NATIONAL THERMAL POWER CORPORATION LTD.

DARLIPALLI SUPER THERMAL POWER PROJECT

STAGE – I (2X800 MW)

TECHNICAL SPECIFICATION
FOR
COMPRESSED AIR SYSTEM

SPECIFICATION NO.: PE- TS- 403- 555- A001
Rev. 00

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

TABLE OF CONTENT

VOLUME II B

SECTION	SUB SECTION	TITLE	PAGE NO
A	-	Intent of Specification	3-5
B	-	Project Information	6-23
C1 (Mech)	I	Scope of Supply, TP & exclusions.	24-27
	II	Specific Technical Requirement -Mechanical	28-41
	III	General Technical Specification- Mech. e.g technical specifications of CAS, piping, valves, general requirements, etc)	42-116
	IV	Functional Guarantees & liquidated damages	117-119
C2 (Elect)	-	Specific Technical Requirement – Electrical	120-182
C3 (C&I)	I	Specific Technical Requirement – C&I	183-186
	II	General Technical Requirements - C&I	187-310
C4	-	Sub-Vendor List	311-315
C5	-	Drawings and documents	316-318
D	-	Technical datasheets (to be filled by bidders)	319-323
E	-	Quality Assurance	324-326
F	-	Suggestive Price format	327-335

ANNEXURES:

I- FORMAT FOR NO DEVIATION CERTIFICATE, (Page 337)
II- FORMAT FOR SEEKING CLARIFICATION. (Page 338)
III – FORMAT FOR SEEKING TECHNICAL DEVIATION. (Page 339)
IV- GUARANTEED POWER CONSUMPTION. (Page 340)
V- LIST OF DRAWINGS (ATTACHED WITH TECHNICAL SPECIFICATION). (Page 341 – 346)

VOLUME - II B

SECTION A

INTENT OF SPECIFICATION

1.0 INTENT OF SPECIFICATION

1.1 The specification is intended to cover design, engineering, manufacture, inspection and testing at vendor's/ sub-vendor's works, painting, forwarding, proper packing and shipment and delivery at site, unloading, storage, handling & transportation at site, Erection & Commissioning including commissioning spares, civil works as required on FOR site basis, Performance and guarantee testing and handing over of **COMPRESSED AIR SYSTEM** as per details in different sections / volumes of this specification for **2X800 MW DARLIPALLI STPP.**

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, erection and commissioning of **COMPRESSED AIR SYSTEM.**

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 high 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.

1.5 The general term and conditions, instructions to tenderer 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 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 Annexures II 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 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 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 / clarifications, if any, should be very clearly brought out clause by clause in the format enclosed in Annexure III; otherwise, it will be presumed that the vendor's offer is strictly in line with NIT specification. Each deviation shall be furnished with its cost of withdrawal in both priced and un-priced bid. In case of No-deviation, bidder to furnish the No-deviation / compliance certificate in the format enclosed in Annexure I of this specification.

1.9 In case all above requirements are not complied with, the offer may be considered as incomplete and would become liable for rejection.

1.10 Unless specified otherwise, all through the specification, the word contractor shall have same meaning as successful bidder /vendor and Customer/ Purchaser/Employer will mean BHEL and /or NTPC.

VOLUME - II B

SECTION B

PROJECT INFORMATION

CLAUSE NO.	PROJECT INFORMATION
1.00.00	**BACKGROUND** Darlipali Integrated Thermal Power Project has been conceived as a 3200 MW capacity coal based power plant, for which about 3000 acres of land has been identified for plant, township and ash disposal areas. Water Resources Department, Govt. of Orissa vides letter dated 06.01.2010 accorded In-principle availability of 160 cusec water from Hirakud reservoir. First Stage Site Clearance is obtained from Ministry of Environment and Forests (MOEF). Presently, Darlipali Integrated TPP, Stage-I (2x800 MW) is proposed to be commissioned as an inter regional power project during XII Plan period for the benefit of States of Eastern Region and adjoining Regions.
1.01.00	**LOCATION AND APPROACH** The site is located north of Raigarh-Jharsuguda NH-200 and is approachable from Gandhi Chowk (near Brajrajnagar) through 15 Kms long single lane village road. Nearest major town Jharsuguda is at a distance of about 25 Kms. Nearest rail head is Brajarajnagar Railway Station (20 Kms) on SEC Rly.(BG) main line. Darlipali project site is about 330 kms from Bhubaneshwar Airport in Orissa and about 300 kms from Raipur Airport in Chhattisgarh State. Vicinity Plan is enclosed as **Annexure – I**
1.02.00	**LAND** About 3000 acres of land (mostly private, rain fed agricultural, yielding single crop) is available. In-principle availability of land received from District Magistrate & Collector, Sundargarh, Govt. of Orissa vide letter dated 22.11.2005. **Land Requirement** The Main Plant, Township, Ash disposal, Railway siding and reservoir etc. for this stage of project shall be accommodated in 2700 Acres.
1.03.00	**WATER** Hirakud reservoir on Mahanadi river (approx. 30 Kms away) is the source of water for the project. Water Resources Department, Govt. of Orissa vides letter dated 06.01.2010 accorded In-principle availability of 160 cusec water from Hirakud reservoir for the proposed power plant at Darlipali.
1.04.00	**Railway Siding** Employer intends to construct the railway siding to the project site for bringing the equipment/ material and coal. However the same may not be available to the bidder for his use to transport equipment and material. Bidder may visit the site and actuquaint themselves with the facilities available.
1.05.00	**COAL AVAILABILITY AND TRANSPORTATION** Coal requirement for 1600 MW project is estimated as 9.40 Million Tonne Per Annum (MTPA) considering average GCV of 3100 kcal/kg. The envisaged mode of coal transportation from the coal mines to the power plant is by MGR through BOBR wagons and also through Indian Railways rakes in BOBR/BOXN wagons. Requirement of coal for ultimate

CLAUSE NO.	PROJECT INFORMATION
	capacity of project will be met from Dulanga (7.0 MTPA) and 12.5 MTPA from Pakri Barwadih captive coal blocks allotted to NTPC.
1.06.00	**Coal Quality Parameters / Fuel Oil Characteristics** The coal quality parameters and Fuel oil Characteristics are attached at SUB-SECTION-V, PART-A.
1.07.00	**Capacity** Stage-I : 2x800 MW Present proposal
1.08.00	**Construction Power** The construction power requirement of the project is envisaged approximately 5-6 MVA. The same is proposed to be availed at 33kV voltage level from Brajrajnagar of WESCO located at approximately 20 kms from plant. Necessary substation and 11kV ring main/ LT substation shall be provided for the power plant area as required.
1.09.00	**Metrological Data** The metrological data from nearest observatory is placed at **Annexure-II.**
1.10.00	**Plant Water Scheme** The Plant water scheme is described below.
1.10.01	**Condenser Cooling (CW) Water System** It is proposed to provide recirculating type CW system with induced draft type cooling towers. For the recirculating type CW system it is proposed to supply clarified water as make up. Clarified water shall be pumped to the cold water channel of CW system. CW system shall be operated at a C.O.C of about 3. The expected circulating water analysis is given in this sub-section. CW blow down shall be drawn from the discharge of CW pumps and the same shall be led to a Service water Tank. For carrying circulating water from CW pump house to TG-area and from TG area to cooling tower, steel lined concrete encased duct would be provided. For interconnecting CW duct with CW pump, condenser and cooling towers, steel pipes would be used. Cooled water from cooling tower will be led to CW pump house through the cold water channel by gravity.
1.10.02	**Equipment Cooling Water (ECW) System (Unit Auxiliaries)** The plant auxiliaries of Steam Generator and Turbine Generator shall be cooled by Demineralised (DM) water in a closed circuit. The primary circuit DM water shall be cooled through plate type heat exchangers by Clarified water. The hot secondary circuit cooling water shall be cooled in the cooling towers and shall be returned back to the system. It is proposed to provide independent primary cooling water circuit for Steam Generator & auxiliaries and TG & its auxiliaries.
1.10.03	**Station Auxiliaries Cooling Water System** The station auxiliaries such as Air compressors, Compressors of ash handling plant, Cooling water circuit of Air Conditioning system, compressor of mill reject system etc. shall be cooled by clarified water pumped by station auxiliary cooling water system The hot station auxiliary cooling water shall be cooled in the auxiliary cooling towers and returned back to the system.

