder.

	2 X 490 MW NCTPPP, DADRI, STAGE-II COMPRESSED AIR SYSTEM	SPECIFICATION No: PE-TS-436-555-A001	
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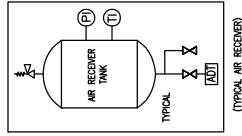
SECTION: 8

LIST OF DRAWINGS



LEGEND :

- | | | |
|-------------------------------|-----|-----------------------------------|
| EDM: | FI | Flow Indicator |
| Electronic Dew Meter | TI | Temperature Indicator |
| Ball Valve | PT | Pressure Indicator |
| Pressure Transmitter | IA | Instrument Air Compressor |
| Non Return Valve | SA | Service Air Compressor |
| Isolation Valve | ADT | Auto Drain Trap Solenoid Operated |
| (Normally Closed) | SV | Safety Valve |
| Solenoid Operated Globe Valve | | |
| Gate Valve | | |
| Water Line | | |
| Air Line | | |



NOTES :

1. THE SCHEMATIC DRAWING SHALL BE READ IN CONJUNCTION WITH TECHNICAL SPECIFICATION.
2. ALL CONTROLS, INTERLOCKS & PROTECTIONS REQUIRE FOR SAFE, RELIABLE AND EFFICIENT OPERATION & MAINTENANCE OF AIR COMPRESSORS & ADP SHALL BE IMPLEMENTED IN CONTROL SYSTEM.
3. ALL IMPORTANT & CRITICAL MEASUREMENTS REQUIRED FOR PROTECTION OF EQUIPMENTS SHALL BE PROVIDED WITH REQUIRED/ADEQUATE
4. VARIOUS FIELD INSTRUMENTS ON AIR AND WATER HAVE BEEN SHOWN. HOWEVER ANY OTHER ADDITIONAL INSTRUMENTS TO MEET THE SYSTEM REQT. & FOR SAFE OPERATION OF THE PLANT & EQUIPMENT SHALL BE INCORPORATED IN THE SCHEME BY CONTRACTOR AT NO ADDITIONAL COST TO EMPLOYER.
5. THE SCHEME DOES NOT SHOW THE CIRCUIT, INSTRUMENTS, VALVES ETC. FOR LOADING/ UNLOADING/MODULATION OF COMPRESSORS, REPRESSURISATION/DEPRESSURISATION OF ABSORBER TOWER OF ADP & THE SAME SHALL BE PROVIDED BY RESPECTIVE CONTRACTOR.
6. THE SCHEME HAS BEEN ENVISAGED CONSIDERING HEAT OF COMPRESSION TYPE AIR DRYER (TWIN TOWER TYPE) IN CASE OF ROTARY DRUM TYPE (HOC) AIR DRYER, SCHEME SHALL BE FINALISED DURING DETAILED ENGINEERING
7. Any other Instrument(s) and valve(s) specified else where in specification.

FOR TENDER PURPOSE ONLY

NTPC Limited
(A GOVT. OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT	FGD		
TITLE	SCHEMATIC DRAWING OF COMPRESSED AIR SYSTEM		
SIZE	A1	SCALE	0000 -109-POM-A-006
DATE		APPROVED BY	
DESIGNED BY		CHECKED BY	
DRAWN		REVIEWED	



2 X 490 MW NCTPPP, DADRI, STAGE-II
COMPRESSED AIR SYSTEM

SPECIFICATION NO. PE-TS-436-555-A001

VOLUME : III

SECTION : 9

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VOLUME-III
SECTION 9
Guaranteed Power Consumption for Compressed Air
System
(To be filled by bidder & be submitted along with offer)

SECTION-9 Guaranteed Power Consumption For Compressed Air System				Doc No:		PE-TS-436-555-A001
				Rev No:		0
				Date of issue		28.03.18
NAME OF PROJECT: 2x490 MW NTPC NCTPP Dadri Stage-II						
NAME OF PACKAGE: COMPRESSED AIR SYSTEM						
TECHNICAL SPECIFICATION: PE-TS-436-555-A001						
S.No. (1)	Description of Equipments (2)	Nos. of Equipments (3)		Total Guaranteed Power Consumption for Each Equipment at Motor Input Terminals & control Panel (4)	Duty Factor (5)	Total (KW) (6) = (3A)*(4)*(5)
		Working A	Standby B			
1	Air Compressors (Oil free Screw type / Centrifugal type) of capacity 15 NM3/min.	1	1	to be filled by bidder	1.0	to be filled by bidder
2	HOC Air Dyrer of capacity 15 NM3/min.	1	1	to be filled by bidder	1.0	to be filled by bidder
					TOTAL	to be filled by bidder
Note :						
1	Estimated Power Consumption Figure for the compressed air system (For Working Drives Only) considered is 160 KW.					
2	Bidders Guaranteed power consumption at motor input terminals (Not Shaft Power) considering motor efficiency as confirmed by motor OEM including power for control panel as furnished in guranteed schedule shall be demonstrated by the successful bidder during performance testing at works/site.					
3	The price quoted by the bidder shall be loaded @ 1,97,080 for every additional kW increase in consumption from the base figure indicated at Note no. 1.0 above.					
4	In case the successful bidder fails to establish / prove the guaranteed values of power consumption (base figure of auxiliary power consumption) on actual performance testing at the manufacturing works / site, penalty @ 1,97,080 per kW increase in power consumption figure shall be levied.					
5	If the contract currency is other than US \$, then the liquidated damages shall be in equivalent amount in contract currency based on billing selling exchange rate of State Bank of India prevailing in the date of Award of Contract.					
Particulars of bidder / authorised representative						
Name	Designation	Signature	Date	Date		Company Seal