MAHARASTRA STATE POWER GENERATION CO. LTD.
(MAHAGENCO)

1 X 660 MW BHUSAWAL TPS

TECHNICAL SPECIFICATION

FOR

AIR CONDITIONING SYSTEM

SPECIFICATION NO.: - PE-TS-415-553-A001 (REV0)

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

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This Technical specification consists of two sections:

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SECTION - I

SECTION-I

SUB-SECTION-A

INTENT OF SPECIFICATION

1.0 INTENT OF SPECIFICATION

1.1 The specification covers Design (i.e. Preparation and submission of drawing /documents including "As Built" drawings and O&M manuals), engineering, manufacture, fabrication, assembly, inspection / testing at vendor's & sub-vendor's works, painting, maintenance tools & tackles (as applicable), fill of lubricants & consumables till COD, mandatory spares along with spares for erection, start up and commissioning as required, forwarding, proper packing, shipment and delivery at site, unloading, handling, transportation & storage at site, in-site transportation, assembly, erection & commissioning, final painting at site, minor civil work, trial run at site, carrying out Performance guarantee / Functional / Demonstration tests at site (As applicable), training of customer/client O&M staff and handover in flawless condition of the package to the end customer complete with all accessories for the total scope defined as per BHEL NIT & tender technical specification as specified above, amendment & agreements till placement of order for **1X660 MW BHUSAWAL TPS in Dipnagar near Bhusawal, Maharashtra**.

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 SEC-II of the specification **within 10 days of receipt of tender documents.** In absence of any such clarifications, in case of any contradictory requirement, the more stringent requirement as per interpretation of Purchaser / Customer shall prevail and shall be complied by the bidder without any 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 Sec – II); 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, Sub-Section - C shall prevail over Sub-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 refer relevant clause of NIT.

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PROJECT INFORMATION WITH WIND AND SEISMIC DESIGN CRITERIA

VOLUME II

SECTION – 2

GENERAL PROJECT INFORMATION

VOID

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VOID

1.0 INTRODUCTION

The proposed 1x 660 MW Bhusawal Thermal Power Project will be set up by Maharashtra State Power Generation Co. Ltd. (MAHAGENCO) in Dipnagar near Bhusawal, Maharashtra, India.

The Bidder shall acquaint himself by a visit to the site, if felt necessary, with the conditions prevailing at site before submission of the bid. The information given herein under is for general guidance and shall not be contractually binding on the Owner. All relevant site data/information as may be necessary shall have to be obtained /collected by the Bidder.

2.0 APPROACH TO SITE

Deepnagar is well connected by rail and road. By road, it is about 8 Km from Bhusawal city. Nearest railway station is at Bhusawal. The nearest Airport is at Aurangabad. The nearest sea port is at Mumbai. The site is located on the Mumbai-Nagpur Highway.

3.0 LAND

Bhusawal Thermal Power Plant is already having 1x62.5 MW + 2x210 MW Units and Two (2) Units of 500 MW each are under execution stage. About 108.94 Hectares of land is acquired by MAHAGENCO near existing TPS. It is proposed to install 1x 660 MW unit on this land.

4.0 SOURCE OF COAL

Indian coal would be sourced from Machaakata coal blocks in Orissa state. The Coal will be received at Plant site directly by rail. The coal from the railway wagons would be unloaded by means of wagon tipplers and will be either bunkered or stacked in the stock pile at site.

5.0 SOURCE OF WATER

The main source of water is considered Ozerkheda Reservoir which is located at around 18 km from plant site.

6.0 ASH DISPOSAL AREA

The ash generated from 1 x 660 MW unit shall be disposed off in slurry form to the existing Ash Pond located at Velhala, approx. 12 Km from the site.