CLAUSE NO.	PROJECT INFORMATION
1.10.04	**Ash Water System** a) It is proposed to operate ash water system in a closed circuit. The ash water from the ash dyke shall be recirculated . Make up to the ash water system (to compensate for the ash water system evaporation loss in ash dyke) shall be supplied from excess CW blow down water (Service water) and raw water supply from water source of the plant.
1.10.05	**Other Miscellaneous Water Systems** a) CW system blow down water shall be used for the plant service water requirement, ash slurry pumps sealing, sealing of Vacuum pumps (if applicable) of Ash Handling plant, make-up to fire water storage tanks and cooling water requirement of hydrogen generation plant. The balance CW blowdown ,service (wash water) water collected from various areas shall be treated using oil water separators, tube settlers, coal settling pits etc. as per requirement and treated water from liquid effluent treatment plant shall be recycled back to the service water system for re-use. The excess service water shall be led to central monitoring basin for disposal. b) Separate water Pre-treatment plants are proposed for Circulating Water (PT-CW) system and Demineralisation Plant (PT-DM) plant c) The drinking water requirement of the plant and colony shall be provided from the above mentioned Water (PT-CW) pretreatment plant. d) Steam Cycle make-up water, makeup to the primary circuit of ECW (unit auxiliaries) system, boiler fill water and makeup to the hydrogen generation plant shall be provided from Demineralising plant. e) The quality of cooling water & DM water is given in this sub-section.
1.11.00	**Criteria for Earthquake Resistant Design of Structures and Equipment** All power plant structures and equipment, including plant auxiliary structures and equipment shall be designed for seismic forces as given in this sub-section as **Annexure-V.**
1.12.00	**Criteria for Wind Resistant Design of Structures and Equipment** All structures and equipment of the power plant, including plant auxiliary structures and equipment, shall be designed for wind forces as given as given in this sub-section as **Annexure-VI.**

SECTION B

CLAUSE NO.	PROJECT INFORMATION

ANNEXURE-I

BHARAT HEAVY ELECTRICALS LIMITED * NEW DELHI * PS-MKTG

Annexure-II

जलवायवी सारणी
CLIMATOLOGICAL TABLE

स्टेशन झारसुगुडा
STATION : Jharsuguda — अक्षांश LAT 21°55' N — देशांतर LONG 84°05' E — समुद्री तल माध्य से ऊँचाई HEIGHT ABOVE M. S. L. 230 मीटर METRES

1951 से 1980 तक के प्रेक्षणों पर आधारित
BASED ON OBSERVATIONS FROM 1951 TO 1980

वायु तापमान AIR TEMPERATURE

माह MONTH		स्टेशन का सतह दाब STATION LEVEL PRESSURE (एच. पी. ए. hPa)	माध्य MEAN: शुष्क बल्ब DRY BULB (डि.से. °C)	नम बल्ब WET BULB (°C)	दैनिक अधिक तम DAILY MAX (°C)	दैनिक न्यून तम DAILY MIN (°C)	माह में उच्चतम HIGHEST IN THE MONTH (°C)	माह में निम्नतम LOWEST IN THE MONTH (°C)	चरम EXTREMES: उच्चतम HIGHEST (°C)	दिनांक और वर्ष DATE AND YEAR	निम्नतम LOWEST (°C)	दिनांक और वर्ष DATE AND YEAR
जनवरी JAN	I	990.6	16.7	13.4	27.7	12.0	30.8	7.5	33.2	04	6.0	10
	II	986.9	23.9	16.4						1973		1976
फरवरी FEB	I	988.6	20.1	15.1	30.6	14.7	35.0	9.9	37.9	22	7.2	02
	II	984.4	28.0	17.8						1967		1967
मार्च MAR	I	986.2	25.4	17.6	35.5	19.0	40.0	13.9	42.7	31	11.1	01
	II	981.6	32.9	19.4						1955		1961
अप्रैल APR	I	982.8	30.8	21.3	40.1	24.2	43.6	19.2	46.0	29	15.8	01
	II	977.6	37.2	21.4						1973		1957
मई MAY	I	978.5	32.9	23.9	41.8	27.1	45.3	22.3	48.0	22	19.3	04
	II	973.5	38.9	23.1						1978		1963
जून JUN	I	975.1	30.2	25.0	37.2	26.4	40.4	22.0	46.0	01	16.3	17
	II	971.3	33.4	25.1						1976		1973
जुलाई JUL	I	975.1	26.9	25.0	31.3	24.6	34.6	22.3	38.2	06	17.4	30
	II	972.2	28.5	25.6						1979		1976
अगस्त AUG	I	976.1	26.8	25.1	31.0	24.5	34.0	22.4	36.2	03	16.6	16
	II	973.2	28.1	25.5						1972		1976
सितम्बर SEP	I	979.7	27.2	25.0	31.8	24.3	34.4	22.3	37.0	11	16.7	05
	II	976.3	28.4	25.3						1966		1976
अक्तूबर OCT	I	985.4	25.7	22.6	31.9	21.6	34.3	17.9	36.1	19 @	12.1	26
	II	981.9	28.1	23.2						1974		1976
नवम्बर NOV	I	989.4	21.3	17.4	30.0	16.0	32.4	12.0	35.6	08	8.4	30
	II	985.6	25.3	18.9						1976		1970
दिसम्बर DEC	I	991.1	17.2	13.6	27.6	12.0	30.2	8.3	32.0	02 @	6.1	29
	II	987.3	23.0	16.2						1977		1955
वार्षिक योग या माध्य ANNUAL TOTAL OR MEAN	I	983.2	25.1	20.4	33.1	20.5	45.6	7.2	48.0		6.0	
	II	979.3	29.6	21.5								
वर्षों की सं NUMBER OF YEARS	I	30	30	30	28	28	28	28	30		30	
	II	30	30	30								

आर्द्रता HUMIDITY — मेघ की मात्रा CLOUD AMOUNT — वर्षा RAINFALL

माह MONTH		सापेक्ष आर्द्रता RELATIVE HUMIDITY (प्रतिशत %)	वाष्प दाब VAPOUR PRESSURE (hPa)	समस्त मेघ ALL CLOUDS (आकाश के अष्टमांश Oktas of sky)	निम्न मेघ LOW CLOUDS	मासिक योग MONTHLY TOTAL (मि.मि. mm)	वर्षा के दिनों की संख्या NO. OF RAINY DAYS	सर्वाधिक वर्षा वाले महीने का योग TOTAL IN WETTEST MONTH WITH YEAR (mm)	सर्वाधिक शुष्कतम महीने का योग TOTAL IN DRIEST MONTH WITH YEAR (mm)	24 घंटों में सबसे भारी वर्षा HEAVIEST FALL IN 24 HOURS (mm)	दिनांक और वर्ष DATE AND YEAR	माध्य पवन गति MEAN WIND SPEED (कि.मी. प्र. घं. Kmph)
जनवरी JAN	I	67	12.8	1.7	0.5	12.5	1.1	61.4	0.0	36.4	11	5.6
	II	43	12.7	2.1	0.8			1957			1968	
फरवरी FEB	I	57	13.2	1.7	0.6	16.0	1.3	116.7	0.0	46.7	08	6.3
	II	33	12.2	2.0	1.0			1961			1981	
मार्च MAR	I	44	14.0	1.8	0.5	21.0	1.8	97.8	0.0	58.7	26	6.9
	II	25	11.8	2.4	0.9			1951			1951	
अप्रैल APR	I	41	17.7	2.1	0.5	13.8	1.4	58.9	0.0	31.8	18	7.5
	II	21	12.8	3.2	1.7			1971			1952	
मई MAY	I	46	22.3	2.5	0.6	29.8	2.2	107.8	0.0	63.6	14	8.0
	II	24	15.5	3.6	2.1			1969			1963	
जून JUN	I	80	27.4	6.0	2.8	228.7	9.5	524.9	42.2	197.9	11	9.3
	II	54	25.1	6.6	3.5			1956	1979		1961	
जुलाई JUL	I	86	30.2	7.2	4.3	402.7	17.5	770.7	230.6	189.6	06	9.0
	II	79	30.5	7.3	4.5			1961	1955		1961	
अगस्त AUG	I	87	30.6	7.2	4.3	428.5	17.3	657.9	212.1	257.8	20	8.3
	II	81	30.9	7.3	4.5			1960	1965		1975	
सितम्बर SEP	I	83	29.9	6.0	3.2	233.1	11.7	714.5	42.5	190.9	03	6.8
	II	77	29.6	6.7	3.9			1961	1974		1973	
अक्तूबर OCT	I	75	24.9	3.6	1.5	85.9	4.0	181.5	0.2	110.2	09	5.5
	II	65	24.5	4.2	2.2			1961	1979		1952	
नवम्बर NOV	I	66	17.0	2.1	0.5	4.3	0.4	28.7	0.0	26.6	24	5.7
	II	52	16.8	2.6	0.9			1953			1972	
दिसम्बर DEC	I	67	13.2	1.8	0.3	3.4	0.5	22.0	0.0	18.8	01	5.3
	II	47	13.1	2.1	0.5			1978			1978	
वार्षिक योग या माध्य ANNUAL TOTAL OR MEAN	I	65	21.1	3.6	1.6	1460.9	66.7	2656.6	901.0	257.8		7.0
	II	50	19.6	4.2	2.2			1961	1979			
वर्षों की सं NUMBER OF YEARS	I	30	30	30	23	30	30	30	30	30		28
	II	30	30	30	23							

