

**TAMILNADU GENERATION & DISTRIBUTION CORPORATION
LIMITED**

1x800 MW TANGEDCO NORTH CHENNAI TPP

TECHNICAL SPECIFICATION

FOR

AIRCONDITIONING SYSTEM

SPECIFICATION NO.: - PE-TS-423-553-A001 (REV-0, APR 2017)



**BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
PROJECT ENGINEERING INSTITUTE BUILDING
SECTOR-16A, PLOT NO.-25, NOIDA, INDIA**



TITLE:
**TECHNICAL SPECIFICATINS FOR
AIR CONDITIONING SYSTEM**

SPECIFICATION No: PE-TS-423-553-A001

SECTION

REV. 00

DATE: APRIL 2017

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SECTION - I



1x800 TANGEDCO NORTH CHENNAI TPP

**AIRCONDITIONING SYSTEM
INTENT OF SPECIFICATION**

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SECTION-I

SUB-SECTION-A

INTENT OF SPECIFICATION

	1x800 TANGEDCO NORTH CHENNAI TPP AIRCONDITIONING SYSTEM INTENT OF SPECIFICATION	SPECIFICATION No: PE-TS-423-553-A001	
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1.0 INTENT OF SPECIFICATION

- 1.1 The specification covers design, engineering, manufacture, supply / procurement, inspection and testing at vendor's / sub vendor's / manufacturer's works, painting, forwarding, proper packing and shipment and delivery at site, unloading, handling & transportation, storage, preservation , security / safety at site , Erection & Commissioning, minor civil & structural (as applicable) works as required on FOR site basis, Performance and guarantee testing / demonstration testing and handing over to BHEL's customer of **AIR CONDITIONING SYSTEM** as per details in different sections / volumes of this specification and various pre award agreements for **1X800 MW TANGEDCO NORTH CHENNAI TPP**.
- 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, performance and guarantee/demonstration testing of **AIR CONDITIONING 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 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 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



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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



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**PROJECT INFORMATION WITH WIND AND
SEISMIC DESIGN CRITERIA**

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**PROJECT INFORMATION WITH WIND AND SEISMIC DESIGN
CRITERIA**



1X800 MW COAL BASED NORTH CHENNAI THERMAL
POWER PROJECT STAGE III
EPC TENDER SPECIFICATION FOR BTG PACKAGE



CHAPTER 2
PROJECT INFORMATION

1.1 GENERAL

TANGEDCO has planned to establish 1X800MW Coal Based Super Critical North Chennai Thermal Power Project Stage III in the premises of existing NCTPS at Ennore & Puzhuthivakkam Village, Ponneri Taluk, Thiruvallur District, Tamil Nadu, India. This project will be executed in two package mode i.e, BTG with related Civil Works and BOP with related Civil Works.

1.2 LOCATION

The proposed site for main power plant is located near Ennore port (approx 5 km) and also 35 km from Chennai City.

The nearest Railway station is at Athipattu Pudunagar (approx 5 km)

All weather road from Pattamandri on the Thiruvotriyur-Ponneri highway is the nearest road access.

The nearest airport is at Chennai at a distance of 60 km.

1.3 PROJECT INFORMATION

1.1	Project Title	:	1 x 800 MW North Chennai Coal Based Super Critical Thermal Power Project Stage III.
1.2	Plant capacity	:	800 MW
1.3	Type of project	:	Brown field
1.4	Owner	:	Tamil Nadu Generation and Distribution Corporation Limited (TANGEDCO)
1.5	Plant site location	:	In the premises of North Chennai Thermal Power Station (NCTPS)
1.6	Location co-ordinates	:	80° 19' E to 80° 20' E Longitude 13° 13' N to 13° 18' N Latitude
1.7	Nearest Village	:	Ennore & Puzhuthivakkam Village
1.8	Nearest Town & City	:	Chennai (35 Km)
1.9	State Capital	:	Chennai (35 Km)



1X800 MW COAL BASED NORTH CHENNAI THERMAL
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EPC TENDER SPECIFICATION FOR BTG PACKAGE

1.10	Nearest Railway Station	:	Athipattu Pudunagar (~ 5 Km) on Chennai – Vijayawada Line
1.11	Nearest Airport	:	Chennai (~ 60 Km)
1.12	Nearest Seaport	:	Ennore (~ 3 Km)
1.13	Nearest Road access	:	All weather road from Pattamandri on the Thiruvottiyur – Ponneri highway
2.0	Meteorological Condition		
2.1	Climate	:	Tropical, very dry and hot summer, dry and cold winter and good rain-fall in monsoon accompanied with strong wind
2.2	Site Elevation	:	(+) 10.0 Meter above Mean Sea Level
2.3	Ambient Temperature		
a.	Annual Maximum Mean Temperature	:	45 °C
b.	Annual Minimum Mean Temperature	:	15 °C
c.	Design ambient temperature	:	30 °C
2.4	Relative Humidity		
a.	Maximum	:	90 %
b.	Minimum	:	36 %
c.	Design	:	75 %
2.5	Annual Rainfall		
	Maximum	:	2540 mm
	Average	:	1600 mm
	Minimum	:	1175 mm
2.6	Basic Design Wind Pressure	:	As per IS: 875 (Latest Edition)



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EPC TENDER SPECIFICATION FOR BTG PACKAGE



2.7	Wind Speed	:	11.8 kmph (Avg), 50 m/s (max)
2.7	Seismic zone	:	Zone: III as defined in IS:1893-2002
2.8	Design ambient temperature for Electrical equipment	:	50 °C

1.4 ACCESS TO SITE

Site is well connected to all weather road from Pattamandri on the Thiruvotriyur – Ponneri highway. Site is located adjacent to the Chennai – Howrah broad gauge line and thus well connected by rail also.

1.5 PLANT RATING, CAPACITY, AVAILABILITY, PLF

Plant continuous rating will be 800MW at Generator terminals based on the following site conditions.

- Ambient Air temperature
- Condenser cooling water inlet temperature of 33 Deg. C and 9 Deg. C temperature rise across the condenser.
- Generator Power factor of 0.85
- Fuel Specification as given elsewhere
- Design temperature of electrical equipment is 50 Deg. C

The VWO capacity of the steam turbine shall not be less than 105% TMCR flow at rated parameters. Boiler maximum Continuous Rating (MCR) is at least 1.02 times the steam flow at turbine VWO condition plus continuous auxiliary steam requirement of unit at TMCR, rounded to next integer divisible by 5.

The capacity of the unit is selected so as to deliver the rated output even after ageing that will occur between overhauls, as a result of deposition of salts in turbine blades, wear and tear etc. The plant load factor (PLF) being considered is 85%.

1.6 SOURCES OF FUEL

TANGEDCO has long term linkage of Coal from the coal sources of Talcher or Mahanadi in Orissa. Domestic coal requirement for the power plant will be sourced from kalinga block of the Talcher, Mahanadhi and IB valley coal field.

The Imported coal has been sourced from foreign countries through sea to Ennore port. The coal will be conveyed from port through conveying system.

The steam generator shall be designed for the following conditions:

Best Coal – 100% Imported Coal
Design Coal – 70% Imported & 30% Domestic Coal
Worst Coal – 50% Imported & 50% Domestic Coal



1X800 MW COAL BASED NORTH CHENNAI THERMAL
POWER PROJECT STAGE III



EPC TENDER SPECIFICATION FOR BTG PACKAGE

1.7 Coal Analysis

1.7.1 Coal Quality parameter

a) Domestic Coal

A. Proximate Analysis			
1.	Total Moisture	%	16.0
2.	Ash	%	45.0
3.	Volatile matter	%	19.0
4.	Fixed Carbon	%	20.0
5.	Gross calorific value (as received basis)	kcal/kg	2800
B. Ultimate Analysis			
1.	Carbon	%	27.7
2.	Hydrogen	%	2.6
3.	Sulphur	%	0.5
4.	Nitrogen	%	0.52
5.	Oxygen	%	7.26
6.	Moisture	%	16.0
7.	Ash	%	45.0
8.	HGI		45 -55, Avg 52
9.	Carbonates		0.38
10.	Phosphorous		0.04
11.	YGP Index	mg/kg	50-70
12.	Shale and Sand stone Content	%	Max 20
13.	Feed Coal Size	mm	Upto 50
C Ash Fusion Temperature			
	Initial Deformation, IT	Deg. C	1100
	Spherical, ST	Deg. C	1200
	Hemispherical, HT	Deg. C	1300
	Fluid, FT	Deg. C	-
ASH ANALYSIS			
	SiO ₂	%	59.54
	Al ₂ O ₃	%	29.00
	Fe ₂ O ₃	%	6.42
	CaO	%	1.50
	Na ₂ O	%	0.08
	K ₂ O	%	-
	TiO ₂	%	1.60
	SO ₃	%	0.25
	P ₂ O ₅	%	0.51
	MgO	%	0.50
	Others	%	0.60
	Total		100.00
	Resistivity of Fly Ash	Ohm-cm	1.73 X10 ¹²



1X800 MW COAL BASED NORTH CHENNAI THERMAL
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b) Imported Coal

A. Proximate Analysis			
1.	Total Moisture	%	16.50
2.	Ash	%	6.62
3.	Volatile matter	%	36.45
4.	Fixed Carbon	%	40.43
5.	Gross calorific value (as received basis)	kcal/kg	5642
B. Ultimate Analysis			
1.	Carbon	%	60.12
2.	Hydrogen	%	4.38
3.	Sulphur	%	0.53
4.	Nitrogen	%	1.48
5.	Oxygen	%	10.37
6.	Moisture	%	16.5
7.	Ash	%	6.62
8	HGI		51
9	Carbonates		-
10	Phosphorous		-
11	Total		100
C			
	Ash fusion temperature		
	Initial Deformation, IT	Deg. C	1230
	Spherical, ST	Deg. C	1270
	Hemispherical, HT	Deg. C	1320
	Fluid, FT	Deg. C	-
ASH ANALYSIS			
	SiO ₂	%	36.00
	Al ₂ O ₃	%	13.90
	Fe ₂ O ₃	%	14.80
	CaO	%	12.70
	Na ₂ O	%	0.70
	K ₂ O	%	1.70
	TiO ₂	%	0.80
	SO ₃	%	10.6
	P ₂ O ₅	%	0.20
	MgO	%	8.60
	Others	%	-
	Total		100.00



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EPC TENDER SPECIFICATION FOR BTG PACKAGE



- c) The plant should be suitable to accept imported coal sourced from any country. The limiting parameters of imported coal are furnished below :

A. Proximate Analysis			
1.	Total Moisture (ARB)	%	Upto 23 Max
2.	Ash (ADB)	%	6.62
3.	Gross calorific value (as dried basis)	kcal/kg	5800 - 6500
4.	Fixed Carbon(ADB)	%	30 - 50
5.	Volatile Matter (ADB)	%	25 - 45
6	HGI		45 - 60
7	IDT (Under Reducing Atmosphere)	Deg.C	1100 - 1250
3.	Sulphur (ADB)	%	Upto 1 Max
4.	Size	mm	< 50

1.7.2 Specification of LDO

Specific Gravity @ 15° C kg/cu.m	: 0.8348
Gross calorific value, kcal/kg	: 10400
Pour point “°C” max.	: 12
Flash point “°C” min.	: 66
Sulphur % “T” max.	: 0.5
K. Viscosity in Centistokes @ 50° C Max	: 7.5
Ash by wt. %	: 0.01
Water & Sediment content Vol. Max. %	: 0.25
Sediment Max. Content by Wt%	: 0.1
Relevant Indian Standard	: IS 1460

1.7.3 Specification of HFO

Flash point “°C” min.	: 66
Sulphur % “T” max.	: 4.5
Viscosity in Centistokes @ 50° C	: 370
Ash by wt. %	: 0.1
Water content Vol. Max. %	: 1.0
Sediment Max. Content by Wt%	: 0.25
Gross Calorific Value, kcal/kg	: 10800

1.8 Fuel Transportation

The coal shall be received at Ennore port. The coal will be transported by conveyor from coal berth 3 in Ennore Port and then through the conveyor to the coal bunker directly or to coal stockyard.



1X800 MW COAL BASED NORTH CHENNAI THERMAL POWER PROJECT STAGE III

EPC TENDER SPECIFICATION FOR BTG PACKAGE



1.9 SOURCE OF WATER

Source of water for the proposed project is sea water. The intake shall be from the existing cooling water fore bay of NCTPS Stage-II. Treated water shall be provided to the plant cycle makeup and other requirements of BTG package at the respective terminal points. Refer Chapter 4 of this section.

1.10 SOURCE OF EQUIPMENT

The proposed plant will be supplied, erected and commissioned on dual EPC basis, i.e, BTG with related civil works and BOP with related civil works.

1.11 POWER EVACUATION PLAN

1x800MW Steam Generating Units shall be with a SF6 Generator Circuit Breaker [GCB] along with necessary additional items between Generator Transformer [GT] and Generator. Therefore GT shall be used for unit start-up / unit shutdown as well as for power evacuation by synchronization of unit by closing GCB.

Power will be evacuated from the proposed thermal power station at 765 KV voltage level through 765 KV transmission lines. The power evacuation lines would be double circuit 765 KV lines which will act as Line in & Line out circuit.



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EPC TENDER SPECIFICATION FOR BTG PACKAGE

during detail engineering. Each ESP hopper shall be supported at four corners by providing four columns from the ground.