7.0 PROJECT INFORMATION

7.1	Client / Owner	:	Maharashtra State Power Generation Co. Ltd.
7.2	Consultant	:	**Procon Engineers, Navi Mumbai** (Division of Nimoto Consulting Engineers Pvt. Ltd.)
7.3	Project Title	:	BHUSAWAL T.P.S. UNIT – 6 : 1X660 MW
7.4	Location	:	Dipnagar, Near Bhusawal, Maharashtra, India
7.5	Nearest railway station	:	Bhusawal
7.6	Nearest Airport	:	Aurangabad
7.7	Nearest Harbour	:	Mumbai
7.8	Access Roads	:	NH 6 (Mumbai-Nagpur Highway)
7.9	Elevation above MSL	:	210 M
7.10	Longitude/latitude	:	75°51'10" East /21° 02' 30" North
7.11	Seismic Zone	:	Zone III as per IS:1893
7.12	AMBIENT TEMPERATURE		
7.12.1	Mean of daily maximum temperature	:	48.25 °C (during May)
7.12.2	Mean of daily minimum temperature	:	18 °C (during January)
7.12.3	Highest temperature recorded	:	48.7°C

7.12.4	Lowest temperature recorded	:	13°C
7.13	Wet bulb temperature	:	27°C (Maximum)
7.14	Rainfall	:	112 mm average annually
7.15	Wind Speed	:	0 to 39 Km/hr
7.16	Wind direction	:	East North East to West South West

ELECTRICAL

7.17 MAIN POWER SOURCE FROM GRID

7.17.1	Rated Voltage	:	400kV
7.17.2	Voltage variation	:	± 10 %
7.17.3	Frequency Variation	:	± 5 %
7.17.4	Rated Short Circuit Level	:	50 kA, Three Phase Symmetrical

7.18 AUXILIARY POWER SUPPLY

Auxiliary electrical equipment shall be suitable for operation on the following supply system:

7.18.1	Motors above 1000 kW & other Power devices	:	11kV,3Ph,3wire,50Hz system
7.18.2	Motors below 1000 kW & above 160kW & other power devices	:	3.3kV, 3 ph, 3 wire 50 Hz, Non Effectively earthed
7.18.3	Motors upto 160 kW & other power devices	:	415V, 3 ph, 4 wire 50 Hz
7.18.4	Motor Starting Methods	:	Direct on Line
7.18.5	(a) Lighting fixtures Space heaters, and single Phase motors	:	240V, 1 phase, 50 Hz Supply through suitably rated transformers to limit the short circuit level to 9kA – 1 sec.

(b) Control & Instrumentation : 240V, 1 Phase, 50 Hz from UPS

7.18.6 Short circuit levels of 11kV, 3.3 kV and 415V system equipments

The equipment shall be suitable for the following short circuit levels

(a) 11kV Switchgears : 44 kA/3 sec

(b) 3.3kV Switchgears : 40 kA/3sec

(c) 415V PCC/ PMCC/ MCC : 50 kA/1sec

(d) Lighting Distribution Boards & 240V A.C. supply : 9 kA/1sec

7.18.7 Auxiliary DC supply

The auxiliary DC supply will be used for control, indication & protection, Turbine lube oil system, AVR, Emergency DC lighting of power plant and Control & Instrumentation etc.

(a) Voltage :
(i) 220V DC for utility purpose
(ii) 24V DC for Control and Instrumentation

(b) Voltage variation : + 10 %, - 15 %

7.18.8 Emergency power supply

(a) Purpose :
(i) Standby power to normal incomer of emergency MCC
(ii) Alternate power source to Fire water Pumps

(b) Rated voltage and frequency : 415 V, 3 phase, 3 wire, 50 Hz.

7.18.9 UPS power supply

(a) Purpose : (i) Vital process loads

(ii) Critical lighting

(iii) Control and Instrumentation

(iv) Office for LAN power supply/Server etc.