जलवायवी सारणी
CLIMATOLOGICAL TABLE

स्टेशन झारसुगुडा
STATION : Jharsuguda

मौसम परिघटना — WEATHER PHENOMENA (No. OF DAYS WITH)

MONTH	PPT 0.3mm or more	HAIL	THUNDER	FOG	DUST STORM	SQUALL
जनवरी JAN	1.7	0.0	0.8	0.4	0.0	0.1
फरवरी FEB	2.2	0.1	1.8	0.2	0.0	0.2
मार्च MAR	3.1	0.0	3.7	0.1	0.1	0.5
अप्रैल APR	2.9	0.0	4.5	0.0	0.2	1.1
मई MAY	4.1	0.0	6.7	0.0	0.4	2.2
जून JUN	13.0	0.0	12.6	0.1	0.4	1.6
जुलाई JUL	22.7	0.0	10.4	0.0	0.0	0.4
अगस्त AUG	22.4	0.0	12.9	0.0	0.0	0.1
सितम्बर SEP	16.6	0.0	12.0	0.2	0.0	0.2
अक्तूबर OCT	6.1	0.0	3.7	0.4	0.0	0.1
नवम्बर NOV	0.9	0.0	0.1	0.1	0.0	0.0
दिसम्बर DEC	0.6	0.0	0.3	0.1	0.0	0.0
वार्षिक योग या माध्य ANNUAL TOTAL OR MEAN	96.3	0.1	69.8	1.8	1.1	6.7
वर्षों की संख्या NUMBER OF YEARS	30					

पवन — WIND

MONTH		No. OF DAYS WITH WIND SPEED (Km. p. h.) 62 or more	20-61	1-19	0	PERCENTAGE No. OF DAYS WIND FROM N	NE	E	SE	S	SW	W	NW	CALM
JAN	I	0	0	28	3	32	45	7	1	1	1	0	3	10
	II	0	0	19	12	8	10	3	4	14	12	8	6	36
FEB	I	0	0	25	3	33	41	6	3	3	1	0	3	10
	II	0	0	22	6	8	10	4	4	16	13	15	10	22
MAR	I	0	1	25	5	23	31	7	7	5	3	3	4	17
	II	0	1	25	5	7	5	3	4	19	14	12	13	16
APR	I	0	1	24	5	9	12	7	12	17	15	8	5	15
	II	0	2	24	4	4	5	3	5	20	20	20	14	9
MAY	I	0	1	26	4	3	8	5	19	22	18	7	4	14
	II	0	3	25	3	5	6	4	9	18	15	20	15	9
JUN	I	0	3	24	3	1	6	4	9	15	28	23	4	10
	II	0	4	23	3	5	6	6	10	14	21	22	7	9
JUL	I	0	3	26	2	2	6	3	4	17	31	26	4	7
	II	0	3	26	2	2	5	4	7	15	30	24	5	8
AUG	I	0	2	26	3	2	8	4	8	15	25	26	4	9
	II	0	2	25	4	2	4	4	8	15	26	24	5	12
SEP	I	0	1	23	6	4	13	8	10	11	14	16	5	15
	II	0	1	23	6	4	7	7	11	12	16	18	6	19
OCT	I	0	0	24	7	16	34	11	6	4	3	3	3	20
	II	0	0	19	12	5	12	10	10	7	7	7	4	38
NOV	I	0	0	26	4	35	43	5	2	1	0	0	2	12
	II	0	0	16	14	6	15	11	6	5	4	3	3	47
DEC	I	0	0	28	3	40	43	3	1	0	0	0	2	11
	II	0	0	18	13	7	13	6	3	10	9	8	3	43
ANNUAL TOTAL OR MEAN	I	0	12	305	48	17	24	6	7	9	12	9	4	12
	II	0	16	265	84	5	8	5	7	14	16	16	8	21
NUMBER OF YEARS	I	24				27								
	II	24				27								

मेघ — CLOUD

MONTH		No. OF DAYS WITH CLOUD AMOUNT (ALL CLOUDS) OKTAS 0	1-2	3-5	6-7	8	No. OF DAYS WITH LOW CLOUD AMOUNT OKTAS 0	1-2	3-5	6-7	8	FOG #
JAN	I	16	6	5	3	1	26	3	2	0	0	0
	II	14	7	5	4	1	22	5	4	0	0	0
FEB	I	16	5	4	2	1	23	3	2	0	0	0
	II	13	6	5	3	1	18	6	4	0	0	0
MAR	I	18	5	4	3	1	26	3	2	0	0	0
	II	13	6	6	5	1	19	6	4	0	0	0
APR	I	13	6	8	4	1	24	4	2	0	0	0
	II	6	7	9	6	2	11	11	7	1	0	0
MAY	I	9	9	8	4	1	22	8	3	0	0	0
	II	3	6	11	8	3	8	10	12	1	0	0
JUN	I	1	2	7	11	9	8	6	10	4	0	0
	II	0	1	5	13	11	2	6	18	4	0	0
JUL	I	0	0	3	11	17	1	4	17	9	0	0
	II	0	0	2	11	18	1	3	19	8	0	0
AUG	I	1	0	3	11	16	1	4	17	9	0	0
	II	0	0	1	13	17	0	3	20	8	0	0
SEP	I	0	2	7	12	9	4	7	14	5	0	0
	II	0	1	4	14	11	1	5	19	5	0	0
OCT	I	9	5	7	7	3	16	6	7	2	0	0
	II	3	7	8	9	4	7	11	11	2	0	0
NOV	I	14	6	5	4	1	24	4	2	0	0	0
	II	9	7	7	5	2	19	7	4	0	0	0
DEC	I	15	6	6	3	1	28	2	1	0	0	0
	II	12	9	8	3	1	25	4	2	0	0	0
ANNUAL TOTAL OR MEAN	I	112	52	65	79	51	203	54	79	29	0	0
	II	73	57	69	94	72	130	79	124	29	0	0
NUMBER OF YEARS	I	27					27					
	II	26					26					

दृश्यता — VISIBILITY (No. OF DAYS WITH VISIBILITY)

MONTH		UP TO 1 Km	1-4 Kms	4-10 Kms	10-20 Kms	OVER 20 Kms
JAN	I	0.1	0.3	22.9	7.4	0.3
	II	0.0	0.0	19.4	10.3	1.3
FEB	I	0.0	0.1	19.2	8.7	0.0
	II	0.0	0.0	14.8	13.2	0.2
MAR	I	0.0	0.4	22.1	8.1	0.4
	II	0.0	0.1	17.3	12.3	1.3
APR	I	0.0	0.3	19.2	9.8	0.9
	II	0.0	0.2	15.2	13.7	0.9
MAY	I	0.0	0.1	18.7	12.1	0.1
	II	0.1	0.5	17.2	12.9	0.3
JUN	I	0.0	0.2	19.3	10.2	0.3
	II	0.1	0.7	19.1	9.8	0.5
JUL	I	0.0	1.9	21.8	7.2	0.1
	II	0.0	1.0	22.0	7.9	0.1
AUG	I	0.0	0.8	22.0	8.0	0.2
	II	0.0	1.7	20.5	8.6	0.2
SEP	I	0.0	0.3	18.0	10.6	0.1
	II	0.0	0.3	20.8	8.8	0.1
OCT	I	0.0	0.2	20.9	9.8	0.1
	II	0.0	0.2	22.3	8.5	0.0
NOV	I	0.0	0.2	21.9	7.7	0.2
	II	0.0	0.1	24.3	5.6	0.0
DEC	I	0.0	0.5	26.4	4.1	0.0
	II	0.0	0.1	27.2	3.8	0.1
ANNUAL TOTAL OR MEAN	I	0.1	5.3	253.4	103.5	2.7
	II	0.2	4.9	239.9	115.0	5.0
NUMBER OF YEARS	I	27				
	II	26				

BHARAT HEAVY ELECTRICALS LIMITED PS-MKTG.

CLAUSE NO.	PROJECT INFORMATION	एनटीपीसी NTPC

Annexure – III

DESIGN CLARIFIED WATER ANALYSIS

S.No	Constituent	As	mg/l
1	Calcium	$CaCO_3$	135
2	Magnesium	$CaCO_3$	88
3	Sodium	$CaCO_3$	40
4	Potassium	$CaCO_3$	9
	Total cations	$CaCO_3$	272
4	HCO3	$CaCO_3$	173
5	P-alkalinity	$CaCO_3$	0
6	Chloride	$CaCO_3$	36
7	Sulphate	$CaCO_3$	63
	Total Anions	$CaCO_3$	272
8	Silica, Reactive	Si	8
9	Iron (Total)	Fe	0.5
10	pH		7.0- 7.8
11	Turbidity	NTU	10
12	Total Dissolved Solids		210-270
13	Temperature	^0C	20 - 35

Note : The C.W system is expected to operate at about 3 Cycles of Concentration. As CW blow down water (Service Water) is tapped from discharge of CW pumps, the water quality of CW Blow down water shall be same as that above.