- viii. In design of boiler /ESP support structures dynamic piping loads need not be considered acting simultaneously with wind or seismic loads. Increase in permissible stresses shall be allowed in load combinations where dynamic piping loads are considered and shall be as permitted under seismic load conditions.

D. Wind Loads

Wind loads for all structures shall be based on IS: 875 (Part 3). Basic wind speed shall be 50m/sec. A step function of pressure with height under different exposure conditions shall be used. For steel structures exceeding 25m height, diagonal wind analysis shall be carried out.

E. Seismic Loads

The seismic zone shall be Zone - III as per IS: 1893. Importance factor (1.75) shall be taken as Table 2 of IS: 1893: Part-4 & Response Reduction Factor will be taken from Table 7 of IS: 1893 - 2002 with 100% of mass participation. Ductile detailing in accordance with IS: 13920 shall be adopted for all concrete structures which is mandatory for Zone -III. Response spectrum method shall be used for seismic analysis using atleast 5 modes of vibration.

Zone factor - 0.16

Importance factor – 1.75

F. Temperature Loads

For temperature loading, the total temperature variation shall be considered as 2/3 of the average maximum annual variation in temperature. The average maximum annual variation in temperature for this purpose shall be taken as the difference between the mean of the daily minimum ambient temperature during the coldest month of the year and mean of daily maximum ambient temperature during the hottest month of the year. The structure shall be designed to withstand stresses due to 50% of the total temperature variation.

Suitable expansion joints shall be provided in the longitudinal direction wherever necessary. The maximum distance of the expansion joint shall be as per the provisions of IS: 800 and IS: 456-2000 for steel and concrete structures respectively.

G. Equipment Loads

Loads of all equipment like water Tanks, Cooling Equipment, Motors, fan drive pulleys, Pumps, Monorails, Ventilation duct, air inlet & exhaust duct, Electrical control and relay panels, Cable load, Pipe load (static and dynamic), Tanks, AHU, Batteries, Air Washer, etc. shall be considered over and above the imposed loads. Equipment loads shall be considered as given by equipment supplier. Equipment loads, which are of permanent nature, shall be treated as dead loads. However, where the uniform floor live load adequately accounts for the equipment moving weight, the weight of such equipment as a dead load shall not be considered.



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TECHNICAL SPECIFICATIONS



**1x800 TANGEDCO NORTH CHENNAI TPP
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SPECIFIC TECHNICAL REQUIREMENT**

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SPECIFIC TECHNICAL REQUIREMENT



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1 FUNCTION

The purpose of the system is to provide Air-conditioning system for different areas of 1x800 TANGEDCO NORTH CHENNAI TPP under the scope of BHEL.

2 SYSTEM DESCRIPTION

2.1 AC PLANT-1

AC plant-1, in main power house building is provided to cater the air conditioning requirements of the following areas:-

- Central Control Room.
- Control Equipment Rooms.
- Shift in-charge/engineers room and other areas at 17 M main control room.
- UPS (Uninterrupted Power Supply) room.
- Steam and water analysis system rooms (SWAS) (if SWAS room is not in the vicinity of the control room areas the same shall be air conditioned through split AC's / Fan Coil Units (FCU).

The AC plant comprises two (2) nos. (1 W + 1 S) screw Chilling machines. The condenser cooling water shall be circulated through these units by means of 2 nos. (1 W +1 S) horizontal centrifugal pump sets and 2 nos. (1 W + 1 S) FRP cooling towers. The chilled water produced by the chilling units shall be circulated to the air handling units (AHU) ((2W + 1S) for area at 17 and (1W +1S) for area at 8.5 M) located adjacent to air-conditioned areas as above in Power House by means of 2 nos. (1 W +1 S) horizontal centrifugal pump sets. The conditioned air from AHUs is distributed to the air-conditioned areas by galvanized sheet steel ducting and extruded aluminium grilles / diffusers. For area at 17 M the return air shall be led back to the AHU Room through return air duct.

Controls for the AC & Ventilation (common) shall be DDCMIS based.

2.2 AC PLANT-2

AC PLANT-2, to cater the air conditioning requirements of ESP control room:-

The AC plant comprises 2 nos. (1 W+1 S) water cooled direct expansion type, with reciprocating/scroll/screw compressor, condensing unit. The condenser cooling water shall be circulated through these units by means of 2 nos. (1 W +1 S) horizontal centrifugal pump sets and 2 nos. (1 W + 1 S) FRP cooling towers. The refrigerant produced by the chilling units shall be circulated to the air handling units (AHU) (1W + 1S) located adjacent to air-conditioned areas. The conditioned air from AHUs shall be distributed to the air-conditioned areas by galvanized sheet steel ducting and extruded aluminium grilles / diffusers. The return air shall be collected above the false ceiling and led back to the AHU rooms which acts as mixing plenum for return and fresh air.

2.3 AC PLANT-3

AC PLANT-3, to cater the air conditioning requirements of Service building:-

To cater air conditioning requirement of various areas in Service building be considered for air conditioning.

The AC plant comprises water cooled direct expansion type Air conditioning system with (1W + 1S) configuration. The condenser cooling water shall be circulated through these units by means of 2 nos. (1 W +1 S) horizontal centrifugal pump sets and 2 nos. (1 W + 1 S) FRP cooling towers. The conditioned air from indoor unit of package AC shall be distributed to the air-conditioned areas by galvanized sheet steel ducting and extruded aluminium grilles / diffusers. The return air shall be collected above



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the false ceiling and led back to indoor unit room of package ACs which acts as mixing plenum for return and fresh air.

2.4 AC PLANT-4

AC PLANT-4, to cater the air conditioning requirements of other areas:-

Split type air conditioners (air cooled) shall be provided to cater to the air conditioning requirements of Compressor house control room areas having workstation for auxiliary plant. For areas requiring multiple working split ACs, One (1) No. standby (of same capacity) shall be provided. (Only those aux. control rooms which are under scope of BHEL). Local isolator / MCB shall be provided with split units.

Hand operated remote and other accessories as specified. Local Distribution Boards containing Switch / MCB shall be provided for Split Air Conditioners, and FCUs. Each split unit shall also be provided with suitable rating stabiliser.

Single phase electrical feeders of following ratings shall be provided for split units. Bidder to ensure the suitability as per these feeder requirement.

Capacity of Split AC	Single phase feeder
1.5 TR	2.2 KW
2 TR	3.0 KW

Further refer relevant clauses of section C2-A, customer specifications for other technical details.

**3 DESIGN CRITERIA
SYSTEM DESIGN CRITERIA - AIR CONDITIONING SYSTEM**

3.1 The outside design conditions considered are as follows:-

	Summer	Monsoon	Winter
DBT (°C)	39.4	28.3	18.3
WBT (°C)	27.8	26.7	13.9
RH (%)	41	88	60

3.2 The inside design conditions to be maintained are as follows:-

Temperature : 22 + 1°C

Relative humidity : 50 + 5%

3.3 For winter heating load calculation, 50% of combined light load and eqpt. /Panel load as available in the room shall be considered.

3.4 Fresh air requirement for air-conditioning shall be considered as under:

- For control room/ control equipment room/UPS room etc. 35/M³/hr/person or 1.5 air changes per hour whichever is higher.
- For service building 1.5 air changes per hour.

3.5 A margin of 10% shall be considered for the capacity of equipment like Chiller, chilled water pumps, AHU and cooling tower.

3.6 Lighting load, minimum 2 W / Sq ft. or actual whichever is higher shall be considered.

3.7 The Occupancy shall be considered as One (1) person in 12 sq.m in general/office areas, for One (1) person in 1.5 sq.m in conference room and One (1) person in 20 sq.m in control room, CER etc.

3.8 Air and water velocity:-

- i) Main ducts: - 7.5m/sec
- ii) Branch duct: - 6.0m/sec
- iii) Grills/Diffuser: - 2.0m/sec



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- | | | |
|------|--|----------|
| iv) | Louvers for air inlet: - | 2.5m/sec |
| v) | Water velocity in piping: - | 2.5m/sec |
| vi) | Water velocity in piping: -
(Gravity flow/pump suction) | 1.5m/sec |
| vii) | AHU (Face velocity):- | 2.5m/sec |

For other design parameters refer relevant clauses of section C2-A, customer specifications.

4 SYSTEM CAPACITY AND CONFIURATION:-

For AC Plant-1:-

2x1750 TR Actual capacity water cooled Screw chiller (1W + 1S) shall be provided.

For AC Pant-2:-

2x30 TR Water cooled condensing unit (1W + 1S) shall be provided.

5 LAYOUT CONSIDERATIONS AND EQUIPMENTS TO BE PROVIDED FOR DIFFERENT AC PLANTS:-

AC PLANT-1

- a) The central chilled water plant, Condenser Water & Chilled Water Pumps for AC Plant-1 shall be housed in AC Plant Room at 0.0 M level in E-F-2-4 Bay Power House Building.
- b) The AHUs/FCUs for this AC Plant would be located as under:
 - 3 AHUs (3 x 50 %) for areas at 17.0 m i.e CCR, CER, computer rooms, shift in-charge, etc. located in AHU Room at 24.0 M level of Power House Building in BC Bay.
 - 2 AHUs (2 x 100 %) for areas at 8.5.0 m i.e UPS panel room, etc. located in AHU Room at 8.5 M level of Power House Building in EF Bay.
 - FCU for SWAS (dry panel room) as per the requirement.
- c) The Cooling Towers, Make-up water Storage Tank, Expansion Tank shall be located at 32.0 M level in E-F Bay.
- d) Two (2) Nos Screw chiller (1W+ 1SB) complete with all accessories as described here in after.
- e) Two (2) Nos. Horizontal Split Casing Centrifugal Condenser Water Pump Sets (1 W + 1 SB) each complete with all accessories as described here in after.
- f) Two (2) Nos. Horizontal Split Casing Centrifugal Chilled Water Pump Sets (1W + 1 SB) each complete with all accessories as described here in after.
- g) Two (2) Nos. Fibre glass reinforced plastic (FRP) construction Cooling Towers (1W + 1 SB), each CT complete with all accessories i.e. fan, motor, basin, nozzles, level switch, make up connection, drains, piping, valves & fittings, strainer, ladder and supporting structure etc.
- h) Pan type humidifier in each AHU room.
- i) Pre-filters (inside the pre-filter section of the AHUs at suction side)
- j) Fine filters (shall be provided at discharge of AHUs and fresh air fan).
- k) One No. MS (spray galvanized) chilled water expansion tank complete with valve, Level Gauge, Level Switch, Make-up connection, overflow and drain etc.
- l) Make up water tank made of MS (spray galvanized) complete with valves, level gauge, level switch, make up connection, over flow and drain etc.
- m) Acoustic insulation for initial length of 6 m from the AHU outlet.
- n) 2x50% Duty fresh air fan with pre-filter & fine filter in AHU Room.

AC PLANT-2

Water cooled DX condensing unit shall be located on terrace.

The AHUs for this AC Plant would be located as under:

- AHU Room at 8.5 M level of Power House Building in E-F Bay.

The Cooling Towers, Make-up water Storage Tank, Expansion Tank, shall be located at terrace.



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- a) Two (2) Nos (1W + 1 SB) sheet metal DX type (double skin) air handling units of sectionalized construction each complete with all accessories as described hereinafter, to match the AC load of ESP control room.
- b) Pan type humidifier in each AHU room.
- c) Pre-filters (inside the pre-filter section of the AHUs at suction side)
- d) Fine filters (shall be provided at discharge of AHU and fresh air fan).
- e) Acoustic insulation for initial length of 6m from the AHU outlet.
- f) 2x50% Duty fresh air fan with pre-filter & fine filter in AHU Room

AC PLANT-3

Water cooled package air condition system shall be provide at each floor of service building.

The Cooling Towers, Make-up water Storage Tank, Expansion Tank, shall be located at the roof of service building

- a) The Cooling Towers, Make-up water Storage Tank shall be located at terrace of service building.
- b) Two (2) Nos. Horizontal Split Casing Centrifugal Condenser Water Pump Sets (1 W + 1 SB) each complete with all accessories as described here in after.
- c) Two (2) Nos. Fibre glass reinforced plastic (FRP) construction Cooling Towers (1W + 1 SB), each CT complete with all accessories i.e. fan, motor, basin, nozzles, level switch, make up connection, drains, piping, valves & fittings, strainer, ladder and supporting structure etc.
- d) Pan type humidifier in each AHU/PU room.
- e) Make up water tank made of MS (spray galvanized) complete with valves, level gauge, level switch, make up connection, over flow and drain etc.
- f) Acoustic insulation for initial length of 6m from the AHU outlet.
- g) 2x50% Duty fresh air fan with pre-filter in AHU/PU Room.

6 SPECIAL CONSIDERATION

- a) Water flow rate for chilled water pump selection: 0.7 cmh/TR
- b) Water flow rate for condenser water pump selection: 1.0 cmh/TR
- c) Condenser water pumps, chilled water pumps, AHUs and FCUs shall have further 10% margin on their flow capacities.
- d) Further design margins in various equipment shall be as per relevant clauses of section C2-A, customer specifications.
- e) All equipment shall be of high quality and high efficiency meeting the stipulated power consumption as defined elsewhere in the specifications.
- f) The minimum COP and IPLV of Screw chiller shall be as per ECBC guidelines.