(b) Rated Voltage : 415V, 3 ph, neutral/240V single phase, 50Hz

7.19 The variation in voltage and frequency may be ± 10% and ± 5% respectively. The combined voltage and frequency variation may be ± 10%. All devices shall be suitable for continuous operation over the entire range of voltage variation without any change in their performance

7.20 Power socket shall be 415V AC, 50 Hz, 4 pin 32/63 Amps. Power socket outlets for portable tools, hand lamps etc shall be 240 volts, single phase, 3 pin, metal clad industrial type

7.21 All electrical equipment shall be designed for the following ambient conditions

(a) Maximum ambient temperature : 50°C

(b) Minimum Ambient temperature : 13°C

ANNEXURE-I

ANALYSIS OF ~~RAW WATER~~ Claified water

SR. NO.	PARAMETERS	UNITS	VALUES
1.0	pH		8.0 – 8.5
2.0	Temperature	^{0}C	22 - 30
3.0	Conductivity	µS/cm	1300
4.0	Colour	Hazen Units	Not Available
5.0	Odour		Not Available
6.0	Taste		Not Available
7.0	TDS	ppm	870
8.0	P-Alkalinity as $CaCO_3$	ppm	Nil
9.0	M-Alkalinity as $CaCO_3$	ppm	400
10.0	T – Alkalinity as $CaCO_3$	ppm	400
11.0	Organic Matter as $KMnO_4$	ppm	50
12.0	Iron (as Fe)	ppm	1
13.0	Turbidity (NTU)	ppm	~~100 during Non – Monsoon Up to 10,000 during Monsoon~~ <15NTU for Clarified water
14.0	**CATIONS**		
	(a) Ca as $CaCO_3$	ppm	295
	(b) Mg as $CaCO_3$	ppm	77
	(c) Na as $CaCO_3$	ppm	203

SR. NO.	PARAMETERS	UNITS	VALUES
	(d) K as $CaCO_3$	ppm	10
	Total Cation	ppm	**585**
15.0	**ANIONS**		
	(a) HCO_3 as $CaCO_3$	ppm	400
	(b) Chlorides	ppm	149
	(c) SO_4 as $CaCO_3$	ppm	33
	(d) Fluoride as $CaCO_3$	ppm	1
	(e) Nitrate as NO_3	ppm	2
	Total Anion	ppm	**585**
16.0	Ammonia	ppm	Absent - Traces
17.0	Silica Colloidal (as SiO_2)	ppm	< 1 (can be present in summer)
18.0	Silica Non - Colloidal (as SiO_2)	ppm	36
19.0	Free Chlorine	ppm	Nil
20.0	Total Suspended Solids	ppm	Not Available
21.0	Carbonates as $CaCO_3$	ppm	Not Available
22.0	Boron	ppm	~~Not Available~~ **<1ppm**
23.0	Oil & Grease	ppm	~~Not Available~~ **Nil**

Following chemicals will be dosed in Raw water in PT plant
1. Ozone - 1ppm (max.)
2. Alum - 60ppm (max.)
3. Lime - 25ppm (max.)
4. Poly - 5ppm (max.)

SECTION: I

SUB SECTION: C

TECHNICAL SPECIFICATIONS

SECTION: I

SUB-SECTION: C 1

SPECIFIC TECHNICAL REQUIREMENT

1. INTRODUCTION

1.1 The purpose of the system is to provide air-conditioning system for different areas of 1 x 660 MW, BHUSAWAL TPS under the scope of this tender.

2. SYSTEM DESCRIPTION

2.1 MAIN POWER HOUSE BUILDING. (AC PLANT – 1)

2.1.1 A Central Chilled water type air conditioning plant is provided to cater to the air conditioning requirements of the following areas of power house**.**

Central Control Room.

Control Equipment room.

Shift –Supervisor room (part of central control room).

Computer room (part of central control room).

PADO room (part of central control room).

Conference room (part of central control room).

UPS room at 8.5 M

SWAS (AC area) room.

FCU shall be provided for SWAS room.