BHARAT HEAVY ELECTRICALS LIMITED * NEW DELHI * BS-IIKTG

SECTION B

CLAUSE NO.	PROJECT INFORMATION

Annexure – IV

ANALYSIS OF DM WATER TO BE USED FOR MAKE-UP WATER TO CONDENSER

S.No.	Characteristics		Value
i)	Silica (Max.)	-	0.02 ppm as SiO_2
ii)	Iron as Fe	-	Nil
iii)	Total hardness	-	Nil
iv)	pH value	-	6.8 to 7.2
v)	Conductivity	-	Not more than 0.1 excluding the effects of free CO_2

BHARAT HEAVY ELECTRICALS LTD. * NEW DELHI * PS-MKTG

CLAUSE NO.	PROJECT INFORMATION

Annexure - V

1.01.00 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):2002 and IS:1893 (Part 4):2005. Pending finalisation of Parts 2, 3 and 5 of IS:1893, provisions of part 1 shall be read along with the relevant clauses of IS:1893:1984, for structures other than the buildings and industrial structures including stack-like structures.

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-A to Annexure-V.

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-A to Annexure-V 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 and Part 4).

1.01.01 Damping in Structures

The damping factor (as a percentage of critical damping) to be adopted shall not be more than as indicated below for:

a)	Steel structures	:	2%
b)	Reinforced Concrete structures	:	5%
c)	Reinforced Concrete Stacks	:	3%
d)	Steel stacks	:	2%

CLAUSE NO.	PROJECT INFORMATION
1.01.02	**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). 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. For regular buildings less than 12m in height, design seismic base shear and its distribution to different floor levels along the height of the building may be carried out as specified under clause 7.5, 7.6 & 7.7 of IS:1893 (Part 1) and using site specific design acceleration spectra. The design horizontal acceleration spectrum value (Ah) shall be computed for the fundamental natural period as per clause 7.6 of IS:1893 (Part 1) using site specific spectral acceleration coefficients with appropriate multiplying factor given in APPENDIX-A to Annexure-V.Further, the spectral acceleration coefficient shall get restricted to the peak spectral value if the fundamental natural period of the building falls to the left of the peak in the spectral acceleration curve.
1.01.03	**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.
1.02.00	**SITE SPECIFIC SEISMIC PARAMETERS FOR DESIGN OF STRUCTURES AND EQUIPMENT** For site specific seismic parameters for design of structures and equipment refer Appendix-A to Annexure-V.

BHARAT HEAVY ELECTRICALS LIMITED * NEW DELHI * PS-MKTG.

CLAUSE NO.	PROJECT INFORMATION एनटीपीसी NTPC

APPENDIX-A TO ANNEXURE-V

The various site specific seismic parameters for the project site shall be as follows:

1) Peak ground horizontal acceleration (MCE) : 0.10g

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 ordinary moment resisting steel frames designed and detailed as per IS:800 : 0.029

   b) for braced steel frames designed and detailed as per IS:800 : 0.022

   c) For special moment resisting RC frames designed and detailed as per IS:456 and IS:13920 : 0.018

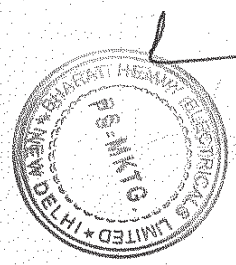
   d) for steel chimney : 0.044

   e) for design of structures not covered under 2 (a) to 2 (d) above and under 3 below : 0.029

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 : 0.058

Note: g = Acceleration due to gravity

The horizontal seismic acceleration spectral coefficients are furnished in subsequent pages.



SECTION B

CLAUSE NO.	PROJECT INFORMATION

APPENDIX-A TO ANNEXURE-V

HORIZONTAL SEISMIC ACCELERATION SPECTRAL COEFFICIENTS
(In units of 'g')

Time Period	Damping Factor (as a percentage of critical damping)		
(Sec)	2%	3%	5%
0.000	1.000	1.000	1.000
0.030	1.000	1.000	1.000
0.031	1.031	1.026	1.020
0.050	1.618	1.502	1.371
0.060	1.921	1.736	1.534
0.070	2.221	1.963	1.687
0.080	2.519	2.183	1.832
0.086	2.697	2.312	1.915
0.088	2.756	2.355	1.943
0.090	2.815	2.398	1.970
0.095	2.962	2.503	2.036
0.098	3.050	2.566	2.076
0.100	3.109	2.607	2.102
0.103	3.196	2.669	2.141
0.108	3.342	2.772	2.204
0.110	3.401	2.813	2.229
0.112	3.459	2.854	2.254
0.115	3.546	2.914	2.291
0.118	3.633	2.975	2.328
0.121	3.720	3.035	2.364
0.122	3.749	3.055	2.376
0.125	3.836	3.114	2.412
0.127	3.893	3.154	2.436
0.129	3.951	3.193	2.460
0.130	3.980	3.213	2.471
0.132	3.980	3.252	2.495
0.134	3.980	3.291	2.518
0.140	3.980	3.408	2.587
0.141	3.980	3.410	2.598
0.150	3.980	3.410	2.700
0.200	3.980	3.410	2.700
0.250	3.980	3.410	2.700
0.300	3.980	3.410	2.700
0.350	3.980	3.410	2.700
0.400	3.980	3.410	2.700
0.431	3.980	3.410	2.700

APPENDIX-A TO ANNEXURE-V

HORIZONTAL SEISMIC ACCELERATION SPECTRAL COEFFICIENTS
(In units of 'g')

Time Period	Damping Factor (as a percentage of critical damping)		
(Sec)	2%	3%	5%
0.442	3.980	3.410	2.700
0.450	3.980	3.410	2.700
0.474	3.980	3.410	2.700
0.495	3.980	3.410	2.700
0.500	3.980	3.410	2.700
0.517	3.849	3.298	2.611
0.525	3.790	3.248	2.571
0.542	3.672	3.146	2.491
0.550	3.618	3.100	2.455
0.562	3.541	3.034	2.402
0.576	3.455	2.960	2.344
0.588	3.384	2.900	2.296
0.597	3.333	2.856	2.261
0.603	3.300	2.828	2.239
0.609	3.268	2.800	2.217
0.615	3.236	2.772	2.195
0.625	3.184	2.728	2.160
0.640	3.109	2.664	2.109
0.658	3.024	2.591	2.052
0.667	2.984	2.556	2.024
0.690	2.884	2.471	1.957
0.700	2.843	2.436	1.929
0.750	2.653	2.273	1.800
0.755	2.636	2.258	1.788
0.800	2.488	2.131	1.688
0.850	2.341	2.006	1.588
0.900	2.211	1.894	1.500
0.950	2.095	1.795	1.421
1.000	1.990	1.705	1.350
1.050	1.895	1.624	1.286
1.100	1.809	1.550	1.227
1.150	1.730	1.483	1.174
1.200	1.658	1.421	1.125
1.250	1.592	1.364	1.080
1.300	1.531	1.312	1.038
1.350	1.474	1.263	1.000
1.400	1.421	1.218	0.964

CLAUSE NO.	PROJECT INFORMATION

APPENDIX-A TO ANNEXURE-V

HORIZONTAL SEISMIC ACCELERATION SPECTRAL COEFFICIENTS
(In units of 'g')

Time Period	Damping Factor (as a percentage of critical damping)		
(Sec)	2%	3%	5%
1.450	1.372	1.176	0.931
1.500	1.327	1.137	0.900
1.550	1.284	1.100	0.871
1.600	1.244	1.066	0.844
1.650	1.206	1.033	0.818
1.700	1.171	1.003	0.794
1.750	1.137	0.974	0.771
1.800	1.106	0.947	0.750
1.850	1.076	0.922	0.730
1.900	1.047	0.897	0.711
1.950	1.021	0.874	0.692
2.000	0.995	0.853	0.675
2.050	0.971	0.832	0.659
2.100	0.948	0.812	0.643
2.150	0.926	0.793	0.628
2.200	0.905	0.775	0.614
2.250	0.884	0.758	0.600
2.300	0.865	0.741	0.587
2.350	0.847	0.726	0.574
2.400	0.829	0.710	0.563
2.450	0.812	0.696	0.551
2.500	0.796	0.682	0.540
2.550	0.780	0.669	0.529
2.600	0.765	0.656	0.519
2.650	0.751	0.643	0.509
2.700	0.737	0.631	0.500
2.750	0.724	0.620	0.491
2.800	0.711	0.609	0.482
2.850	0.698	0.598	0.474
2.900	0.686	0.588	0.466
2.950	0.675	0.578	0.458
3.000	0.663	0.568	0.450
3.050	0.652	0.559	0.443
3.100	0.642	0.550	0.435
3.150	0.632	0.541	0.429
3.200	0.622	0.533	0.422
3.250	0.612	0.525	0.415