7 AC EQUIPMENT DETAILS

7.1 WATER COOLED CHILLER PACKAGE

Each chilling package (Screw/Scroll) shall comprise of the following:

- a) Screw compressors (suitable for Refrigerant R-134a/R407C) with motors complete with suction and discharge shut off valves, oil pumps, high pressure cut-out, low pressure cut-out, oil pressure cut-out, built-in automatic capacity control etc.
- b) One (1) No. shell and tube type water cooled condenser and integrally finned copper tubes complete with hot gas inlet, liquid outlet, relief and purge connection for refrigerant and water inlet, water outlet, drain connection etc.
- c) One (1) No. shell and tube type water chiller and seamless copper tubes, plain from outside, integrally surface enhanced complete with liquid inlet and vapour outlet connection for refrigerant and water inlet, water outlet, drain connection etc.



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- d) MS heavy class (IS 1239) seamless refrigerant piping, valves and fittings, inter-connecting compressor, condenser and chiller.
- e) MS structural frame work with anti-vibration pads.
- f) Initial fill of refrigerant and compressor lube oil
- g) insulation of suction line and chiller
- h) 150 mm dial type pressure gauges at the inlet and outlet of the condenser and chiller respectively
- i) 150 mm dial type temperature gauges at the inlet and outlet of condenser and chiller respectively
- j) Controls comprising the following: -
 - All controls for Screw/Scroll chiller are sensor based as part of Screw/Scroll chiller package.
 - Water flow switch at the outlet of the each condenser and chiller
- k) Refer to clause 2.1.10.8.1 and other relevant clauses of section C2-A, customer specifications.
- l) Accessories (valves, pressure gauges, water flow switches, controls and instruments etc. shall be provided with each screw/scroll chiller as per customer approved P&ID.

7.2 CENTRIFUGAL PUMP FOR CHILLED AND CONDENSER WATER LINE

Each Chilled/condenser water circulating pump set shall comprise of the following:-

- a) Horizontal split casing centrifugal pump of adequate capacity to match the package chiller / system requirement. Each condenser water circulating pump set shall comprise of the following:-
- b) One No. adequately sized TEFC sq. cage induction motor suitable for 415 V, 3 phase, 50 Hz AC supply.
- c) One set of base plate, coupling guard, anti-vibration pads, and foundation bolts etc.
- d) Valves, strainer, Instruments, other fittings etc.
- e) Other details shall be as per technical specification clause number 2.1.10.8.4.
- f) Accessories (valves, pressure gauges, water flow switches, controls and instruments etc shall be provided with pump as per customer approved P&ID

7.3 COOLING TOWER

- a) Induced draft fibre glass reinforced plastic (FRP) construction Cooling Towers, each CT complete with all accessories i.e. fan, motor, FRP basin, nozzles, level switch, make up connection, drains, piping, valves & fittings, strainer, ladder and supporting structure etc.
- b) Cooling tower shall be designed as under:-
 - Design wet bulb: 27.8⁰ C.
 - Approach: 4⁰ C.
- c) Refer to clause 2.1.10.8.6 and other relevant clauses of section C2-A, customer specifications.

7.4 AIR HANDLING UNIT

Each air-handling unit shall comprise of the following: -

- a) The casing of AHU shall be of double skin construction, DIDW type. Double skin sandwich panels (inside and outside) shall be fabricated using minimum 0.80 mm (22 SWG) galvanised steel, with 25 mm thick polyurethane (PUF) foam insulation of minimum 40 kg/m³ density in between 16G galvanised steel sheet channel shall be used as reinforcing to give structural strength.
- b) Fan section complete with forward / backward curved multi-bladed centrifugal fan mounted on a shaft with adjustable motor base.



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- c) One No adequately sized TEFC sq. cage induction motor suitable for 415 V, 3 phase, 50 Hz AC supply with drive package comprising fan pulley, motor pulley, V-belt and belt guard.
- d) Cooling coil section (integral with filter section) with suitably sized chilled water cooling coil made of copper tubes and aluminium fins along with valves for isolation.
- e) Pre filter, fine filter and HEPA filter along with DPG, shall be provided for main control room control equipment room, UPS room of main plant building and ESP control room only, however other areas like service building shall be provided with pre and fine filters.
- f) Pre filters shall be provided the suction of each individual AHUs whereas fine and HEPA filters shall be provided at discharge of individual AHUs or plenum of duct.
- g) Controls comprising
 - One No. 3 way mixing valve with actuator
 - One No. Proportionating type thermostat / temperature & RH sensor.
 - Pressures switch at the discharge of AHU to modulate VFD
- h) AHUs shall be provided with VFD.
- i) Motors shall be installed inside the AHU.
- j) Accessories (valves, pressure gauges, water flow switches, controls and instruments etc shall be provided with pump as per customer approved PID
- k) Drain piping from the AHUs up to nearest drain point.
- l) Serrated rubber pads for vibration isolation.
- m) Refer to clause 2.1.10.8.2 and other relevant clauses of section C2-A, customer specifications.

7.5 STRIP HEATER PACKAGE AND HUMIDIFICATION PACKAGE

- a) One common set of electrical strip heaters package of suitable capacity complete with contactor, air-stat, humidistat (room or mounted on strip heater control box), safety thermostat, heater box with insulation etc. for winter heating and monsoon reheat, mounted inside the AC plenum/duct for each AHU Room.
- b) One No. Pan humidification system comprising heater, humidistat, water tank, low level switch over flow, draining, make up connection, float valves etc for each AHU Room.
- c) Temp gauge, temp element, RH and temp sensor shall also be provided and the same shall be hooked with DDCMIS system.
- d) Refer to relevant clause of section C2-A, customer specifications

7.6 SHEET METAL WORK

- a) GSS supply and return air Ducting (as per IS-277) with 275 gms/sqm of zinc coating complete with vanes, damper, hangers / supports etc. Insulation of supply air AC duct and return air duct, piping, fitting etc. shall be provided as per clause number 2.1.10.3 (y) of customer technical specification.
- b) Supply air diffusers / grilles (Frame and Louvers of Diffuser/Grilles shall be of extruded aluminium of 1.2 mm thick section, duly powder coated) with volume control dampers. Return air Diffusers will have no Volume control Damper.
- c) Other details shall be as per customer technical specification clause number and 2.1.10.8.7.

7.7 INSULATION

Refer to clause 2.1.10.3 (y) and other relevant clauses of section C2-A, customer specifications.

7.8 PIPING VALVES ETC

Refer to relevant clauses of section C2-A, customer specifications

7.9 FRESH AIR FAN

2x50% Duty fresh air fan with pre-filter & fine filter in all AHU Rooms.

7.10 ONLINE NON-CHEMICAL WATER TREATMENT EQUIPMENT



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Online non-chemical type scale preventer shall be provided at header of cooling tower make line to avoid scaling.

7.11 AIR FILTERS

Refer to clause 2.1.10.8.5 and other relevant clauses of section C2-A, customer specifications.

7.12 CONDENSER WATER PIPING

Refer to clause 2.1.10.8.8 and other relevant clauses of section C2-A, customer specifications.

7.13 CHILLED WATER PIPING

- a) Chilled water piping with insulation interconnecting chiller, air-handling units and pumps sets complete with valves and fittings such as elbows, tees, reducers, flanges etc.
- b) Other details shall be as per technical specification clause number 2.1.10.8.8.

7.14 DRAIN WATER PIPING

Drain water piping out of MS pipes conforming to IS-1239, Part I, heavy grade and galvanised as per IS:4736, from various equipments like chillers, pumps, AHUs, cooling tower area etc. up to the nearest drain point. (Within the room & for Cooling tower up to nearest drain point or rain water pipe on the roof).

7.15 TANKS

Make up water tank and expansion tank shall be made of HDPE / MS (with inner surface spray galvanised.) complete with valves, level gauge, level switch, make up connection, over flow and drain etc. however expansion shall be insulated as per clause number 2.1.10.3 (y) of customer technical specification.

7.15 FIRE DAMPERS

The supply and return air ducts shall be provided with solenoid type fire damper at locations where duct pass through walls & floors for ease of isolation, maintenance and as well as for emergency operation. The operation of these automatic dampers shall be interlocked the fire alarm system. Fire rating for the fire dampers shall be minimum 90 minutes.

7.16 ELECTRICAL ITEMS

Refer to relevant clauses of section C2-A, customer specifications and section C-3, electrical portion of specifications.

7.17 C&I ITEMS

Refer to relevant clauses of section C2-A, customer specifications and section C-4, C&I portion of specifications.

7.18 For other items refer to relevant clauses of section C2-A, customer specifications

8 CONTROL PHILOSOPHY

SYSTEM CONTROL FOR CENTRAL AC PLANTS

- a) The operation of the AC plant-1, 2 & 3, and associated AHUs shall be done from the DDCMIS based control panel. The AC Plant compressor can be started only when its associated cooling tower fan, condenser & chilled water pumps are in operation.
- b) Chiller Package shall be provided with skid mounted microprocessor based control panel.
- c) The operation of the Split air conditioners shall be done from local MCB.
- d) All the drives of the AC system shall have the provision of manual starting.
- e) DDCMIS shall suitably interface with microprocessor based control units of chiller units.



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- f) Water chilling unit control system shall be designed to have a constant chilled water outlet from evaporator at all load condition by means of controlling ON-OFF thermostat (one for each compressor). The closure of liquid line solenoid valve and tripping of compressor at lower water temperature and opening of solenoid valve and starting of compressor at high set (water Temperature) point shall be automatic through the thermostat. Between the above set points the compressor capacity shall be controlled automatically through cylinder "load- unload" mechanism activated through the suction pressure or return chilled water temperature.
- g) Water chilling unit shall be equipped with superheat control of water chilling unit through thermostatic expansion valve, which gets its impulse from temperature element connected with suction line after chiller outlet.
- h) High discharge pressure cut-out and oil pressure (OP) differential cut-out shall be of manual reset type and low pressure cut-out shall be automatic reset type. The OP cut-out shall trip the compressor in case of low oil pressure.
- i) Facility toggle to close the liquid refrigerant line solenoid valve shall be provided to shut the compressor by the operation of the low pressure cut-out (after the refrigerant has been pumped to the condenser).
- j) On-off type anti-freeze thermostats, one for each chiller shall be provided in addition to the controlling on-off thermostat for safety purpose and shall act in the event of failure of on-off thermostat to close the liquid line solenoid valve and also to trip the compressor simultaneously.
- k) Compressor starting/running shall be interlocked with the low/adequate flow at the outlet of each chiller and each condenser and as well as with pressure in the inlet of the condensers. In addition closure or open status of various valves shall be used for interlock, alarm and control of Air Conditioning System.
- l) The standby condenser water pumps, standby chilled water pumps & standby AHU shall be started automatically when the working equipments are stopped/tripped. Auto/Manual selecting and working/Standby selecting facility for the pumps/AHU/fresh air fan shall be provided.
- m) Operation of Air conditioning system shall be interlocked with the required minimum pressure and temperature of cooling water at inlet to the condenser. Status indication of cooling water pumps & associated cooling towers shall be provided in the control panel of air conditioning plant.

AHU CONTROL

- a) Control of the inside room temperature and humidity shall be by controlling the chilled water flow by means of motor operated three way modulating valve and the modulating valve shall get its signal from the modulating thermostat.
- b) Humidity sensor located in the return air duct shall actuate the pan humidifier to obtain the desired degree of humidification.
- c) Separate humidity & temperature sensor shall be provided and interlocked in steps with winter heater / re-heater / strip heaters for monsoon and winter re-heating or heating as the case may be.
- d) Heater banks shall be interlocked with the running of AHU, temperature of return air, humidity of return air and safety thermostat (Geyserstat-located in front of the each heater in the supply air duct).

MISCELLANEOUS CONTROL REQUIREMENTS

- a) Separate emergency local stop push button shall be provided for each pump, compressor, fans etc. of AC system.
- b) Status shall be provided of each pump, compressor, fans etc. of AC system on MMI system at control room.
- c) All the alarms related to failure of equipment's, tripping of equipment's, source of failure / reason due to which the equipment is stopped / tripped, low & high limits of parameters such as level, temperature, pressure drop, pressure etc shall be provided for each pump, fan, compressor, AHU, etc.
- d) The AC Plant shall be provided with the following safety controls.



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- High discharge pressure cut-out (HP)
- Low suction pressure cut out (LP)
- Oil pressure cut-out (OP)
- Condenser water flow switch
- Chilled water flow switch
- Anti-freeze thermostat (AFT)
- Air-stat / safety thermostat with heaters of the AHUs.
- Overload trip of cooling tower fan motor.
- Over load trip of condenser cooling water, chilled water and water softening plant pump motors.

e) The AC Plant shall be provided with the following operating controls.

- Automatic capacity control system
- Automatic unloaded starting device
- Operating Thermostat
- Unloading solenoid valves (if applicable)
- Way flow control valve at the AHUs.
- AHU fan (chilled water, cooling water CT Fan and chiller) motor shall be provided with overload trip.
- Strip heaters shall be provided with high Temperature and "no air flow cut out".
- Humidity & Temperature indicator/sensor in control equipment room for monitoring shall be provided and the system will be hooked up with DDCMIS.
- MCB shall be provided for operating Split Air-Conditioners.