The air conditioning plant shall comprise of one (1) number working Vapour compression chiller and one (1) numbers stand by Vapour compression chiller each of capacity 220 TR. The condenser cooling & chilled water shall be circulated through these units by means of 2 x 100% horizontal centrifugal pump sets and 2 x 100% FRP cooling towers. These condenser water pump and cooling tower shall also serve the purpose of cooling water requirement of vapour compression chiller of service building. Condenser water pipe shall be routed up to service building from AC plant room 1 for this purpose. The chilled water produced by the chilling units shall be circulated to the air handling units by means 2 x 100% horizontal centrifugal pump sets. 2 AHU Room located adjacent to air-conditioned areas in Power House Building. The conditioned air from AHUs is distributed to the air-conditioned areas by galvanised sheet steel ducting (Zn coating conform to IS: 277 with 275 g/sq.m. of zinc coating) and grilles / diffusers with volume control dampers and supporting frames. The return air is led back to the AHU Room in ducts for air conditioned areas at 17.0M level in control tower, for balance areas, i.e air conditioned areas at 8.5M level in control tower, the return air is collected above the false ceiling/return air duct depending upon the feasibility and led back to the AHU rooms which acts as mixing plenum for return and fresh air.

Cooling water requirement for water cooled Precision package AC of ESP control room shall be taken from main plant ACW line and terminal point for ACW pipe shall be near to ESP control room at elevation of 8.5 M.

Acoustic insulation of first 6 m of duct from AHU outlet shall be provided.

2.1.2 The central chilled water plant, condenser water & chilled water pumps for AC plant shall be housed in AC Plant Room at 0.0 M level in control tower of Power House Building. Control and power cable shall be routed for these drive through cable slit.

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

One number AHU Room at 8.5 M level of Power House Building for AC areas at 8.5 m level.

One number AHU Room at 24.0 M level of Power House Building in B-C Bay for AC areas at 17 m level.

2.1.4 The Cooling Towers, Make-up water Storage Tank, Booster pump & Expansion Tank shall be located at terrace level of control tower of power house.

2.1.5 For AC plant room and AHU room chain pulley block of suitable capacity shall be provided by vendor for maintenance purpose.

2.2 SERVICE BUILDING. (AC PLANT – 2)

2.2.1 A Central Chilled water type air conditioning plant is provided to cater to the air conditioning requirements of AC areas of all floors of service building**.**

The air conditioning plant shall comprise of one (1) number working Vapour compression chiller and one (1) numbers stand by Vapour compression chiller each of capacity 200 TR. The condenser cooling water shall be circulated through these units by means of 2 x 100% horizontal centrifugal pump sets of AC plant 1 and 2 x 100% FRP cooling towers of AC plant 1. The chilled water produced by the chilling units shall be circulated to the air handling units by means 2 x 100% horizontal centrifugal pump sets. 1 no. AHU Room shall be located at each floor (except ground floor) of service building (each AHU room shall contain 2 x 100% capacity AHU). Air conditioning in ground floor of service building shall be provided with FCU. The conditioned air from AHUs is distributed to the air-conditioned areas by galvanised sheet steel ducting (Zn coating conform to IS: 277 with 275 g/sq.m. of zinc coating) and grilles / diffusers with volume control dampers and supporting frames. The return air is led back to the AHU Room by collecting return above the false ceiling which acts as mixing plenum for return and fresh air.

Acoustic insulation of first 6 m of duct from AHU outlet shall be provided.

2.2.2 The central chilled water plant & chilled water pumps for AC plant shall be housed in AC Plant Room at 0.0 M level in service building. Control and power cable shall be routed for these drive through cable slit.

2.2.3 Expansion Tank shall be located at terrace level of Service building.

2.2.4 For AC plant room and AHU room chain pulley block of suitable capacity shall be provided for maintenance purpose.

2.3 ESP control room (AC plant - 3)

2.3.1 The air conditioning plant shall comprise of (4 x 50 %) water Cooled precision AC each of 25 TR capacity to air-condition areas in ESP Control Room. The conditioned air from water Cooled precision AC is distributed to the air-conditioned areas by galvanized sheet steel ducting (Zn coating conform to IS: 277 with 275 g/sq.m. of zinc coating) and grilles / diffusers. The return air is collected above the false ceiling and led back to the PAC room which acts as mixing plenum for return and fresh air. Cooling water required for these package units shall be supplied from main plant ACW line.