CLAUSE NO.	PROJECT INFORMATION

APPENDIX-A TO ANNEXURE-V

HORIZONTAL SEISMIC ACCELERATION SPECTRAL COEFFICIENTS
(In units of 'g')

Time Period	Damping Factor (as a percentage of critical damping)		
(Sec)	2%	3%	5%
3.300	0.603	0.517	0.409
3.350	0.594	0.509	0.403
3.400	0.585	0.501	0.397
3.450	0.577	0.494	0.391
3.500	0.569	0.487	0.386
3.550	0.561	0.480	0.380
3.600	0.553	0.474	0.375
3.650	0.545	0.467	0.370
3.700	0.538	0.461	0.365
3.750	0.531	0.455	0.360
3.800	0.524	0.449	0.355
3.850	0.517	0.443	0.351
3.900	0.510	0.437	0.346
3.950	0.504	0.432	0.342
4.000	0.498	0.426	0.338

BHARAT HEAVY ELECTRICALS LIMITED * NEW DELHI * P.S.-MKTG.

CLAUSE NO.	PROJECT INFORMATION

ANNEXURE-VI

1.01.00 **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 APPENDIX – B TO ANNEXURE-VI 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.

1.01.01 **Damping in Structures**

The damping factor (as a percentage of critical damping) to be adopted shall not be more than as indicated below for:

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.

BHARAT HEAVY ELECTRICALS LIMITED PS-MKTG NEW DELHI

CLAUSE NO.	PROJECT INFORMATION

APPENDIX-I TO ANNEXURE-VI

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 "Vb" at ten metres above the mean ground level	:	39 metres/second
b) The risk coefficient "K1"	:	1.06
c) Category of terrain	:	Category-2

Note: Notwithstanding the values of the above mentioned parameters, the design wind pressure so computed at any point shall not be taken less than 1500 N/Sq. metre for all classes of structures, i.e. A, B & C, as defined in IS: 875 (Part-3).

VOLUME - II B

SECTION C1
SUB-SECTION - I

SCOPE OF SUPPLY,TERMINAL POINTS AND EXCLUSIONS

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 Total lump sum for Equipment & Services as specified, comprising of design & engineering, manufacture, inspection & testing at manufacturer's works, painting at manufacturer's works, duly packed for transportation, delivery to site, unloading storage & handling at site, erection & commissioning, carrying out performance/acceptance tests at site & final painting of complete Compressed Air System consisting of following equipment:

1.1.1 Three (3) Nos. Instrument Air Compressors (Oil Free Screw / Centrifugal type) each of minimum 60 NM^3/Min capacity at 8 Kg/sqcm (min) discharge pressure with electric motor drive, suction filter with silencer, inter cooler and after cooler with moisture separators, automatic drain traps, instruments, control system and other accessories.

1.1.2 Three (3) Nos. Air Drying Plants Heat of compression (HOC) Rotary type / Dual Tower Type of min. 60 NM^3/min. capacity connected to above IA compressors with all instruments, control panels and other accessories as specified.

1.1.3 Four (4) Nos. Service Air Compressors (Oil Free Screw/Centrifugal type) each of minimum 60 NM^3/Min capacity at 8 Kg/sqcm (min) discharge pressure with electric motor drive, suction filter with silencer, inter cooler and after cooler with moisture separators, automatic drain traps, instruments, control system and other accessories.

1.1.4 Nine (9) Nos. Air Receivers (Seven (7) nos adjacent to compressor house and two (2) nos in TG Hall B-C Bay) of minimum ten (10) Cu.M capacity each with instruments, relief valve, drain connection with automatic trap stations and other accessories as specified.

1.1.5 One (1) No Air Receiver of minimum two (2) Cu.M capacity near DM plant with instruments, relief valve, drain connection with automatic trap stations and other accessories as specified.

1.1.6 Three (3) Nos. Electronic Dew point meters.

1.1.6.1 Pipes for compressed air line & interconnecting airline shall be galvanized as per IS-4736 and shall conform to IS-1239 Part-1 Heavy Grade Size up to 150 NB and IS-3589 for sizes greater than 150 mm NB. Fittings for air piping shall be conforming to IS-1239 Part-II, cooling water piping will be M.S. conforming to IS: 1239 (Part-I) (Heavy Grade). Fittings for cooling water line ASTM A-234 Gr. WPB for sizing including 65 mm NB and above and ASTM A 105 or as compatible with IS 1239 for size up to 50 NB. including hanger/supports, auxiliary structural members etc. inclusive of all cu-tubing for control air piping, 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 including drain piping - Lot .

1.1.7 All airline valves shall be ball valve type. Valves for airline shall be Cast Steel body above 50 NB and Forged Steel Body up to 50 NB with SS internals. Valve size 65 Nb and above with flanged end, valve size 50 Nb and below with screwed. For water service, cast iron valves with GM internals as per relevant IS/equivalent and other applicable standards above 50 mm size. Gunmetal valves as per IS-778/equivalent up to size 50mm– Lot

1.1.8 Field instruments as specified, all instruments necessary for performance testing of compressors as well as air drying plants.

1.1.9 Control and Instrumentation – Individual compressor control shall be through compressor mounted PLC / microprocessor based control panel. Each compressor shall be interfaced with DCS through gateway / convertor for start, stop, load and unload from common control room (CCR) including giving input for developing software at DCS (by BHEL EDN) and hardware link for status monitoring, start/stop, load/unload from CCR.

1.1.10 Control cable from Compressor House to HT Switch Gear & Signal cable between Compressor House & DDCMIS (SG C&I) as specified elsewhere in the technical specification - Lot

The Bidder shall also provide Vibration monitoring system for all compressors and their motors as mentioned in different sections of this specification.

1.1.11 Maintenance tools and tackles, start up and commissioning spares, consumables, first fill of lubricants inclusive of packing – Lot

1.1.12 Any other item not included above or in specification but required for Compressed Air System.

1.1.13 The maximum velocity to be considered in compressed air shall be 15.0 m/s(under Average pr. & Temp. Conditions).

1.1.14 Civil works:-Minor dressings of foundation blocks, equipment grouting, supply and fixing of supports etc. on walls, foundations; floor and trenches will be done by successful bidder.

1.1.15 Design, all calculations, equipment selection criterion, layout drawings/schemes/G.A. drg and documents like data sheet/Technical particulars etc. shall be prepared by successful bidder and shall be subjected to Customer & BHEL approval during detail engineering stage.

1.1.16 All drawings and documents shall be computer based.

1.1.17 All commissioning spares & consumables for trouble free operation shall be in scope of bidder.

1.1.18 Bidder to clearly note that the instruments, valves etc as shown in the P&I Diagram (documents attached with this specification) is the bare minimum and any additional instruments/valves required to complete the system in line with Technical Specification shall be supplied by the bidder without any commercial implication.

1.1.19 Quality Plans attached in different sections of this specification are indicating minimum requirements for inspection and testing. Bidder shall note that quality plan is subject to Customer & BHEL approval during detail engineering stage.

1.1.20 Compressed air plant supplier to furnish drawings/documents as per the drgs./documents distribution as per project requirement.

1.1.21 List of Makes is enclosed in the Technical Specification. Compressed air plant supplier to note that Makes of equipment/items shall be subject to BHEL & Customer approval during detail engineering stage.

1.1.22 Bidder to confirm that there is no deviation from the tech specification and furnish signed no deviation certificate enclosed as Annexure-I of the Technical Specification.

1.1.23 If any deviation is there then same to be indicated separately under the heading “Schedule of Technical Deviation” enclosed as per Annexure III of the Technical Specification along with Cost of Withdrawal. Incase 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.

2.0 TERMINAL POINTS :

2.1 Bidder will terminate compressed air piping at common IA header and common SA header downstream of air receiver with isolation valve as per enclosed tender drawing.

2.2 300 Nb Cooling water supply pipeline connection will be provided by the purchaser outside the compressor house (at 5.0 m from compressor house building).The return hot water shall be terminated by the contractor at the same location. Further interconnection from these terminal points shall be in bidder's scope. Refer enclosed tender drawing.

3.0 EXCLUSIONS:

3.1 MCC/Switchgear for power supply to Air Compressors and other drives and panels.

3.1.1 Civil works including construction of compressor house, foundation of all compressor, air dryer and air receiver, pipe / cable trenches.