SYSTEM CONTROL FOR CENTRAL AC PLANTS

The basic function of the system is as follows: -

- To closely control and monitor inside temperature and humidity condition inside the air-conditioned spaces.
- To optimize / minimize energy consumption by automated operation.
- To provide remote centralized monitoring and control for various mechanical facilities including sequential start/stop of the whole AC system and automatically calculate record and cooling load for each hour/day/season.
- To generate maintenance data and alarms.
- To maintain records of plant operation and energy consumption for varying loads.
- Duty cycling to operate all the equipment including standby equipment for equal duration.
- Automatic start of standby equipment in cases of failure of operating unit and displaying fault alarm status of the tripped unit.
- Activating / deactivating water valves to start up/stop water flow through chiller/condenser circuit for sequential operation / duty cycling
- Programmed startup /stop of individual AHU as per operating requirements and for maintain the room temperature /RH by controlling the 3 way mixing valves at chilled water line, humidified system and duct heater.

SYSTEM OPERATION

- All drives would operate in two modes (Local / Remote). In Local mode, it will operate through push button station with ON/OFF indication.
- In Remote mode, it will operate through OWS (DDCMIS)
- All motorised butterfly valve, 3-way mixing valve, duct heaters and pan humidifier will be operate as per system logic depending upon necessary field input signals.
- The control scheme for the AIR-CONDITIONING SYSTEM shall be implemented in DDCMIS & shall be based on OEM recommended logic scheme.



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9 GENERAL

- 1) Basis of design all calculations including heat load calculations for summer seasons, equipment selection criterion, layout drawings/ schemes/G.A. dwg and documents like data sheet/ technical particulars etc are subject to Customer approval during detail engineering stage.
- 2) Vendor to furnish characteristic curves for all major equipment offered indicating duty point during detailed engineering.
- 3) All drawings and documents shall be computer based.
- 4) All commissioning spares & consumables for trouble free operation shall be provided Vendor to include level gauge & level switch for each tank for alarm & trip of the pumps. Also include one no. Pressure switch for each pump
- 5) Quality Requirements in the Technical Specification are indicating minimum requirements for inspection and testing. Vendor shall note that quality plan is subject to Customer & BHEL-approval during detail engineering stage. Standard QP format is enclosed in the technical specification.
- 6) Indicative list of makes is enclosed elsewhere in the specifications, however these equipments / items shall be subject to Customer & BHEL approval during detail engineering Stage.
- 7) Inserts or any support arrangement for fixing ducting, fans, piping etc. shall not be provided by BHEL. Necessary supports may be taken from nearest structure / walls / roofs / floors etc. by Vendor.
- 8) Fixing frame works for diffusers and grilles in the scope of Vendor.
- 9) Efficiency of centrifugal fan and pump shall not be less than 70%.
- 10) Anchor fastener shall be used by vendor for fixing duct pipes etc. wherever applicable.
- 11) Necessary supports and structures / frames etc. as required for supporting the duct / piping / equipments etc. as lump-sum basis is in the scope of Vendor and no unit rates shall be applicable for these items.
- 12) Drain piping within room up to the drain point to be provided by the Vendor.
- 13) Vendor to furnish schedule of power and control cables. Vendor to furnish cable termination details interconnection drawings etc. during detail engineering stage.
- 14) The tools and machine required for erection of equipment shall be arranged by Vendor.
- 15) Tools & tackles as required for regular maintenance shall be supplied by Vendor.
- 16) Instruments required for performance testing of various equipment / system of the package shall be arranged by Vendor at site.
- 17) Instrument for testing shall be calibrated by Air-conditioning plant supplier before taking up testing.
- 18) Temperature gauges shall be provided with thermo wells and fixing arrangement.
- 19) Pressure gauges shall have provision for air venting. Three way valves shall be used which shall have air venting provision.
- 20) Matching sockets / stubs (weld type) for flow switches and other instruments shall be supplied.
- 21) Bidders shall guarantee to maintain specified inside design conditions during summer, monsoon and winter and also even if the internal equipment load varies from 100% to 25%.
- 22) Besides the system performance as above, bidder shall guarantee major technical parameters of various equipments as per design basis / details furnished.
- 23) The guarantee tests shall cover but not limited to the following rated parameters for smooth operation of ventilation system.
 - Design dry bulb temperature and relative humidity of conditioned air, Auxiliary power consumption, Vibration and noise level etc.
 - Performance test of the Ventilation system shall be carried out at site after proper installation. The site test shall include performance testing of equipment for 72 continuous hours in summer or monsoon and 24 continuous hours in winter.



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Bidder, as may be required to carry out site tests shall arrange all instruments, tools etc.

- All calibrated instruments to be used for the tests at manufacturer's works/site shall be arranged by the bidder. Any Electrical/C&I items and accessories like junction box, glands etc. shall be included by vendor in his scope. Only those items shall be provide free of cost which are categorically listed in the Electrical scope sheet of technical specification.

- 24) For motorized fire damper / 3 Way valve actuators / motorised valves, power supply shall be derived by vendor from respective control panels. BHEL shall not provide any feeder for them. Suitable transformer shall be provided by bidder (if required) to derive the power input. Further distribution through junction box / distribution board shall be in vendor scope and shall have provision for isolation of individual fire damper/ valves.
- 25) Tender drawings enclosed form the part of specification and the bidder shall check the space requirements for installing the equipment as per the specification and layout requirements given in the specifications.
- 26) Bidder should suitably group the signals coming from various instruments etc. & the same shall terminate in local JB, from Local JB common cable to PLC / panel / MCC shall be selected. Any Electrical / C&I items and accessories like junction box, glands etc. shall be included by vendor in his scope. Only those items shall be provided free of cost which are categorically listed in the Electrical scope sheet of technical specification.
- 27) In the event of any conflict between the requirements of two clauses of this specification documents or requirements of different codes and standards specified, the more stringent requirement as per the interpretation of the owner shall apply.
- 28) Bidder to note that BHEL reserve the right for drg/doc submission through web based Document Management System. Bidder would be provided access to the DMS for drg/doc approval and adequate training for the same. Bidder to ensure proper net connectivity at their end.
- 29) Quality requirements in the Technical specification are minimum requirements for inspection and testing. Vendor to note that quality plans are subject to Customer approval during detail engineering stage. Standard QP format is enclosed in the technical specification.
- 30) The drawings/ documents submitted by vendor shall be complete in all respects with revised drawing submitted incorporating all comments. Any incomplete drawing submitted shall be treated as non- submission with delays attributable to vendor's account. For any clarification/discussion required to complete the drawings, the bidder shall himself depute his personal to BHEL / Customer's place any number of time as per the requirement for across the table discussions/ finalizations/ submissions of drawings.
- 31) Sealing of duct opening, grouting of foundation / foundation bolts etc. including special type of grouting like GPX2 etc. are in the scope of Air-conditioning system vendor.
- 32) Flat, platform type RCC / PCC foundation shall be provided for installing Chiller/ PUMP, AHU and FAN etc. Vendor shall fix the equipment using anchor fasteners to secure the equipment obtain parameters related to vibration and noise.
- 33) Bidder to note that the P&ID shows only the bare minimum requirement of valves and instruments. Any instrumentation & valves as required for the completion of the system in line with technical specification shall be provided by bidder during detailed engineering without any commercial implication.
- 34) RCC foundation of cooling tower shall be provided by BHEL. However, steel beam / joist etc as required shall be supplied by air-conditioning plant supplier.
- 35) Air-conditioning plant supplier to furnish drawings/ documents as per the dwg. / documents distribution as per project requirement.
- 36) Each motor terminal box shall be provided with cable gland and lugs for the size and type of power and control cable of respective motor.
- 37) All electrical equipment shall be suitable for the power supply fault levels and other climatic conditions indicated in project information / synopsis / specifications enclosed.



**1x800 TANGEDCO NORTH CHENNAI TPP
AIR CONDITIONING SYSTEM
SPECIFIC TECHNICAL REQUIREMENT**

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- 38) The bidder's proposal shall be for equipment in accordance with the tech. Specification.
- 39) The bidder shall furnish complete tech. Particulars in data sheet and schedules as specified elsewhere in the specification.
- 40) Necessary duct mounted Booster fan (if required) to maintain the static pressure for Precision AC shall be provided without any implication.
- 41) VFD driven motor shall be provided along with the VFD panel in bidder's scope.

10 EXCLUSIONS

Items of works listed below are excluded from scope of the air-conditioning plant supplier.

- a) Construction of AC plant room, air handling unit room, foundations for AC equipments.
- b) False ceiling, drop ceiling.
- c) Slab cut out for running ducts, pipes, cables, grilles/dampers. Underground masonry trenches and masonry risers. However minor civil work like making opening to suit / finishing of opening, sealing of duct opening, grouting of foundation bolts including special type of grouting like GPX2 etc. are in the scope of AC system vendor.
- d) Provision of drain traps / points,
- e) For Electrical scope, refer Electrical scope matrix sheet.

11 Codes and Standards

Design, manufacture, inspection and testing of the equipment covered by the specification shall unless otherwise specified conform to the latest edition of the standards and codes as specified under clause 03.00.00, 04.07.00 and other relevant clauses of section C2-A, customer specifications.



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TPP
AIRCONDITIONING SYSTEM
CUSTOMER SPECIFICATIONS

SPECIFICATION No: PE-TS-423-553-A001

SECTION : I

SUB-SECTION : C 2

REV. 00

DATE: April 2017

SECTION: I

SUB-SECTION: C 2

CUSTOMER SPECIFICATIONS



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AIR CONDITIONING SYSTEM
CUSTOMER SPECIFICATIONS
TECHNICAL REQUIREMENT

SPECIFICATION No: PE-TS-423-553-A001

SECTION : I

SUB-SECTION : C 2A

REV. 00

DATE: April 2017

SECTION: I

SUB-SECTION: C 2A

CUSTOMER SPECIFICATIONS
TECHNICAL REQUIREMENT



1X800 MW COAL BASED NORTH CHENNAI THERMAL
POWER PROJECT STAGE III



EPC TENDER SPECIFICATION FOR BTG PACKAGE

AIR CONDITIONING AND VENTILATION SYSTEM



1X800 MW COAL BASED NORTH CHENNAI THERMAL
POWER PROJECT STAGE III



EPC TENDER SPECIFICATION FOR BTG PACKAGE

2.1.10 AIR CONDITIONING AND VENTILATION SYSTEM

2.1.10.1 General

The air conditioning and ventilation system shall be provided so as to achieve inside design conditions for proper performance of equipment and personnel. The extent of supply under this contract includes all items required to complete the intent of the contract notwithstanding the fact that such items may have been omitted from the specification or drawings. The air conditioning and ventilation system shall also meet the requirements specified elsewhere in the specification.

2.1.10.2 Codes and Standards

Relevant Indian/International standards, such as ASHRAE, ISHRAE, AMCA and IS etc. as applicable to AC & ventilation system and latest issues of these applicable codes and standards shall be adopted.

2.1.10.3 Design Criteria for Air conditioning system

- a. Dry bulb temperature 47°C. For other details of ambient conditions, refer published documents for meteorological data for Plant site.
- b. Inside design conditions to be maintained in all air-conditioned areas.
Dry bulb temperature: 22+ 1.0°C
Relative humidity: 50+ 5%
- c. A minimum design margin of 10 % shall be considered while sizing AC Plant and related equipment like chillers, chilled water pumps and AHUs for each area. Solar load, all internal loads due to equipment, lighting, fresh air, occupants etc shall be considered while calculating the heat load.
- d. Margins for calculating heat load:
 - i. 12.5%, 10% & 10% margins on sensible heat, latent heat & overall heat respectively is to be considered while calculating heat load.
 - ii. For winter load calculations, 50% of the equipment load as available in the room is to be considered.
- e. All windows in the air conditioned area shall be provided with light coloured venetian blinds.
- f. Fresh air quantity of 1.5 air change/hour or 35m³/hr per person or suitable to maintain over pressure of 2 MMWC whichever is higher shall be considered.
- g. False-ceiling shall be provided in all air conditioning areas.
- h. For chemical lab, the air-conditioning system shall be designed for 100% outdoor air (the room air is exhausted and not recirculated through the A/C unit). 2 x 100 % Split units are acceptable for chemical lab.



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- i. To reduce the air-conditioning load the exposed roof slabs (Including beams and column etc.) of air-conditioning areas , air handling units room and Packaged Air conditioners (PAC) rooms shall be insulated with 50 mm thickness fibre glass insulation of density 48 kg/m³ finished with 26 swg aluminium cladding.
- j. AHU room's walls ,Packaged Air Conditioners room's walls and first 6 meters of supply air duct from AHU/PAC air outlet shall be acoustically insulated with 25 mm thick fiberglass crown 150 of density 48 kg/m³ and shall be covered with 26G aluminum perforated sheet. Perforation area shall be 30% of free area.
- k. Lighting load of 2 Watts per Ft² or actual which ever is higher shall be considered for heat load calculations.
- l. The occupancy for general/ office area shall be minimum one person per 3 Sq.M and for conference room the same shall be one per 1.5 Sq.M. In the control rooms, control equipment rooms etc, the occupancy may be one person per 20 Sq.M (Minimum).
- m. The Air-conditioning spaces shall be maintained at positive pressure of 2mmwc to avoid any infiltration of dust.
- n. Plant for all air-conditioned areas shall operate continuous (24 hours a day, 7 days a week except during loss of normal power failure).
- o. Motor operated valves shall be provided as per system requirement for chilling machines, pumps, cooling towers in order to facilitate remote operation of entire air- conditioning plant and to select standby unit.
- p. Noise Criteria – Design noise level shall be of NC 35-45 within Control room, Control equipment room, Instruments and Electronic room and offices.
- q. Design Criteria for Air Inlet Louver – Face velocity of the louver shall be 2.5 m/s (max.).
- r. Design Criteria for Volume Control Damper – Velocity across the Damper shall not exceed 10 m/s.
- s. Duct Design Criteria – Velocity shall be 7.5 m/s. (max.) for main duct, 6.0 M/s. (max.) for branch duct and 2.0 m/s. for the diffusers/grills.
- t. Coil face area of Air handling Units shall be designed considering a face velocity of not more than 2.5 M/ Sec.
- u. Water piping shall be sized for a maximum velocity of 2.5m/sec. However gravity flow/pump suction line shall be sized for a maximum water velocity of 1.5 m/sec.