2.4 SPLIT TYPE AIR CONDITIONERS

2.4.1 Split type air conditioners (air cooled) shall be provided to cater to the air conditioning requirements of all other Auxiliary building and control room under BHEL scope listed as under :

- CW-ACW pump house control room
- Fuel oil heating and pressurizing pump house
- Chemical and fuel testing Lab
- DM plant control room
- Store in charge room
- Security and time office building computer punching room
- Weighbridge control room
- Other area, which contains PLC based control system or local control panel or control and instrumentation requiring Air conditioning system.

3. DESIGN INPUT / CRITERIA

3.1 System design criteria

3.1.1 As per MAHAGENCO Specification, clause number 5.1.1 to 6.1.16, Volume III-G, Section 2, bid specification number DG/BSL U-6/2011/T-1.

3.1.2 For winter heating load calculation, 50% of equipment load as available in the room shall be considered.

4. BRIEF SCOPE

4.1 System Capacity:

The air conditioning system shall include the following: -

4.1.1 AC Plant – 1 (Central Control Room).

To meet the AC requirement, suitable capacity of 1 (one) number working Vapour compression chiller and 1 (one) number stand by Vapour compression chiller shall be provided.

4.1.2 **AC Plant – 2 (Service building).**

To meet the AC requirement, suitable capacity of 1 (one) number working Chiller and 1 (one) number stand by chiller shall be provided.

4.1.3 **AC plant-3 (ESP Control room)**

To meet the AC requirement, (4 x 50 %) water cooled Precision AC shall be provided.

4.2 **EQUIPMENT'S TO BE PROVIDED FOR DIFFERENT AC PLANT**

4.2.1 **AC Plant-1**

4.2.1.1. Two (2) no. Vapour compression chiller (1Working + 1 standby) complete with all accessories as described here in after.

4.2.1.2. Two (2) Nos. Horizontal Split Casing Centrifugal Condenser Water Pump Sets (1 Working + 1 Standby) catering to cooling water requirement of AC Plant 1 and 2 and each complete with all accessories.

4.2.1.3. Two (2) Nos. Horizontal Split Casing Centrifugal Chilled Water Pump Sets (1Working + 1 Standby) each complete with all accessories.

4.2.1.4. Two (2) Nos. Fibre glass reinforced plastic (FRP) construction Cooling Towers (1 Working + 1 Standby) catering to cooling water requirement of AC Plant 1 and 2 and 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.

4.2.1.5. Air Handling Units (AHUs).

(4 x 50%) sheet metal cabinet type (double skin) air handing units of sectionalized construction each complete with all accessories as described hereinafter, to match the AC load of Central Control Room, Central Equipment Room area at 17.0 M level of Control Tower.

2 x 100 % sheet metal cabinet type (double skin) air handing units of sectionalized construction each complete with all accessories as described hereinafter, to match the AC load of UPS panel room etc. at 8.5 M.

4.2.1.6. Pan type humidifier in each AHU room in common discharge of AHU.

4.2.1.7. Strip heater in each AHU room in common discharge of AHU

4.2.1.8. Lot – Pre-filters (inside the pre-filter section of the AHUs at suction side)

4.2.1.9. Lot - Fine filters (shall be provided at discharge of each individual AHUs and fresh air fan).

4.2.1.10. Condenser water piping.

Lot- condenser water piping interconnecting condensers, cooling tower, pumps etc. complete with strainers, valves, fittings etc. Black steel pipe conforming to IS-1239, upto 150 NB, Part I, heavy grade or IS-3589 (6.35 mm thk), 200 NB and above depending upon pipe size shall be used.

4.2.1.11. Chilled water piping

Lot- 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. Black steel pipe conforming to IS-1239, upto 150 NB part I, heavy grade or IS-3589 (min. 6mm thk), 200 NB and above depending upon pipe size shall be used.

One No. FRP chilled water expansion tank with insulation complete with valve, instrument, Make-up connection, overflow and drain etc.

4.2.1.12. Lot-Drain water piping out of MS pipes conforming to IS-1239, Part I, heavy grade and galvanised as per IS:4736, from various equipment's 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)

4.2.1.13. One number water softening plant to feed make up in condenser water line and chilled water line through expansion tank.