3.1.2 Lighting and ventilation of compressor house.

3.1.3 Monorail hoists/Cranes as necessary for handling of equipment after erection.

3.1.4 Compressed Air Distribution Piping running from isolation valve of the IA & SA header after the air receivers outside the compressor house.

4.0 BIDDER TO NOTE THE FOLLOWING INFORMATION:

4.0.0 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.

4.1.0 Compressor and air dryer shall be designed for cooling water (ACW compressor cooling water system) with inlet temp of thermal 36 deg C and terminal pressure 6 kg/sqcm(g). Bidder to restrict the temperature rise to 10 deg C and pressure drop across Compressed Air System within terminal points to 10 MWC. Qty of cooling water shall be 560 cum/hr (Maximum) considering working equipment only.

4.2.0 Design Inlet conditions for Compressor
a) Temp : 45.0 Deg C
b) Relative humidity : 75%
c) Altitude : 222.0 m above MSL

VOLUME - II B

SECTION C1
SUB-SECTION - II

SPECIFIC TECHNICAL REQUIREMENTS
MECHANICAL

1.00.00 FUNCTION

The purpose of this system is the supply of Instrument and service air through the distribution system to the different areas of DARLIPALI STPP, STAGE I (2x800 MW) Power Plant as indicated in this specification.

2.00.00 SYSTEM DESCRIPTION

2.01.01 Compressed air system includes the following: Three (3) no. (2W + 1S) Instrument air compressors and Four (4) no. Service air compressor (2W+2S), including drives, intercoolers, after coolers, step up gearbox, silencer and other accessories.

In addition, the service air compressor may be used for instrument air system connecting ADP with plant air compressor in case of instrument air compressor failure.

Two nos. of standby service air compressors will remain in operation as per requirement to cater the enhanced service air during **"start-up & flame stabilisation"** of boiler, where in LDO will be fired till 30% of BMCR. In addition to, instrument air compressor can also be utilised to cater the service air requirements for LDO Firing during **"start-up & flame stabilisation"** of boiler.

Refer P & I diagram attached for detailed arrangement.

2.01.02 Three (3) nos. (2W+1S) Heat of Compression type air-drying plants (Conventional Twin Tower type / single rotary drum type) suitable for connecting to individual instrument air compressor.

2.01.03 Intake air filters.

2.01.04 Ten (10) nos. air receivers, (i.e. one for each compressor near compressor house & 2 nos. unit air receiver of 10m^3 capacity and 1 no. Air receiver of capacity 2M^3 for DM Plant).

2.01.05 All interconnecting piping, valves, fittings, supports/hangers, control air tubing (complete with valves and fittings between air receiver, compressor and local panel for each compressor), cooling water piping & valves for safe and satisfactory operation of air compressors.

2.01.06 All instruments including the electronic on line dew point meter with suitable sampling connection.

3.00.00 EQUIPMENT DESIGN CRITERIA

3.01.00 Equipment Description:

3.01.01 The minimum requirements of design and construction features of various components of Compressed air system (screw /Centrifugal type air compressor, air dryer, air receiver etc.) are described below.

3.01.02 The motor drives shall be as per relevant Electrical sub-section of Technical Specification.

3.02.00 Screw Air Compressors

3.02.01 **CODES AND STANDARDS**

3.02.02 The design, manufacture, testing and performance of the various components of the Rotary Screw type Air Compressors shall comply with the requirements of one or more of the following codes, as applicable :

3.02.03 IS-5456: Code of Practice for testing of positive displacement type air compressors and exhausters.

3.02.04 IS-10431 [part -1]: Measurement of Air Flow of Compressors and Exhausters.

3.02.05 ASME PTC-9: Performance Test Codes for Displacement Compressors, Vacuum Pumps and Blowers.

3.02.06 IS-6206: Guide for selection, installation and maintenance of Air compressor plants with operating pressure up to 10 bars.

3.02.07 IS-5727: Glossary of terms relating to compressors and Exhausters

3.02.08 CAGI: Compressed Air & Gas Institute

3.02.09 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.

3.02.10 The materials of the various components shall conform to the applicable IS/BS/ASTM/DIN Standards.

3.02.11 In case of any contradiction with the aforesaid standards and the stipulations as per this Technical Specification and Technical Data Sheets, the stipulations of the Technical Specification and Technical Data Sheets shall prevail. In case of any contradiction between Technical Specification and Technical Data Sheet, stipulations of the later shall prevail.

3.03.00 PERFORMANCE REQUIREMENT

3.03.01 Air Compressors shall be designed for continuous operation with high efficiency to satisfy the performance requirement as specified by the bidder in the Technical Data Sheet.

3.03.02 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 at all the operating ambient specified in the data sheet. When the driver is not directly coupled to the compressor, due account should be made for losses in power transmission, in addition to the above margin. However, the power rating of the driver thus selected shall have sufficient margin to run the compressor under relief valve discharge condition considering that the compressor is operating at its rated capacity and discharge pressure corresponding to set pressure of relief valve.

3.03.03 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.

3.03.04 The Contractor under this specification shall assume full responsibility in the operation of the compressor and the drive as a unit.

3.04.00 DESIGN AND CONSTRUCTION

3.04.01 The design shall be such as to ensure trouble free operation with least vibration and noise. Different parts of the compressor and accessories shall be arranged neatly in a compact manner. Due consideration shall be given for easy accessibility and maintenance of the compressors.

3.04.02 Unless inconsistent with this specification equipment from the standard range of manufacture of the bidder shall be preferred.

3.04.03 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.

3.04.04 Compressor elements shall be completely removable as independent parts. Materials of construction shall be suitable for the service.

3.04.05 Rotors shall be supported on both sides by suitable antifriction type bearings. The rotors shall not touch each other so that there shall be no metal to metal contact between them. The rotors shall have profile that keeps leakage losses to a minimum to ensure high efficiency.

3.04.06 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.

3.04.07 The seal rings and retainers shall be of stainless steel construction and be free for radial self-adjustment along the rotor shafts. The seals shall prevent air and oil leakage along the shaft. Air vented from second stage discharge end seals shall provide buffer air to the other seals to prevent migration of oil towards the compression chamber under all operating conditions.

3.04.08 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.

3.05.00 Lubrication system

3.05.01 The compressor package shall include a lubricant management system which shall lubricate the compressor rotors, bearings and seal and also cool the air.

3.05.02 A thermostatically controlled valve shall modulate lubricant around and through the cooler to maintain a constant oil temperature. Bidder shall be responsible for selecting proper oil temperature.

3.05.03 The lubricant pump shall be shaft driven. An auxiliary motor driven pump shall be provided if required by the manufacturer to supply pre-start and shut down system. All lube oil pumps shall be of rotary positive displacement type, having stainless steel rotors and steel casing. The pump discharge system will be protected by a relief valve.

3.05.04 All tapered roller – type antifriction bearing shall have a L10 rated life of at least 50,000 hours with continuous operation at rated conditions.

3.05.05 The lubrication system shall be designed to prevent oil leakage or discharge of oil mist to the compressed air chamber.

3.05.06 All instrumentation and accessories in the lubrication circuit, namely discharge pressure gauge, pressure switch, relief valve etc. shall be included in the **contractor's** scope of supply. Suitable time delay relay or equivalent device to bypass low oil pressure switch during start-up shall be provided **by contractor**.

3.06.00 Gear Box

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. Gears shall have a rating of AGMA-12 or equivalent.

3.07.00 Centrifugal Air Compressors

3.07.01 **CODES AND STANDARDS**

3.07.02 The design, manufacture, testing and performance of air compressors and accessories shall comply with the requirements of one or more of the following codes as applicable:

IS-2825: Code for unfired pressure vessels.

IS-4503: Shell and Tube Type Heat Exchanger.

CAGI: Compressed air and gas institute

IS-5727: Glossary of terms relating to compressors and exhausters.

IS-1239 [Part-I & II]: Mild Steel tube and fittings.

IS-6206: Guide for selection, installation and maintenance of air compressor plants with operating pressure upto 10 bars.

ANSI-B16.5: Steel Pipes Flanges and Fittings.

IS-7938: Air Receivers for Compressed Air Installations.

BS-487: Fusion Welded Steel Air Receiver.

IS-10431 [Part-I]: Measurement of Air Flow of Compressors and Exhausters.

IS-4736: Hot dip zinc coating for steel tubes.

IS-11989: Specification for compressed air dryers.

IS-14875: Compressed air filters – evaluation parameters.

IS-11727: Measurement and evaluation of vibration severity in situ of large rotating machines with speed ranging from 10 to 200 rev/sec.

ASME-PTC-10: Code for testing of Air-Compressors.