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- v. Refrigerant suction, discharge/hot gas lines & liquid lines shall be sized such that the total pressure drop is equivalent to not more than 1.1 deg C in saturation temperature of refrigerants. However, refrigerant velocity shall not be greater than 0.5 m/sec in liquid line.
- w. All Carbon steel sheets under air conditioning system shall be hot dip galvanized or spray galvanized unless otherwise specified and minimum zinc deposition shall conform to Class 275 of IS: 277. The air distribution system shall be sized to have a constant frictional drop.
- x. For calculating friction loss in piping system: WILLIAM & HAZEN formula shall be used with C value as 100.
- y. Thermal Insulation Design Criteria

EQUIPMENT/MATERIAL	THERMAL INSULATION
Ducting	50 mm thick fibre glass of density 48 kg/cum and TF quality finished with 26 swg aluminium cladding. For Exposed ducting, 50 mm thick fibre glass rigid board (density 48 kg/cum and TF quality) finished with 26 swg aluminium cladding.
Refrigerant Piping for Split Air Conditioners and Packaged air conditioners	13 mm thick Nitrile foam.
Refrigerant Piping of Water Chilling Unit	75 mm thick expanded polystyrene (TF Quality) of density 32 kg/cum finished with chicken wire mesh, 12.5 mm thick sand cement plaster.
Chilled Water Piping and associated valves.	Chilled water piping shall be insulated with 50 mm thick (TF quality) expanded polystyrene of density 32 kg/cum covered with 12.5 mm thick Sand Cement Plaster. The portion of CHW pipe exposed to atmosphere shall be insulated with 50 mm thick (TF quality) expanded polystyrene of density 32 kg/cum and finished with 26 swg aluminium cladding.
Drain Piping from AHU and Chiller	Drain Piping shall be insulated with 25 mm thick EPS (TF quality) of density 16 kg/cum covered with 26 swg aluminium cladding
Chiller	As per manufacturer standard
Chilled Water Pump	50 mm thick thermal insulation of EPS (TF quality) of density 32 kg/cum covered with 26 swg aluminium cladding.
Expansion Tank	50mm thick thermal insulation of EPS (TF quality) of density 16 kg/cum covered with Sand Cement Plaster.
Air Handling Unit	Double skin type with PUF insulation
Indoor Unit of split AC	As per Manufacture's Standard
Package A.C	As per manufacturer's standard

- z. Design Chilled water flow shall not be less than 0.7 Cu.M/hr per TR air-conditioning load and design Condenser cooling water flow shall not be less than 1.0 Cu.M/hr per TR air-conditioning load.



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- aa. For maintenance of compressors/chilling units, pumps, AHUs (air handling units) etc. chain pulley block of suitable capacity and/or suitable structure shall be provided in the AC plant rooms and AHU rooms.

Redundancy of Equipments

Chilling Units	- 2 x 100%
Condensing Unit	- 2 x 100%
Condenser water pumps	- 2 x 100%
Chilled water pumps	- 2 x 100%
Package air conditioners	- 2 x 100%
Window/Split air conditioners	- 2 x 100%
FRP cooling towers	- 2 x 100%
Air handling units (DX type)	- 2 x 100%
(Per AHU room)	
Multiple AHUs of similar	
Air handling units	- (Chilled water type)
capacities per AHU room	
Fresh air fan unit	- 2 x 50% per AHU room

The number of chilled water pumps, condenser water pumps and cooling towers shall be equal to the number of chilling units and condensing units.

All the pumps shall have 10% margin on capacity and head over the actual requirement.

2.1.10.4 Design Criteria for Ventilation system

- a. The capacity of Air washers, Supply air fans, exhaust air fans/ roof extractors, ducting system shall be designed as per the Design criteria & Equipment specification elaborated below. Sizing calculations for all the equipment's shall be submitted for approval of Owner. However the minimum quantity of the air washer units of Ventilation System for each unit shall not be less than 4 numbers (two numbers on a row and two on B row). A minimum 10% margin shall be considered while sizing the equipment/plant capacity.
- b. The number of air changes per hour in evaporative/mechanically ventilated areas shall be as follows:

Sl.No.	Area	Air Changes
1	For all evaporative type ventilation system	8
2	General areas	15
3	Switch gear / MCC rooms.	25
4	Battery rooms & other areas where gaseous fumes are generated	30
5	DG set room	45

- c. However in areas producing lot of heat, the temperature limitation should be the criteria, which is as follows:
- i. Inside dry bulb temperature shall be minimum 5 deg.C below the design ambient dry Bulb temperature during summer for evaporative cooled areas.



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- ii. Inside dry bulb Temperature shall be maximum 3 deg.C above the design ambient dry Bulb temperature during summer for mechanically ventilated areas.
 - iii. The criterion which gives higher number of air changes/higher quantity of air in either of the conditions as mentioned above shall be the basis for selecting the required air flow for that area. Inside dry bulb temperature for battery room shall be maintained at 25oC.
 - iv. The air flow rate for battery room shall be sized considering minimum 30 air changes per hour or hydrogen concentration of 2% or less of the room volume whichever gives higher air flow shall be considered.
- d. All ventilation system shall operate on 100% fresh air.
- e. All mechanically ventilated areas like MCC/Switchgear rooms shall be positively ventilated by means of supply air fans, generally in combination with exhaust fan/ roof extractors. Wherever exhaust fan/ roof extractors are not provided, the pressurised condition shall be maintained with gravity operated backdraft dampers. However, as exception, hazardous areas and fumes/odour generating areas such as toilets shall be negatively ventilated by means of exhaust air fans/ roof exhausters and inlet louvers.
- f. Supply air fan catering for electrical switchgear/MCC rooms, Elevator machine rooms etc. shall be provided with pre filters and fine filters. Efficiency of Pre filter shall not be less than 90% down to 10 microns while for fine filter 99.5% down to 5 microns.
- g. All the equipments of Ventilation system shall be designed for continuous duty for continuous operation of 24 hours a day.
- h. The supply air ducts of evaporative/ UAF type ventilation system shall be provided with automatic (motor operated) fire dampers of fire rating 2 hours at the entry to each of the enclosed area like switchgear rooms, cable galleries etc. The operation of these automatic dampers shall be interlocked with the fire alarm system and the operation of these dampers shall also be possible from the control panel remote manually.
- i. For maintenance of Air washer unit material handling equipment as per size & type defined in Volume II Section 2, Clause no. 2.1.8 of this specification shall be provided in the Air Washer rooms of Evaporative Ventilation System.
- j. Circulating water capacity for Air washer units shall be minimum 1 cu.m per 1000 cu.m/hr of air flow while for Unitary Filtration Unit, it shall be minimum 0.6 cu.m per 1000 M3 /hr of air flow.
- k. Water piping shall be sized for a maximum velocity of 2.5 m/sec. However gravity flow/pump suction line shall be sized for a maximum water velocity of 1.5 m/sec.
- l. The air distribution system shall be sized to have a constant frictional drop along its length.
- m. The air washer unit and unitary air filtration unit shall be designed for a maximum face velocity of 2.0 m/sec.



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- n. The air washer unit shall be designed for at least 90% saturation efficiency while UAF for 60% saturation efficiency.
- o. For pumps, fans and blowers, continuous motor rating (at 500 deg C ambient) shall be at fifteen percent (15%) above the demand of the equipment at duty point or ten percent (10%) above maximum load demand of the equipment whichever is higher.
- p. For Belt drives, the belts shall be sized for 150% of the rated power and there shall be minimum of two belts per drive.
- q. All Carbon steel sheets under evaporative ventilation system shall be hot dip galvanized or spray galvanized unless otherwise specified and minimum zinc deposition shall conform to Class 275 of IS: 277.
- r. For calculating friction loss in piping system, WILLIAM & HAZEN formula shall be used with C - value as 100.
- s. Supply air fans, exhaust air fans/ roof ventilators of each area shall be provided with their local starter panel.
- t. Design Criteria for Back Draft Damper – Velocity across damper shall not exceed 6 m/s.
- u. Duct Design Criteria – Velocity shall be 12 m/s.(max.) for main duct, 9.0 M/s. (max.) for branch duct and 3.75 m/s. for the grills.
- v. Redundancy of Equipments
 - i. Pumps for each Air Washer Unit shall be 2 x 100% Capacity or 3 x50%. For UAF it shall be 1 x 100%.
 - ii. Fans for each air washer unit shall be 3x 33% capacity while for unitary air filtration unit shall be 1x100% capacity.
 - iii. Supply air fans/Exhaust air fans/roof exhausters shall be in multiplicity.

2.1.10.5 Systems to be furnished

2.1.10.5.1 Air Conditioning System

- a. A centralized water cooled chilled water system with screw chilling units shall be provided for the following areas: Main control room areas comprising unit control room, electronic cubicle room, shift in-charge, engineers room, maintenance engineers room, printer room, UPS room, relay room, SWAS (Dry) panel room, conference room, office rooms, record room, analyzer room and static excitation room in TG building.
- b. A separate water cooled direct expansion type air conditioning plant of 2x100% capacity shall be provided for ESP/VFD control room.
- c. Air Cooled Non Ductable Split/Window AC units shall be provided for the following areas



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- i. Operator cabin of TG Hall EOT Crane
- ii. Any other Control Room

d. Water Cooled package type AC unit shall be provided in each floor of Service building.

2.1.10.5.2 Ventilation System

a. TG Building

Evaporative type ventilation system shall be provided for TG building as specified below. Air washer units of double bank spray system shall be distributed along A-row and B-row of the building. Filtered and Cooled air from each air washer unit shall be distributed to various areas through supply air ducting and grills. The TG building shall be provided with adequate number of roof extractors.

b. ESP Control Room (Non air conditioned areas)

Unitary Air filtration units of single bank spray system using water repellant type nylon filters shall be provided for ESP building. Unitary air filtration units shall be located at roof top of ESP building.

c. Ambient air ventilation system for the other areas

- i. Turbine hall- Roof exhausters
- ii. DG set rooms
- iii. Mill reject Compressor Room
- iv. CPU
- v. Battery and battery charger rooms
- vi. All MCC rooms & cable vaults
- vii. Elevator machine rooms
- viii. All other areas not airconditioned.
- ix. Toilets

Any other area/building which has not been specifically included above, but required ventilation shall be provided with suitable ventilation system.

2.1.10.6 System description Air Conditioning System

2.1.10.6.1 Centralized Water Cooled Chilled Water System

- a. A centralized water cooled chilled water system with screw chilling units are envisaged for air-conditioning the areas viz. main control room areas. The water cooled screw chilling units along with chilled water pumps, condenser cooling water pumps and cooling towers shall be provided. The number of chilled water pumps, condenser cooling water pumps, cooling towers shall be equal to the number of chilling units. The air conditioning system shall also include multiple air handling units, associated air distribution system, chilled water piping, condenser water piping, valves & fittings, insulation, strip heaters, humidifiers, expansion tank and all other associated accessories and controls. A central control panel within the air conditioning plant room is to be provided. Local control panel for individual AHU rooms and other areas to be provided. Makeup water for water



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system to be provided at the air conditioning cooling towers as per required pressure and flow. Fresh air system shall be provided in all the AHU rooms.

- b. The screw chillers shall operate to meet the overall building cooling load requirements throughout the day. The chillers shall operate by a combination of chiller optimization and sequencing. The air conditioning controls shall be designed as to interface with the safety controls of each of the air conditioning equipment along with automatic operation. Selector switches and push buttons shall be provided for manual operation of all air conditioning equipment.
- c. Chilled water flow of 10 cum/hr shall be supplied to Sample Cooler in the Analyzer room from the main air-conditioning chilled water system.
- d. The air handling units shall be draw through type and casing shall be of double skin construction. Fans shall be double inlet double width (DIDW) centrifugal type. Fans shall have forward or backward curved blades. The cooling coil face air velocity shall not exceed 2.5 m/sec.
- e. Strip heaters of suitable capacity with controls shall be provided in the supply air duct plenum.
- f. Humidification package with all necessary controls.
- g. Air distribution system including ducting, grilles, diffusers fresh air unit, fire dampers, volume control dampers, thermal and acoustic insulation for ducts and accessories.
- h. Monorail and hoist for handling the A/C units, pumps, etc.
- i. Required Pre filters, Fine filters and Absolute (Hepa) filters along with differential pressure gauge shall be provided for sensitive areas of main control room i.e unit control room, electronic cubicle room, printer room, UPS room, relay room, SWAS (Dry) panel room, & conference room. Other areas shall be provided with pre filters & fine filters.
- j. The chilling plant and pumps shall be located in a separate room and the A/C plant room layout shall be made such that adequate space is provided for maintenance of chilling units, pumps etc.
- k. Online non- chemical type scale preventer shall be used to avoid formation of scale in the condenser water circuit.