4.2.1.14. Make up water tank made of G.I / FRP complete with valves, level gauge, level switch, make up connection, over flow and drain etc.

4.2.1.15. Fire dampers

The supply and return air ducts shall be provided with motor operated 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.

4.2.1.16. Lot – GSS Ducting sheet metal work including thermal insulation on complete supply air duct & return air duct and acoustic insulation for initial length of 5m from the AHU outlet.

4.2.1.17. 2X100% Duty fresh air fan with pre-filter & fine filter in all AHU Rooms**.**

4.2.2 AC Plant-2

4.2.2.1. Two (2) no. Vapour compression machine (1Working + 1 standby) complete with all accessories as described here in after.

4.2.2.2. Two (2) Nos. Horizontal Split Casing Centrifugal Chilled Water Pump Sets (1Working + 1 Standby) each complete with all accessories.

4.2.2.3. Air Handling Units (AHUs).

2 x 100 % sheet metal cabinet type (double skin) air handing units of sectionalized construction each complete with all accessories as described hereinafter, to match the AC load of service building.

4.2.2.4. Pan type humidifier in each AHU room in common discharge of AHU.

4.2.2.5. Strip heater in each AHU room in common discharge of AHU

4.2.2.6. Lot – Pre-filters (inside the pre-filter section of the AHUs at suction side)

4.2.2.7. Lot - Fine filters (shall be provided at discharge of each individual AHUs and fresh air fan).

4.2.2.8. Chilled water piping

Lot- 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. Black steel pipe conforming to IS-1239, upto 150 NB part I, heavy grade or IS-3589 (min. 6mm thk), 200 NB and above depending upon pipe size shall be used.

One No. FRP chilled water expansion tank with insulation complete with valve, Level Gauge, Level Switch, Make-up connection, overflow and drain etc.

4.2.2.9. Lot-Drain water piping out of MS pipes conforming to IS-1239, Part I, heavy grade and galvanised as per IS:4736, from various equipment's 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)

4.2.2.10. Fire dampers

The supply and return air ducts shall be provided with motor operated 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.

4.2.2.11. Lot – GSS Ducting sheet metal work including thermal insulation on complete supply air duct & return air duct and acoustic insulation for initial length of 5m from the AHU outlet.

4.2.2.12. 2X100% Duty fresh air fan with pre-filter & fine filter in all AHU Rooms**.**

4.2.3 AC Plant-3 for ESP control room

4.2.3.1. (4 x 50%) water Cooled Precision AC unit complete with Strip heater, Electrode humidifier and all accessories as described here in after.

4.2.3.2. Fire dampers

The supply and return air ducts shall be provided with motor operated 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.

4.2.3.3. Lot – GSS Ducting (class 275) of zinc coating sheet metal work including thermal insulation on complete supply air duct & return air duct (if applicable) and acoustic insulation for initial length of 6 m from the precision AC outlet.

4.2.3.4. 2X100% Duty fresh air fan with pre-filter & fine filter in Precision AC room**.**

4.3 AC EQUIPMENT CONSTRUCTIONAL DETAIL

4.3.1 Water Cooled Screw Chiller Package:

4.3.1.1. As per MAHAGENCO Specification, clause number 6.2 to 6.6, Volume III-G, Section 2, bid specification number DG/BSL U-6/2011/T-1.

4.3.2 CONDENSER WATER PUMP SETS

4.3.2.1. As per MAHAGENCO Specification, clause number 6.7, Volume III-G, Section 2, bid specification number DG/BSL U-6/2011/T-1.

4.3.3 CHILLED WATER PUMP SETS

4.3.3.1. As per MAHAGENCO Specification, clause number 6.7, Volume III-G, Section 2, bid specification number DG/BSL U-6/2011/T-1.

4.3.4 AIR HANDLING UNIT (Double SKIN TYPE)

4.3.4.1. As per MAHAGENCO Specification, clause number 6.8.1 to 6.8.3, Volume III-G, Section 2, bid specification number DG/BSL U-6/2011/T-1.