3.07.03 International Standards like American/BS/DIN etc. equivalent or superior to above mentioned standards are acceptable. When IS specification is not available the equipment shall conform to one such International Standard, which shall be indicated in the proposal. All codes and standards used/ referred to shall be to their latest edition/ version as on the date of the acceptance of the tender.

3.07.04 Standard of TEMA.

3.07.05 All equipment as may be necessary shall conform to the provision of statutory and other regulations in force, such as Indian Explosive Act, Indian Factories Act, Indian Petroleum Act and also those of State Government.

3.07.06 All electrical equipment supplied shall comply with the latest revision of Indian Electricity Rules and within the statutory requirement of the Government of India and State Government as regards safety, earthing and provision specified therein for installation and operation of electrical equipment.

3.07.07 The materials of the various components shall conform to those specified in the Data specification Sheet.

3.07.08 In case of any contradiction with the aforesaid standards and the stipulations as per this Technical Specification and Data Specification Sheets, the stipulations of this Technical Specification and Data Specification Sheets shall prevail. In case of any contradiction between technical specification and Data Specification Sheets, stipulations of data specification sheets shall prevail.

3.08.00 PERFORMANCE REQUIREMENT

3.08.01 Air Compressors shall be designed for continuous operation with high efficiency to satisfy the performance requirement as specified in the Data Specification Sheet.

3.08.02 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. When the driver is not directly coupled to the compressor, due account should be made for losses in power transmission, in addition to the above margin. However, the power rating of the driver thus selected shall have sufficient margin to run the

compressor under relief valve discharge condition considering that the compressor is operating at its rated capacity and discharge pressure corresponding to set pressure of relief valve.

3.08.02 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.

3.08.03 The Contractor under this specification shall assume full responsibility in the operation of the compressor and the drive as a unit.

3.08.04 Compressor frame shall have minimum 10% extra capacity. Compressor shall have 25% minimum turndown capability (at 45 deg C & 75% RH). Compressor shall be provided with IGV at the suction flange.

3.09.00 DESIGN AND CONSTRUCTION

3.09.01 The design shall be such as to ensure trouble free operation with least vibration and noise. Different parts of the compressor and accessories shall be arranged neatly in a compact manner. Due consideration shall be given for easy accessibility and maintenance of the compressors.

3.09.02 Each compressor unit shall be complete with HT electric motor drive of suitable capacity. Driving motor shall have adequate margin over rated capacity of compressor not less than 10%.

3.09.03 Unless inconsistent with this specification equipment from the standard range of manufacture of the bidder shall be preferred.

3.09.04 Compressor components shall be interchangeable as far as possible.

3.09.05 Air Compressors shall be oil free centrifugal air compressors with non-contact air/oil seals, each capable of delivering continuously rated volume flows at rated delivery pressure.

3.09.06 Compressor elements shall be completely removable as independent parts. Materials of construction shall be suitable for the service.

3.09.07 Rotors shall be supported on both sides by suitable self aligning tilting pad bearings/ equivalent proven self aligning bearings. The rotors shall not touch each other so that there shall be no metal-to-metal contact between them. The rotors shall have profile that keeps leakage losses to a minimum to ensure high efficiency.

3.09.08 The rotor shaft shall be of single piece construction, made of Stainless Steel (or equivalent). The stator (casing) shall be of Cast-Iron Construction with integral jacket cooling. The rotors shall be dynamically balanced to reduce vibration.

3.09.09 Bearings shall be high precision self aligning tilting pad bearings/ equivalent proven self aligning bearings. The axial thrust load shall be minimized by dividing the axial load of compression on the main and auxiliary bearings through suitable balancing arrangement.

3.09.10 The gaskets shall be of asbestos free material.

3.10.00 Lubrication system

Suitable lubrication systems for bearings, gear box etc. for the compressors and other moving parts shall be provided. Lubrication system shall be complete with shaft driven main oil pump, Electric motor driven auxiliary oil pump, strainers, full flow oil coolers, full flow duplex type oil filters regenerative mist eliminator, level indicators, oil temperature control valve with regulating by pass, mixing valves, pressure transducers, air ejectors, oil reservoirs of suitable capacity, pipes, fittings and valves etc. Hand pump/oil pump priming system shall be provided to ensure that all parts are sufficiently lubricated before starting the

compressors. Lubricating oil pipes shall be of stainless steel. The Tenderer for each Air ejector shall provide separate air drying unit. Lub. Oil pressure should be more than water pressure.

3.10.01 Each compressor shall be provided with Inlet Guide Vane (IGV) control for suction air volume control.

3.10.02 Each compressor shall be provided with coupling guard with fixing arrangement.

3.10.02 Proper and robust supporting arrangement shall be provided from foundation/ floor for overhang casing, oil coolers, air piping, cooling water piping, oil piping, etc.

3.10.03 Noise level must not exceed 90 dB (A) at a distance of 1 m from source.

3.10.04 Compressors shall be provided with adequate safety, protection control system including antisurge protection with bypass valve etc. and auto dual control (either; controlled for constant pressure or constant volume flow). The duty points shall be at least 15% away from the antisurge line.

3.10.05 The compressors with all accessories shall be designed and tested as per API 672.

3.11.00 Intercooler, After cooler& Oil Coolers (for Screw /Centrifugal)

3.11.01 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.

3.11.02 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.

3.11.03 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.

3.11.04 The coolers shall be constructed and arranged to allow removal of tube bundles without dismantling piping or compressor components.

3.11.05 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 after coolers shall be provided.

3.11.06 Design pressure shall be 8 Kg/cm2 (g) based on shut-off head of cooling water pumps.

3.11.07 The coolers shall be designed for maximum heat load and at least 10 percent design margin shall be provided in the number of tubes.

3.11.08 Adequately sized safety valves shall be provided for both intercoolers and after coolers.

3.11.09 Each intercooler and after cooler shall be provided with moisture separator units with suitable baffling. Moisture separator units shall be equipped with a level gauge glass with isolating cock.

3.11.10 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.

3.11.11 Cooler shells, channels and covers shall be of carbon steel (SA 285 Gr C or equivalent).Tube sheet shall be of Brass or SS and the tubes shall be of Admiralty brass or Aluminum brass or Copper or SS 304.

3.11.12 For the instrument air compressors offered with "Heat of compression" type air drying plants, the after coolers shall also be provided at downstream of Air Drying Plant.

3.12.00 Air Receivers

3.12.01 There shall one air receiver for each compressor near compressor house, one receiver for DM plant (2 M3) capacity and one Unit Instrument air receiver for each unit.

3.12.02 Capacity of each of the air receivers near the compressor house shall be of 10 M^3 (nominal). The capacity of the Unit air receivers shall be 10 M^3 (nominal).

3.12.03 Receivers (other than unit air receivers) shall be outdoor located and vertical cylindrical vessel with dished ends.

3.12.04 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.

3.12.05 Air receivers are to be provided with gasketted inspection manhole of minimum 500 mm diameter with cover plate, lifting handle, davit cap etc. Opening shall not pierce any seam &shall be as far as possible away from any welded seam.

3.12.06 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.

3.12.07 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.

3.12.08 Each receiver shall be provided with drain connection with electrically operated automatic drain trap arrangement with isolation and bypass valves.

3.12.09 The material of construction of shell, dished ends, flanges, etc of the air receivers shall be of **Boiler quality carbon steel as per IS:2002** or equivalent.

3.13.00 INTAKE AIR FILTER AND SILENCER

3.13.01 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.

3.13.02 The filters shall be complete with integral silencers. Separate silencers, if specified, shall be provided. The filtering elements shall be easily removable for cleaning.

3.13.03 The filters shall be designed for an efficiency of not less than 99% for particles 2 microns and larger.

3.13.04 If filter after receiver is specified in the data specification sheet, the same shall be provided to remove the bulk of moisture and other contaminants entrained in the air stream.

3.14.00 AIR DRYING PLANTS

3.14.01 One number Air drying plant shall be provided for each Instrument air compressor. Dryingshall be by adsorption process through a desiccant medium.

3.14.02 Air Drying (ADP) Plant may be of "Open Through type (Blower reactivated)" OR "Heat of (HOC) Compression type".

3.14.03 Regeneration of desiccant shall be achieved by "open through" or "Heat of compression" method without any air purge loss.

3.14.04 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".

3.14.05 Each ADP shall be provided with two absorber towers each sized for design drying cycle of minimum 8 hours. After this period, the absorber 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.

3.14.06 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 absorber tower. The moist air shall be cooled in dehumidifier and passed through the second absorber for final drying.

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.

3.14.07 Each ADP shall be provided with 2 numbers of 100 percent capacity pre-filters and 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 at least 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.

3.14.08 The electric heaters (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.

3.14.09 Each electric motor driven blower (2x100% capacity for each ADP) shall be provided with individual dry type filters at inlet.