2.1.10.6.2 Water Cooled Direct Expansion System (DX System)

Independent water cooled central air conditioning system of direct expansion (DX) type with reciprocating compressor is envisaged for ESP control room

- a. The water cooled condensing unit along with Air handling units, condenser cooling water pumps and cooling towers shall be provided. The number of Air handling units, condenser cooling water pumps, cooling towers shall be equal to the number of condensing units. In addition, one common standby condensing unit and the associated equipment shall be provided. The air conditioning



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system shall also include associated air distribution system, condenser water piping, valves and fittings, insulation, strip heaters, humidifier, Differential pressure for filters and all other accessories and controls. A central control panel within air conditioning plant room is to be provided. Local control panel for individual AHU rooms and other areas to be provided. Make up water for the condenser cooling water system to be provided at the air conditioning cooling towers as per required pressure and flow. Fresh air system shall be provided in all the AHU rooms.

- b. The air handling units shall be draw through type and casing shall be of double skin construction. Fans shall be double inlet double width (DIDW) centrifugal type. Fans shall have forward or backward curved blades. The cooling coil face air velocity shall not exceed 2.5 m/sec.
- c. Strip heaters of suitable capacity with controls shall be provided in the supply air duct plenum.
- d. Humidification package with all necessary controls.
- e. Air distribution system including ducting, grillers, diffusers fresh air unit, fire dampers, volume control dampers, thermal and acoustic insulation for ducts and accessories.
- f. Monorail and hoist for handling the A/C units, pumps, etc.
- g. Required Pre filters, Fine filters and Absolute (Hepa) filters along with differential pressure gauge.
- h. The condensing plant and pumps shall be located in a separate room and the A/C plant room layout shall be made such that adequate space is provided for maintenance of condensing units, pumps etc.
- i. Online non- chemical type scale preventer shall be used to avoid formation of scale in the condenser water circuit.

2.1.10.7 System description Ventilation System

2.1.10.7.1 Evaporative Cooling System for Turbine Building

- a. Four (4) nos. air washers of adequate capacity shall be provided for evaporative cooling of various floors of turbine building including maintenance bay and electrical bay. Each air washer system shall consists of two (2) nos. centrifugal fans (both working), two (2) nos. centrifugal circulating water pumps (1 working + 1 standby), Send trap and air intake louvers, filters, air washer internal, ducts and other accessories. Besides, roof extractors shall be provided. With this system the dry bulb temperature (DBT) within the turbine building shall be maintained at a temperature not exceeding 5°C less than ambient DBT at all times of the year. The air washer capacity is to be decided based on:
 - i. Total internal heat load within the turbine building, inclusive of electricity bay and maintenance bay and considering the heat dissipated by various electrical switchgear,



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- motors, equipment hot surface, steam piping as well as the dissipated heat, solar transmission through the building walls and glass, and any other sources of heat.
- ii. Summer ambient conditions as furnished to be considered.
- iii. Efficiency of air washer shall be 90% with two banks opposed type spray system

- b. The number of roof extractors in the turbine building to be sized so as to exhaust about 70% of the total air supplied in order to reduce ingress of dust-laden air into the building.
- c. Air washer shall be double bank spray type mainly consists of an airtight chamber or casing containing air distribution louvers, spray nozzles, a tank for collecting spray water, eliminators with flooding nozzles, pre and fine filters and a pump with piping valves, strainers and specialities for re- circulating water. One (1) level switch in the air washer tank shall be provided to give an alarm in the air washer plant room.
- d. The supplied air will be exhausted through roof exhausters to maintain an overpressure of 1-2mm of water column to reduce dust ingress.

2.1.10.7.2 Unitary Air filtration Unit for ESP Control Building

For ventilation of this building (except the control room), ambient air will be drawn through unitary air filtration units of single bank type comprising fresh air intake louvers, automatically cleanable nylon filters (with water spray) and moisture eliminator and supplied to the space by means of centrifugal fans.

The supplied air will be exhausted through wall mounted gravity operated dampers to maintain an overpressure of 1-2mm of water column to reduce dust ingress.

2.1.10.7.3 Ambient Ventilation System for other areas

Ambient ventilation system shall comprise of supply air fan assemblies with Pre & Fine filters, Gravity louvers, exhaust air fans, roof extractors, gravity dampers or a suitable combination of these along with necessary filters, ducting, grilles etc.

Transfer towers/tunnels of Coal handling plant shall mainly consists Supply air fans of DIDW type with pre and fine filters, Supply air ducting and grills, Exhaust air ducting and grills and Exhaust air fans of SISW type.

The ventilation system for the various areas shall be designed duly considering the factors such as temperature, relative humidity and maximum allowable concentration of gases present in the rooms, corresponding to international guidelines.

2.1.10.7.4 Specific Requirements

All battery rooms to be painted with acid & fume resistant paint.

- a. For hazardous areas, fans with anti-spark characteristics to be provided.



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- b. For elevator machine room, filtered air shall be supplied by supply air fan. Exhaust shall be through gravity dampers.
- c. Evaporative cooling ventilation fans shall be interlocked with fire protection system, to get the same tripped in the event of fire.
- d. Online non- chemical type scale preventer shall be used to avoid formation of scale in the Airwasher nozzles/ water circuit.

2.1.10.8 Equipment Description

2.1.10.8.1 Chilling Unit/Condensing Unit

Type	Water cooled type.
Vibration isolators	Steel spring/ Neoprene rubber cushy foot/ neoprene serrated rubber pad type with isolation efficiency not less than 85%.
Compressor Type	a. For the Chilling units of T G building control room areas, the compressor shall be Hermetically sealed Screw type operating on R134a/R407C refrigerant complete with accessories and automatic control facilities
	b. For condensing units of ESP/VFD control rooms shall be Hermetically sealed screw type operating on R134a/R407C refrigerant complete with accessories and automatic control facilities
Type of drive	Motor driven, through direct
Accessories	High / Low pressure cutouts, Oil pressure switches, relief valves, Pressure gauges at each stage, lube oil/Control oil pressure gauges, Suction and discharge stop valves, Muffler, Crank Case heaters, Oil filters, Magnetic oil Separators, Temperature indicators for Lube oil/ Heaters, Oil level indicators, Safety thermostat for crank case heater, Vibration Isolators etc.
Condenser	
Type	Water cooled, shell and tube type.
Fluid	Shell side – Refrigerant
	Tube side - Water
Capacity	To match with respective compressor and to provide atleast 2 deg.C sub-cooling. To store full charge of refrigerant.
Design fouling Factor	Not less than 0.0002 (in MKS units)
Shell material	Mild steel (IS:2062)
Tube material	Replaceable seamless copper (ASME B-111)
Fin material	Copper



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Accessories	Purge and drain connections, relief valves, liquid line shut-off valves, refrigerant filling charging, flow switches, Isolating valves, Pressure & temperature indicators at inlet and outlet etc.
Refrigerant	For chilling Unit- R 134a For Condensing Unit - R-22
Steel structure	The complete condensing/ chilling unit shall be mounted on steel structure and shall be provided with necessary vibration isolators
Chiller	
Type	DX type and Shell and tube type
Superheating of	At least 2 deg.C
Design Fouling Factor	Minimum 0.0001 (MKS units)
Fluid	Shell side - Water Tube side - Refrigerant
Capacity	To match with respective plant capacity.
Shell material	Mild steel (IS : 2062)
Tube material	Replaceable seamless finned copper

2.1.10.8.2 Air Handling Unit (AHU)

- Each AHU shall consist of Casing, Fan impeller section, Cooling coil section, damper section, Steel frame with vibration isolators (minimum efficiency of 85%) for the complete AHU, Isolation dampers at the Suction and discharge of each AHU, Pre-filter at the suction and Fine filters (micro- vee type) in the discharge of each individual AHU/common plenum, Absolute (HEPA type) filters in individual discharge of all AHU's/common plenum of Control room, control equipment room, computer, programmer rooms etc and Heater section in the common discharge of AHUs.
- The casing of AHUs shall be of double skin construction. Double skin sandwich panels (inside and outside) shall be fabricated using minimum 22 swg (0.8 mm) galvanized steel, with 25mm thick polyurethane (PUF) insulation of minimum 40Kg./ Cum density in between. 16 gauge galvanized steel hat-channel shall be used as reinforcing to give structural strength.
- Face and bypass dampers (motor operated for DX type plant) of opposed blade type shall be provided. Dampers shall be made of 16 gauge G.S sheet metal (class 275 of IS: 277). The area of the bypass section shall be minimum 30% of the coil face area. Damper operating linkage and the operating motor shall be located outside the casing. Each AHU shall be provided with motorized volume control damper at air discharge.
- Cooling coil shall be of seamless copper tubes with Aluminium fins and shall be provided with suitable drains and vents connections.



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- e. All filter plenum shall be provided with a walking platform inside the plenum chamber for filter cleaning purpose. Inspection door shall be provided at the plenum chamber and a removable type ladder shall be attached to plenum.
- f. Air handling units/centrifugal fans shall be provided with Variable frequency drive (VFD) and velocity sensor/static pressure sensor in supply air path to adjust air flow automatically. The minimum efficiency of VFD at full load shall not be less than 96%.
- g. Centrifugal Fan

1	Fan impeller	Forward/ backward curved blade & centrifugal type.
2	Impeller material	Mild steel spray galvanised with minimum zinc deposition conforming to Class 275 of IS:277.
3	Fan bearings	Self aligning type, permanently lubricated, heavy duty with a design life of 10,000 operating hours.
4	Critical speed	First critical speed of rotating assembly shall be at least 25% above the operating speed.
5	Drive	Motor driven. With removable belt guard.
6	Static pressure (minimum)	120 mm wc

2.1.10.8.3 Precision Type Packaged Air Conditioners

Packaged air conditioners shall be of precision control type complete with hermetic type Scroll compressor, shell and tube type water cooled condenser, air handling fan, D-X cooling coil, Microvee filters, In-built dehumidification cycle thru solenoid valve for reading ADP, humidifier package with humidistat and other accessories and controls, electrical strip heaters with suitable thermostat, first charge of refrigerant and oil, controls and all necessary instruments and accessories, all housed in a cabinet made of heavy gauge sheet steel finished in epoxy paint of approved colour and suitable for floor mounting. Suitable drain connection shall be provided for removal of condensable collected inside a tray under cooling coil.

- a. Compressor shall be hermetically sealed Scroll type with drive motor. It shall be suitable for R22/R407c refrigerant. The compressor shall be mounted on springs at the lower most section of packaged unit such that the same is easily accessible for servicing.
- b. The condenser shall be water cooled shell and tube type having replaceable seamless copper tubes with integral fins and removable head. The condenser shall be provided with fusible relief plug and all other accessories as required.
- c. The air handling fan shall be centrifugal type with forward curved blades and complete with belt drive and electric motor. Each PAC shall be provided with motorized volume control damper at air discharge.



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- d. Cooling coils shall be of direct expansion type and made of heavy gauge copper with hydraulically bonded aluminium fins. Rows shall be staggered in the direction of air flow.
- e. Filters shall be non-rusting corrugated metallic wire mesh cleanable type and of adequate area so that the air velocity across the filters shall not exceed 2.5 m/sec. Filter shall be in-built with unit heaving efficiency 95% down to 5 microns.
- f. Refrigerant piping shall be heavy gauge copper or IS:1239 heavy class seamless MS pipe complete with thermostatic expansion valve, liquid line shut-off valve, high and low pressure gauges.
- g. Cabinet Construction:
The frame & panel shall be constructed of Cold rolled cold annealed sheet steel duly powder coated and shall be assembled with pop rivets. The side panels of unit shall be double skinned for increase life span and reduction of noise & vibration. Front panel shall be removable hinge for easy service.
- h. De-Humidification
Specific de-humidification cycle (Split Liquid / Split Suction) shall operate by reducing the operating surface temperature in a section of one of the Refrigeration coil by means of a solenoid valve in the Liquid line / Suction line. Full air flow of the unit will be maintained at all times to ensure consistent air distribution to the conditioned space.
- i. All necessary operating and safety controls shall be provided including the following:
- i. Controls
The controls shall be of microprocessor based programmable PID (Proportional, integral and derivative control logic) controller. The controller shall have a LCD display screen, which shall be visible from the front of the unit without removing any covers/external panels. This LCD display screen should show the following information / data:
1. Modes of operation (cooling, heating, humidification, de- humidification).
 2. Simultaneous displays of set temperature and actual temperature and set Relative Humidity and actual Relative Humidity.
 3. Date, time and unit identification display.
 4. System component Auto / Manual status display on the controller screen.
 5. Backup battery charge status display on the controller screen.
 6. Visual system alarm indication (along with mutable audio alarm as well).
 7. Alarm display menu (incorporating various system alarms like temperature high / low, humidity high / low, Compressor HP/LP, Wet floor and loss of air flow conditions).
 8. 24 Hours temperature and relative humidity graph display menu.
 9. Programmable services interval indication display / alarm.