4.3.5 HUMIDIFICATION PACKAGE

4.3.5.1. As per MAHAGENCO Specification, clause number 6.8.4, Volume III-G, Section 2, bid specification number DG/BSL U-6/2011/T-1.

4.3.6 COOLING TOWER

The cooling towers shall be cross flow induced draft type with FRP casing & sump with air entry on all four sides and air discharge on top. The fan motor shall be easily accessible from outside and out of moist air stream.

The internals shall be of stainless steel SS or MS epoxy painted to withstand corrosive atmosphere.

Cooling tower shall be of sufficient capacity to cool the rated amount of water through the specified range at the design W.B. temperature.

The structural frame work of the tower including all members and connections shall be designed for operating loads and prevailing wind pressure. Steel members shall be MS epoxy painted and be of sufficient size to safely withstand all imposed loads.

FRP casing sheets shall be clamped on close centre to the structural steel members. Rubber neoprene gaskets shall used on all bolted joints as a seal against water leakage.

Louvers shall be of fixed type.

The fan deck shall be of ample strength to support all loads normally encountered in operation and maintenance. Stiffeners shall be provided on the underside.

Galvanised steel ladder with safety cage and hand railing shall be provided in such a number and locations as necessary to give safe and complete access to all parts to tower requiring occasional inspection or adjustment. An access door shall be provided for fan deck and the cell for ready access to the interior parts of the tower.

Fills shall be of extended area of formed PVC suitable to withstand hot water temperature of 55°C.

Louvers and drift eliminators shall be of PVC/FRP construction.

Eliminators shall be provided in removable sections & installed in the cell of the tower. The number of deflection in the eliminators shall be so arranged as to reduce drift loss to 0.2% of the water circulated.

The water distribution system shall be open basin with gravity feed nozzles. The system shall be self draining and non-clogging and designed for flexible operation and ready accessibility.

The cold water basin shall be of F.R.P. construction. The basin shall be complete with float valve for male up water control, a drain and overflow connection.

Fan shall be of the propeller/axial type, multi bladed aero foil construction with adjustable pitch. The entire fan assembly shall be statically balanced.

Each fan shall be either direct driven or gear driven. Where reduction gears are used, housing shall be of heavy cast iron construction with large oil reservoir and complete with supply of oil.

Fan motors shall be of the totally enclosed fan cooled type and of the required capacities.

Fan drive shaft using reduction gearing shall be dynamically balanced and connected through flexible couplings.

The mechanical equipment assembly shall be adequately supported on the fan deck.

Fan discharge hatch shall be covered with galvanized wire mesh to prevent birds nesting during idle periods.

All nuts, bolts and fasteners used in the cooling tower shall be stainless steel / Nickel or chrome plated.

4.3.7 SHEET METAL WORK

4.3.8 As per MAHAGENCO Specification, clause number 6.12.7 to 6.12.15, Volume III-G, Section 2, bid specification number DG/BSL U-6/2011/T-1

4.3.9 INSULATION

4.3.9.1. As per MAHAGENCO Specification, clause number 6.12.16, Volume III-G, Section 2, bid specification number DG/BSL U-6/2011/T-1.

4.3.10 PRECISION AC UNITS

4.3.10.1. As per MAHAGENCO Specification, clause number 6.10.1 to 6.10.8, Volume III-G, Section 2, bid specification number DG/BSL U-6/2011/T-1.

4.3.11 SPLIT AC UNITS

4.3.11.1. As per MAHAGENCO Specification, clause number 6.11.1 to 6.11.10, Volume III-G, Section 2, bid specification number DG/BSL U-6/2011/T-1.

5. CONTROL PHILOSOPHY

5.1 The operation of the AC plant shall be done by microprocessor-based panel mounted on the chiller package. Further, overall control of AC system shall be DCS based. The AC Plant compressor can be started only when its associated condenser fan, chilled water pumps are in operation.