3.14.10 The absorber 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 absorber vessels. Absorber 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 absorber vessels.

3.14.11 The coolers/heat exchangers/ dehumidifiers of ADP shall be designed & constructed as per the requirements specified for “Intercoolers, After coolers & Oil coolers" above.

3.14.12 All pressure vessels such as pre-filters, after-filters, absorber 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 gasketted manholes/handholes and relief valves.

3.14.13 Quantity of desiccant to be calculated shall take into account residual moisture content at the end of regeneration cycle. Design calculation with curves shall be submitted for approval of Employer.

3.14.14 Adsorption capacity and density to be considered for silica gel shall not be more than 10% and 550 kg/M3 respectively. In case of activated alumina the same shall be 8% (max) and 900 kg/M3 (max.) respectively.

3.14.15 In case of Heat of compression type, absorbers 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.

3.14.16 Complete ADP equipments shall preferably be mounted on a skid.

3.14.17 Required sample connections in piping be provided for sampling of air at desired locations.

3.14.18 Non-lubricated two way / three way / four way valves ball valves with pneumatic actuators be provided.

3.14.19 The material of Construction for various components of ADP shall be as follows:-

(a) Absorber vessel Carbon steel

(b) All internals of absorber vessels SS 304

(c) Cooler shells, channels and covers, Same as that in intercoolers/Cooler Tube sheet & tubes after coolers

(d) Blower casing Carbon steel

(e) Blower blades & shaft Stainless steel

(f) Relief valves Brass or SS

(g) Desiccant Silica gel or Activated Alumina

(h) Air piping Galvanized steel

(i) Valves in Air Line CI or Cast steel or Forged steel body with stainless steel trim

(j) Valves in water pipelines SS / Bronze / Gunmetal

3.14.20 HOC dryers of single rotating drum type design using packed desiccant 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. The control & instrumentation requirements specified is applicable for such design also. Further for such design of HOC dryer, the contractor shall supply two sets of spare drum (with required bearings) assembly packed with desiccant and one set of spare drive assembly (for dryer) consisting of motor, gear boxes, drive shaft & couplings in addition to the applicable items specified under "Mandatory Spares" elsewhere in Technical Specification within the contract price.

4.00.00 INTERCONNECTING PIPING, FITTING AND VALVES

4.01.01 All interconnecting compressed air piping shall conform to IS: 1239 (Heavy Grade) or IS: 3589 Gr. 410 and galvanised as per IS: 4736.

4.01.02 Fittings for air piping shall be conforming to IS: 1239/IS: 1879 and Grade equivalent that of parent pipe Grade.

4.01.03 Compressed air piping from air compressor to after cooler 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.

4.01.04 All cooling water piping will be M.S. conforming to IS: 1239 (Part-I) (Heavy Grade).

4.01.05 Air pipe sizing shall be done by considering compressed air velocity not exceeding 15 m/s.

4.01.06 Water pipe sizing shall be done by considering water velocity in pipes 1.2-1.8 m/s for pipe sizes below 50 Nb, 1.8-2.4 m/s for pipe sizes 50 Nb to 150 Nb and 2.1-2.5 m/s for pipe sizes of 200 Nb and above.

4.02.0 **VALVES**

a) Compressed Air Services:

All airline valves shall be ball valve type. Cast steel body with Stainless steel internals shall be provided for valve size 65 Nb and above with flanged end. Forged carbon steel body with Stainless steel internals shall be provided for valve size 50 Nb and below with screwed.

b) Water Service:

Cast iron valves with GM internals as per IS-780/equivalent and other applicable standards above 50 mm size. Gunmetal valves as per IS-778/equivalent up to size 50mm.

c) Auto drain trap for each air receiver shall be provided.

5.00.00 CONTROL PHILOSPHY

5.01.00 GENERAL

5.01.01 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.

5.01.02 Any of the compressor and Air drying Plant may be selectable for "shutdown", "working" or "standby" duty.

5.01.03 On tripping of working equipment, the standby equipment shall come into operation automatically in case of very low air pressure in the system.

5.01.04 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.

5.01.05 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.

5.01.06 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

5.01.07 Lube oil pressure and temperature in the oil circuit of compressor shall be automatically controlled.

5.01.08 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.

5.02.00 Screw Compressors

5.02.01 Each compressor shall be in the control panel to operate either in Base duty (Auto Load- Unload) or Standby duty (Auto On-Off) mode.

5.02.02 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.

5.02.03 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 shall be started 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.

5.02.04 The control system shall provide warning to the operator that a hot-start condition exists forth motor driver and adequate cool-down period has not occurred after the motor was shutdown.

5.02.05 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

5.03.00 Centrifugal compressor

5.03.01 Each compressor shall be in the control panel to operate either in unload/modulate/energy optimization (Auto Dual Mode).

5.03.02 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.

5.03.03 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 shall be started 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 apre-set time.

5.03.04 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 shutdown.

5.03.05 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

5.04.00 Air Drying Plant

5.04.01 Sequential operation of the absorber towers & air compressors shall be controlled automatically with a provision for manual take over.

5.04.02 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 aluminum 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, incase, 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.

5.04.03 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.

5.04.04 For rotary drum type Air drying plant, control philosophy as per manufacture’s standard and proven practice is also acceptable.

6.00.00 PAINTING

6.01.01 All the Equipment shall be protected against external corrosion by providing suitable painting.

6.01.02 The surfaces of stainless steel, Galvanized steel, Gunmetal, brass, bronze and non- metallic components shall not be applied with any painting.

6.01.03 The steel surface to be applied with painting shall be thoroughly cleaned before applying painting by brushing, shot blasting etc as per the agreed procedure.

7.00.00 LAYOUT CONSIDERATIONS

Air compressors and dryers will be located indoor in a separate compressor room .The air receivers will be located outdoors adjacent to the compressor room. For receiver necessary maintenance access will be provided in the layout. Unit air receiver shall be located suitably in BC Bay of powerhouse area. Complete ADP equipment shall be preferably mounted on a skid and located indoor. Compressor house is a pre-engineered building, layout attached at Annexure V of this specification, with length 42.0m, width 15.0m and height 9.8m; all the equipment shall be accommodated inside this space as stipulated above. Adequate in-situ maintenance and walk over space in addition to a separate maintenance bay shall be considered by bidder while preparing the compressor house layout during detailed engineering stage.

VOLUME - II B

SECTION C1
SUB-SECTION - III

GENERAL TECHNICAL SPECIFICATION MECHANICAL

CLAUSE NO.	TECHNICAL REQUIREMENTS
	COMPRESSED AIR SYSTEM
1.00.00	**SYSTEM DESCRIPTION**
1.01.00	The compressed air system shall consist of Instrument Air compressors & their motor drives, Air Drying (ADPs) Plants, Service Air compressors & their motor drives, air receivers for each Air compressor, instrumentation and control, control panels, interconnecting compressed air piping in the compressor house, Instrument Air Piping network, service air piping network and Unit Instrument Air receivers (One for each unit).
1.02.00	The Air compressors & Drives, instruments, control panels and ADPs shall be located indoor inside the compressor house and the air receivers shall be located outside the compressor house. The compressor house shall be provided with an electrically (with pendent control for long travel, cross travel and lifting) operated, overhead travelling type (EOT) crane.
1.03.00	In addition to the air receivers mentioned above, Unit Air receivers for instrument air system shall be provided, one for each Unit of the main plant systems to cater to the requirements of Instrument air requirement of respective SG (Steam generator) & auxiliaries and TG (Turbine Generator) and its auxiliaries. The Unit Air receivers shall be located in "BC" bay of TG building area.
1.04.00	Further a dedicated air receiver shall be provided near Demineralising Plant to meet the instrument air requirement of Water Treatment plant if included in the scope of works in Part-A of technical specification, Section-VI.
1.05.00	Air from Instrument 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 instrument air piping header for each unit of main plant and one for balance of plant shall be provided. Distribution of instrument air network shall be provided as per the tender drawing and as detailed out under "Terminal Points" in Part-A of technical Specification, Section-VI.
1.06.00	A separate service air header shall be tapped off from the pipe header at Service Air receiver outlet and distributed as per the tender drawing and as detailed out under "Terminal Points" in Part-A of technical Specification, Section-VI .
1.07.00	The compressors shall be arranged such that all the service air compressors shall be able to supply air at upstream of each ADP through an isolation and a non-return valve so that in the event of failure of instrument air compressor, instrument air is ensured continuously from service air compressor. The instrument air header piping & valves at ADP outlet in compressor house shall be provided such that all the instrument air compressors may be interconnected and the entire system can be used as a station facility.
2.00.00	**DESIGN CRITERIA / BASIS AND PERFORMANCE GUARANTEE**
2.01.00	All the equipments 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.
2.02.00	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