There should be a feature to enable operator to program the start-up and shut off of the system components (blower fan start / stop delay, first compressor start / stop delay, second compressor start / stop delay, etc.). Access to the controller settings shall be protected with passwords to prevent against unauthorized access.



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ii. Safety Protections

The unit shall also incorporate the following protections:

1. High pressure trip- Manual reset for each compressor
2. Low pressure trip- Manual reset for each compressor.
3. Single phasing preventers.
4. Reverse phasing
5. Phase imbalancing
6. Phase failure
7. Overload tripping (MPCB) of all components

iii. Safety Interlocks

Operation of heaters & humidifiers shall be possible only when blower fan is in operation.

Fire detection signal from fire detector system shall be able to switch off the package unit operation in event of fire in conditioned space.

- j. A suitable number of vibration isolation pads shall be provided for the packaged units.

2.1.10.8.4 Centrifugal Pumps

1	Type	Horizontal Centrifugal, Axially split type casing pump
2	Impeller	Closed type
3	Material of Construction	
	a.Casing	2% Ni Cast Iron : IS:210 Gr. FG-260
	b.Impeller	Bronze IS:318 Gr-2
	c.Wearing rings	Bronze
	d.Shaft	SS 410
	e.Shaft sleeve	SS 316
	f.Lantern ring	Brass / Bronze
	g.Packing	As per manufacturer's standard.
	h.Base Plate	Carbon steel as per IS:2062
	i.Speed	Maximum 1500 rpm

2.1.10.8.5 Air Filters

a. Pre Filter

1	Filter medium :	
	a.	Fibrous material (extruded polyethylene) or felt filter fabric; Dry type with element of 5 ply construction for Fabric type.
	b.	V-fold galvanized wire mesh inter spaced with a flat layer of galvanized wire mesh for Metallic type pre-filters.
2	Frame	



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	a.	GI sheet (minimum 18 gauge thick) or Aluminium alloy of (minimum 16 gauge) supported by galvanised steel wire mesh of 10 mm Square with handles.	
3	Other requirements :		
	a.	Suitable aluminium spacers be provided for uniform air flow;	
	b.	Casing shall be provided with neoprene sponge rubber sealing.	
	c.	Capable of being cleaned by water flushing.	
	d.	Density of filter medium shall increase in the direction of air flow in case of metallic filter.	
4	Efficiency :		
	a.	Average arresstance of 65 - 80 % when tested in accordance with BS:6540/ASHRAE – 52 - 76.	
5		Minimum thickness	50 mm for Fabric type.
6		Face Velocity	Not more than 2.5 m/sec.
7		Pressure drop	Initial pressure drop - Not to exceed 5.0 mm WC at rated flow. Final pressure drop - Upto 7.5 mm WC.
8		Location	
		a) Fabric type	At the suction of each AHUs (AC system)
			At the suction of each Fresh air fan (AC)
			3) At suction of each PAC unit

b. Fine Filters (Microvee type)

1	Construction	By pleating a continuous sheet of filter medium into closely spaced plates separated by heavy corrugated aluminium spacers.
2	Frame	Aluminium alloy of (minimum 16 gauge conforming to IS:737)
3	Other requirements	A neoprene sponge rubber sealing shall be provided on either face of the filter frame. Capable of being cleaned by air or water flushing.
4	Efficiency	Average arresstance of 80-90% when tested in accordance with BS:6540/ASHRAE-52-76.
5	Minimum thickness	150 mm or 300 mm.
6	Face Velocity	Not more than 1.2 m/sec for 150 mm and not more than 2.4 m/sec. for 300 mm.
7	Pressure drop	Initial pressure drop - Not to exceed 10 mm WC at rated flow ; Final pressure drop-Up to 18 mm WC.
8	Location	At the discharge of each individual AHU (AC system). At the discharge of each Fresh air fan (AC system)

c. Absolute Filter / Hepa Filter

1	Media	100% sub-microscopic glass fibres.
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2	Frame	Aluminium alloy of (minimum 16 gauge conforming to IS: 737) with handles.
3	Other requirements	A neoprene sponge rubber sealing shall be provided on either face of the filter frame.
4	Efficiency	99.97 % down to 0.3 micron when tested in accordance with BS: 3928 (Sodium flame test)/FED-209B.
5	Minimum thickness	300 mm
6	Face Velocity	Not more than 1.2 m/sec.
7	Pressure drop	Initial pressure drop - Not to exceed 20 mm WC at rated flow; Final pressure drop - Up to 60 mm WC.
8	Location	At the discharge of each individual AHU feeding to computer rooms, programmer rooms, control room and control equipment room in central control building.

2.1.10.8.6 Cooling Towers

Type	Induced draft, cross or counter flow.
Capacity	110% of rated capacity of each cooling water pump.
Material of construction of Casing & Sump tank	F.R.P
Fan	Cast Aluminium / FRP Propeller type and multi-blade aerofoil construction with adjustable pitch.
Fill	Non-combustible PVC or Equivalent of light grey, cream or white colour.
Louvers	F.R.P / PVC / Aluminium.
Nozzles	Brass with chrome plating/Polypropylene.
Eliminators	In removable sections to reduce the drift loss to 0.2% of water flow.
Supporting structure	Mild steel with spray galvanisation or epoxy painting.
Strainer at water outlet	Plate strainer made of GI /SS wire mesh of 16 gauge.
Bird screen	25 mm square made of GI/SS wire mesh of 16 gauge.
Ladder	Hot dip galvanised steel ladder for each tower.
Distribution Pipe	Galvanised MS pipe.
Accessories	Drain connection with isolation valve Make up connection with ball - float valve, back up gate valve and a bypass with a gate valve for manual operation. Overflow connection Equalizing connection to connect sump of all the towers wherever applicable. Access door in louvers / fan deck.

Individual sets of cooling towers shall be provided for Central chilling plant in T G building areas, DX type air conditioning system for ESP/VFD control room and Packaged type air conditioning



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systems for Administrative building, Switchyard control room, AHP control room and other areas/control rooms.

a. Non- Chemical Type Scale Preventor

The unit should be a non-chemical on-line type scale preventor not requiring any chemicals. Non-chemical water treatment system should prevent the formation of hard scale in cooling circuits of air conditioning equipment. It should work with a combination of Adsorption, and Turbulence. The inner core should be able to convert the hardness salts into colloidal particles. The unit should not require any electricity or any other source of energy. The unit should not have any recurring, operating and maintenance cost. The size of the unit shall be determined based on the water quality and water flow rate. The unit shall be installed in the condenser water circuit. The outer casing should be of stainless steel. The method of checking the performance of system through computer simulation shall be provided

2.1.10.8.7 Air Distribution System

- a. Galvanized sheet steel fabricated rectangular ducting shall be provided for the low pressure air distribution system. The thickness of sheets type of bracings and other fabrication details shall be as specified below:

Sl.No.	Larger dimensions of Duct	Thickness of GS sheet (mm)	Type of Transverse Joint Connection	Bracing
1	Upto 600	0.63 (24 g)	S-drive, 25 mm pocket or bar slips on 2.5 m centers	25 x 25 x3 angles 1.2 m from joint
2	601 thru 750	0.63 (24 g)	S-drive, 25 mm pocket or 25 mm bar slipson 2.5 m centers	25 x 25 x 3 angles braced at 1.2 m from joints.
3	751 thru 1000	0.80 (22 g)	S-drive, 25 mm pocket or 25 mm bar slips on 2.5 m centers	25 x 25 x3 angles braced at 1.2 m from joints.
4	1001 thru 1500	0.80 (22 g)	40 x 40 angle connections or 40 mm pocket or 40 mm bar slips with 35 x 3 bar reinforcing on 2.5 m centers	40 x 40 x 4 angle braced at 1.2 m from joints.



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5	1501 thru 2250	1.00 (20 g)	40 x 40 angle connections or 40 mm pocket or 40 mm bar slips with 35 x 3 bar reinforcing on 2.5 m centers.	40 x 40x 4 angle braced at 600 mm from joints.
6	2251 and larger	1.25 (18 g)	50 x 50 angle connections or 40mm pocket or 40 mm bar slips 1 m centers with 35 x 3 bar reinforcing	50 x 50 x 5 angle braced at 600 mm from joints

- b. The longitudinal seams and transverse joints shall be flat and smooth inside the duct. All rectangular ducts shall be flat on face and pittsburgh on corner of duct. Duct pieces shall be joined together by 'S' and drive slip joints or by angle iron flanges. The size of connecting flanges shall be same as that of the bracing angle. The interconnecting flanges shall be connected with 10 mm galvanised bolts and nuts at about 125 mm centres. All flanges shall be connected to the ducts by rivets at about 125 mm centres. The ducts shall be tapped 6 mm across the flanges. All flanged joints shall have 6 mm thick felt packing stuck to the flanges with shellace varnish or approved equal adhesive. The holes in the felt packing shall be burnt through.
- c. Ducts 2250 mm and larger require special field study for supporting. Unless otherwise specified, the ducts with larger side greater than 2250 mm shall be supported by 15mm MS rods and 65x65x5 mm MS angles while those below 2250 mm shall be supported by 10 mm MS rods and 50x50x4 mm MS angles. The MS rods and angles shall be given two coats of redoxide primer paint and final coat of silver colour. The duct support shall be at a distance of not more than 1800 mm. The MS rods shall be hung from the building steel with provision of necessary auxiliary steel members or approved means fixed to the ceiling slab. The auxiliary steel members, hooks, coach screws and all other supporting materials required shall be provided by the bidder. Wherever in passage, if overhead vertical hanger supports are not possible for the duct length, then channel/beam shall be used, grouted in floor foundation is in the scope of bidders.
- d. Flexible joints shall be provided on the inlet and outlet of each fan and unit to which duct connections are made or where fan sections are isolated from other air handling sections. Connections shall be made from non-combustible heavy glass fabric 1.02 kg/M² (30 Oz per sq.yd) double coated with Du Pont's Neoprene (polychloroprene) or Hypalon. Fire standards shall comply with UL214 and NFPA Pamphlet 90A paragraph 2.1.2.3 outlining standards for vibration isolation connectors to duct systems. Minimum 25 mm stack shall be allowed in these connections to isolate transmission of vibration from fan or fan section. The fabric shall either be folded in with the metal or attached with metal collar frames at each end to prevent leakage. The width of the joints from metal edge to metal edge shall be not less than 80 mm and not more than 250 mm. The ends of



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the ducts or duct and fan connection shall be in line. Canvas or fiberglass shall not be accepted for flexible joints.

- e. All curves, bends, offsets and other transformations shall be made for an easy and noiseless flow of air. The throat of every branch duct shall be sized to have the same resistance in the main duct to which the branch duct is connected. All elbows shall have the throat radius of at least seventy five (75) percent of the duct width. In case the throat radius is smaller, suitable single thickness vanes of approved details shall be provided.
- f. Wherever duct passes through wall, all the openings between masonry and duct work shall be neatly caulked or sealed to prevent movement of air from one space to the adjoining space. Where duct passes through the floor, at the lowest point in the elbow a drain trap of 100 mm width across the width of the duct and 50 mm deep shall be provided with suitable gauge valve.
- g. An adequately sized access doors lined with substantial felt edgings shall be provided in the duct work where required. The access doors shall be built up construction, structurally strong and each shall have two rust proof window sash locks of approved type. All doors shall be set out so as to flush with any insulation or plaster finish on the duct.
- h. Splitters and dampers shall be placed at approved locations for proportional volume control of the system. Splitters and dampers shall be made in 18 gauge GSS of quadrant type with suitable locking device, mounted outside of duct in an accessible location. The metal shall be bent over at each side of the splitter to form a reinforced edge. Each splitter shall be securely attached with a locking device to rods which shall be installed through ducts. On one end of these rods, there shall be locking device with a mark to show the final adjusted position of the splitter
- i. All the plenum chambers or connections to fans, dampers etc, shall be constructed in 18 gauge GSS, supported on 40x40x6 mm MS angle frames. All vertical angles shall be rivetted at approximately 125 mm centres to the casing. 'Pecora' or equivalent caulking compound shall be inserted between the base of angle and all masonry construction to which angles are fastened.
- j. Wherever pipe hangers or rods pass through the ducts, light and stream lined casement around the same shall be provided to maintain smooth flow of air.
- k. Supply air grilles shall be of mill finished extruded aluminium construction. Grilles shall be provided with volume control dampers of opposed blade type. Supply air grilles shall be of double deflection type. All the required steel/wooden frame work for fixing grilles shall be furnished by the bidder.
- l. All air terminals shall be of mill finish extruded aluminium profile construction.
- m. The proposed ducting scheme, duct sizes, location of supply air grilles etc shown on the enclosed drawings is tentative and subject to finalisation during detailed engineering by the Bidder. The bidders shall furnish in their proposal quantities of ducting, duct insulation, supply air grilles. However, these quantities may increase or decrease depending upon the final layout.
- n. Each branch line shall have dampers to isolate the branch for maintenance purpose.



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2.1.10.8.8 Pipe work Valves and Specialities

- a. Unless otherwise specified herein the specification. Piping for sizes smaller than 150 mm NB shall be continuous welded Galvanised steel pipes to IS: 1239 heavy class. Piping for sizes 150 mm and larger shall conform to IS:3589 with minimum 6.35 mm thickness.
- b. Fabricated elbows from pipe (5 piece mitre) shall be furnished for pipe fittings of sizes 200 mm & larger. Locally available long radius ($R=1.5D$) hot bends with thickness same as that of the pipe having butt welding ends as per ASA B-16.9 shall be furnished for pipe fittings of sizes 150 mm up to 65 mm NB. 3000 # ASA standard forged carbon steel pipe fittings to A-105 Gr.II or IS:1875 Class-2 or approved equal with socket welding ends as per ASA-B- 16.11 shall be furnished for pipe fittings of sizes 50 mm NB and smaller.
- c. Unless otherwise specified, all flanges shall be ASA # 150 standard (as applicable) forged carbon steel slipon flanges to A-105 Gr.II or approved equal, faced and drilled to ASA-B-16.5. The pipework flanges shall match with the valves and equipment connections. Hexagonal head machined carbon steel bolts to IS:1367 Class 4.6 or approved equal shall be furnished with hot forged carbon steel hexagonal head nuts to IS:1367 class 4.6. The gaskets shall be 3 mm thick wire inserted red rubber full face gaskets, 150 # ASA standard and drilling details to match with the flanges as required.
- d. In general, all the line joints for sizes 65 mm and larger shall be butt welded and the joints at valves shall be flanged unless otherwise specified. For pipe sizes 50 mm and smaller, the line joints shall be in general socket welded and the joints at valves shall be screwed unless otherwise specified. The joints at equipment and instruments shall be as per manufacturer's drawings.
- e. All valves for sizes 65 mm and larger shall be 150 # ASA standard, double flanged, cast iron body to IS:210 Gr.260, stainless steel trim, bolted bonnet, bolted gland, rising stem outside scraw and yoke, back seated, ends flanged (PF) faced and drilled to ASA-B-16.5. All valves for sizes 50 mm and smaller shall be 800 class standard forged carbon steel body construction to ASTM A 105 stainless steel trim, union bonnets, rising stem inside screw, renewable seats ends female screwed to IS:554. The butterfly valves shall be designed as per AWWA C 504 and designed to fit between flanges. The butterfly valves shall be provided with flow control lever, black nitrile rubber integrally moulded seating, disc of aluminium bronze to BS 1400 Gr. AB2/AB1, shafts of stainless steel AISI 410. The butterfly valve shall be rated for 16 bar; body/disc tested at 24 bar and seat at 14 bar.
- f. All the pipe supports, guides, anchors, turn buckles, rods, hangers with secondary structural steel framing shall be furnished and installed by the Seller. The Seller's support shall utilize the Purchaser's steel as far as practicable. Where additional secondary steel is required for the hangers, these shall be furnished. The secondary auxiliary steel required for the hangers and supports shall be welded to the Purchaser's steel structure as directed by the Engineer. Welding shall not be permitted across the bottom flange of main structural members.
- g. The bidder shall ensure that the location of hangers and supports shall not increase the force and moments on equipment beyond the permissible limits. The anchors shall be designed for rigid fastening to the structure directly or through brackets. As far as possible, attachments of supports



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brackets to brick walls shall be avoided. All concrete inserts shall be galvanised and shall be installed on the concrete structure where required for fastening supporting devices.

- h. Bolted pipe clamps used for rod hangers shall be of minimum 6 mm thick. Hanger rods shall be 10 mm dia. All hanger components shall be given a shop prime coat of red lead paint.
- i. Upon completion of the installation of all pipework as per approved drawings, the pipe lines section shall be subjected to hydrostatic testing at 1.5 times the design pressure. All joints shall be carefully examined for sweating or leakage and repairs conducted as necessary and the hydrostatic test repeated till its satisfactory completion to the Engineer's satisfaction. After completing the hydrostatic test, the pipe lines shall be drained and flushed several times to ensure complete cleanliness inside the pipes.
- j. All the drain piping between the drain connections of each equipment upto the Purchaser's common drain point in the equipment room shall be provided by the Bidder. Necessary seal loops as required shall be incorporated in the drain piping.
- k. The bidder shall submit the circulating water piping layout for Evaporative Cooling System. The quantities of piping, valves and instruments as required shall be included in the proposal. Requirement of pipe fittings, flanges, bolts and nuts, gaskets, couplings and associated accessories shall be estimated by the bidder and included in the scope of supply.

2.1.10.8.9 Valves

- a. Valves shall have full size port and Suitable for horizontal and as well as vertical installation.
- b. Valves for regulating duty shall be of Globe type suitable for controlling throughout its lift.
- c. Gate, Globe and stop Check valves shall have bonnet back seat to facilitate easy replacement of packing with the valves in service.
- d. All Safety / relief valves shall be so constructed that the failure of any part does not obstruct the free discharge.
- e. Manual gear operator be provided for valves of size 250 NB and above.
- f. All valves with rising stem shall have position indicators.
- g. All valves shall be provided with locking arrangement.
- h. All valves for sizes 65 mm and larger shall be 150 # ASA standard, double flanged, cast iron body to IS:210 Gr.260, stainless steel trim, bolted bonnet, bolted gland, rising stem outside screw and yoke, back seated, ends flanged (PF) faced and drilled to ASA-B-16.5. All valves for sizes 50 mm and smaller shall be 800 class standard forged carbon steel body construction to ASTM A 105 stainless steel trim, union bonnets, rising stem inside screw, renewable seats ends female screwed to IS:554.



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- i. The butterfly valves shall be designed as per AWWA C 504 and designed to fit between flanges. The butterfly valves shall be provided with flow control lever, black nitrile rubber integrally moulded seating, disc of aluminium bronze to BS 1400 Gr. AB2/AB1, shafts of stainless steel AISI 410. The butterfly valve shall be rated for 16 bar; body/disc tested at 24 bar and seat at 14 bar.

2.1.10.8.10 Air Washer Unit

- a. Each Air Washer Units (Evaporative System) shall consist of the various Sections such as Air washer chamber / Casing, Tank, Distribution louvers, set of metallic/fabric filters, suction louvers, bird screens, water headers, Spray nozzle, piping, valves, etc, Drift eliminators, Pumps, Fans, Necessary controls & Instrumentation and all other required accessories.
- b. ii. The air washer chamber casing shall be RCC or fabricated from MS sheet as the case may be. The sheet metal air washer chamber casing shall be fabricated from 3.15 mm black M.S. sheet with adequate stiffeners etc. and various sections shall be bolted through gaskets to avoid leakage of water. The inside of casing shall be protected by spray galvanization or by three coats of epoxy painting.
- c. The air washer tank shall be fabricated from MS plate of minimum 6 mm thick and inside and outside surface of the casing and tank shall be spray galvanized. Minimum depth of the tank shall be 600 mm. Tank construction shall be such that the suction screen can be replaced while the unit is operating. Tank shall be provided with overflow, drain with valve, float valve makeup connection with a gate valve backup, quick fill connection with globe valve etc. The overflow pipe shall be connected to drain pipe after isolating valve on drain pipe.
- d. The distribution plate shall be fabricated out of 16G galvanized steel sheet & galvanized steel angle supports with minimum 50% free area.
- e. Air washer shall be two-bank construction (one uni-flow and the other cross flow). The water shall be sprayed at filter bank. All header and stand pipes shall be galvanized.
- f. The spray nozzles shall be of brass or bronze with chrome plating and shall be self-cleaning type. The nozzle shall be designed to produce fine atomised spray and shall be properly spaced to give a uniform coverage of the air washer section. The pressure drop through the nozzle should be in the range of 1.4 to 2.4 Kg/cm²(g).
- g. The eliminator plates shall be of 24G thick GS sheets class 350 or from 100% virgin PVC of minimum finished thickness of 3 mm. The eliminator section made of GSS shall have minimum six bends. The PVC eliminators shall be UV stabilised using Titanium di-oxide and shall withstand the weathering test as per IS:4892 for 500 hrs. Type test report of the compound testing carried out in any reputed laboratory shall be submitted for approval. All supports, tie rods and space bar shall be of either galvanized steel or PVC construction and shall be complete with suitable drip tray and drain pipe.
- h. An airtight inspection door of 600mm X 700mm size and a water marine light be provided for each air washer unit.



- i. Suitable number of brass screen shall be provided in the air washer tank to arrest the dirt entering the circulating water pump suction. Suitable GI grid shall be used inside the screen for reinforcement
- j. The specification for centrifugal fans shall generally be as indicated below. However, the fan shall be of DIDW type for TG building and SISW / DIDW for and ESP/VFD building. xi. Both inside and outside of all the sections of the metal chamber unit shall be spray galvanized to prevent corrosion. The nuts and bolts used for joining the section shall be stainless steel. The connection pieces shall have at least two (2) coats of rust inhibiting paint.

2.1.10.8.11 Unitary Air Filtration

Each unitary air filtration shall be of single bank (cross flow) consist of Casing, Tanks, Fans, Distribution plates, Moisture eliminator and water repellent type nylon filter with frame and support, Header and standpipe with support, Spray and flooding type nozzle. Water shall be sprayed at filter bank. Screen type suction strainer, Pumps, Necessary controls & Instrumentation, and all other required accessories.

All equipment's, components used in unitary air filtration system shall be in line with the specification requirements stipulated in air washer units above except the fans may be of SISW type.

2.1.10.8.12 Instruments, Protective Devices and Interlock

On-off thermostat with adjustable setting shall be provided with temperature control. Interlocks shall be provided such that compressor can start only after starting the air handling fan. Provision shall also be made to interlock the compressor with condenser water flow switch, chilled water flow switch / circulation pump. Safety devices such as high/low pressure cut out, hermetic motor winding thermostat etc. shall be provided. HP cut-out shall be manual reset type while LP cut-out shall be auto reset type. The control system shall be PLC based with redundant processor, power supply and communication modules, with CRT operator interface and peripherals serial link shall be provided for transfer of important signals to the DCS in the central control room.

Strip heaters shall be provided with an adjustable thermostat to control the temperature and a safety thermostat and safety interlock shall be incorporated to cut-off the electrical supply to the heater whenever there is failure of airflow.

Fire dampers (solenoid operated) shall be installed at places where supply air duct crosses fire barrier wall, floor slab, return air space (near the wall separating AHU rooms / PAC rooms and A/C area). The fire damper shall be of the same fire resistance as the structure but in no case less than 90 minutes and should be energized to close and the air conditioning equipment shall be tripped off in the event of fire.

2.1.10.8.13 Centrifugal Fans for Evaporative cooling plants



1X800 MW COAL BASED NORTH CHENNAI THERMAL
POWER PROJECT STAGE III



EPC TENDER SPECIFICATION FOR BTG PACKAGE

- a. The casing shall be of welded construction fabricated with heavy gauge galvanised sheet steel or MS sheet with spray galvanisation. In case of spray galvanisation zinc deposition should conform to class 275 of IS:277. The minimum thickness of casing shall be 3 mm. It shall be rigidly reinforced and supported by structural angles. The seams shall be permanently sealed air-tight. Split casings shall be provided on larger sizes of fans. Casing drain with valves shall be provided wherever required. The fan shall be of class I construction and Fan velocity should not exceed 10 m/s.
- b. The impeller shall have die-formed backward-curved blades tie welded to the rim and back plate to have a non overloading characteristics of the fan. Rim shall be spun to have a smooth contour. If required intermediate stiffening rings shall be provided. Shaft sleeves shall be furnished wherever required. The impeller, pulley and shaft sleeves shall be secured to the shaft by key and/or nuts. The impeller along with driven pulley shall be dynamically balanced as per AMCA standard.
- c. The bearing shall be self-aligning, heavy duty ball, roller or sleeve bearing. They shall be adequately supported. They shall be easily accessible and lubricated properly from outside.
- d. Inlet guard shall be spun to have a smooth contour. Inlet screen, if provided, shall be of galvanized wire mesh of 25 mm square.
- e. Base plate with necessary number of spring type vibration isolators or ribbed neoprene rubber pad or cushy foot mounting shall be provided. The vibration isolators should have a minimum of 70% efficiency.
- f. The first critical speed of the rotating assembly shall be at least 25% above the operating speed.
- g. Centrifugal fans shall be provided with Variable frequency drive (VFD) and velocity sensor/static pressure sensor in supply air path to adjust air flow automatically. The minimum efficiency of VFD at full load shall not be less than 96%.
- h. The static pressure of fan shall not be less than 75 mmwc.

2.1.10.8.14 Power Roof Extractors

Power roof extractor's impeller shall be of axial type. Casing shall be made of MS minimum thickness of 3 mm up to a fan diameter of 750 mm, 5 mm for fans with impeller diameter of 750 mm and above and the same shall be spray or hot dip galvanized and impeller shall be made of cast aluminium impeller with blades of aerofoil design. The speed of the roof ventilators shall not exceed 960 rpm for impeller diameters larger than 450 mm and 1440 rpm for impeller diameters 450 mm and less. Hood of the roof ventilator shall be of hinged type providing easy access to motor and impeller. Mounting frame for mounting the roof ventilators shall be provided. Weatherproof lockable type disconnect switch shall be provided such that, the hood can be opened only when the disconnect switch is in "OFF" position.

The roof extractors shall be used for buildings of height 7 (seven) metres and above. The static pressure of power roof extractor shall not be less than 15 mmwc. All accessories rain protection