5.2 SAFETY CONTROLS

All necessary measuring – control instruments & control system shall be provided. With following compressor & evaporator interlock in the control panel of the Chiller Package.

a) High discharge pressure cut-out (HP)

b) Low suction pressure cut out (LP)

c) Oil pressure cut-out (OP)

d) Chilled water flow switch

e) Anti-freeze thermostat (AFT)

f) Airstat / safety thermostat with heaters of the AHU's

5.3 OPERATING CONTROL

All operating control as necessary shall be provided. However following minimum control shall be provided. Central chilled water system shall have the following controls:

5.3.1 Automatic capacity control system.

5.3.2 Automatic unloaded starting device

5.3.3 Operating Thermostat

5.3.4 Unloading solenoid valves (if applicable)

5.3.5 3 way flow control valve at the AHU 's

5.3.6 Operation / Sequence Interlock of the Air conditioning system shall be as under:

5.3.6.1. Condenser fan is started**.**

5.3.6.2. The Air Handling Unit is started**.**

5.3.6.3. Chiller Pump is started

5.3.6.4. Chilling unit is started

5.4 POWER SUPPLY ARRANGEMENT

The power supply (rated voltage, frequency, and phase) of the equipment's will be 415V +/- 10%, 3ph, 50 Hz +/- 5% or 240V+/- 10%, 1ph, 50 Hz +/- 5% as the case may be.

6. PAINTING SCHEDULE

6.1.1.1. As per MAHAGENCO Specification, clause number 6.12.19, 6.15, 7.2.3, 10.1 & 10.2, Volume III-G, Section 2, bid specification number DG/BSL U-6/2011/T-1.

7. 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 until handing over of the system shall be provided

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 for reference.

6) Indicative list of makes is enclosed as per Annexure-I. However, these makes shall be subject to Customer & BHEL approval during detail engineering Stage.

7) Fixing frame works for diffusers and grilles in the scope of Vendor.

8) Anchor fastener shall be used by vendor for fixing duct pipes etc. wherever applicable.

9) Necessary supports and structures / frames etc. as required for supporting the duct / piping / equipment etc. as lump-sum basis is in the scope of Vendor and no unit rates shall be applicable for these items.

10) Drain piping within room up to the drain point to be provided by the Vendor.

11) Vendor shall furnish schedule of power and control cables. Vendor shall also furnish cable termination details interconnection drawings etc. during detail engineering stage.

12) The tools and machine required for erection of equipment shall be arranged by Vendor.

13) Tools & tackles as required for regular maintenance shall be supplied by Vendor.

14) Instruments required for performance testing of various equipment / system of the package shall be arranged by Vendor at site.

15) Instrument for testing shall be calibrated by Air-conditioning plant supplier before taking up testing.

16) Temperature gauges shall be provided with thermo wells and fixing arrangement.

17) Pressure gauges shall have provision for air venting. Three way valves shall be used which shall have air venting provision.

18) Matching sockets / stubs (weld type) for flow switches and other instruments shall be supplied.

19) 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%.

20) Besides the system performance as above, bidder shall guarantee major technical parameters of various equipment as per design basis / details furnished.

21) 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.

22) 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.

23) Bidder should suitably group the signals coming from various instruments etc. & the same shall terminate in local JB, from Local JB common cable to DCS / 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.

24) 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.

25) 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.

26) 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 as per the requirement for across the table discussions/ finalizations/ submissions of drawings.

27) 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.

28) Flat, platform type RCC / PCC foundation along with pocket (as required) shall be provided for installing Chiller/ PUMP, AHU and FAN etc. Vendor shall fix the equipment using anchor fasteners, as applicable, to secure the equipment obtain parameters related to vibration and noise.

29) 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.

30) 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.

31) Air-conditioning plant supplier to furnish drawings/ documents as per the dwg. / documents distribution as per project requirement.

32) 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.

33) All electrical equipment shall be suitable for the power supply fault levels and other climatic conditions indicated in project information / synopsis / specifications enclosed.

34) The bidder shall furnish complete tech. Particulars in data sheet and schedules as specified elsewhere in the specification during detail engineering.

35) Supports required for supporting the fan and/or filter section for FA fans shall be under bidder's scope

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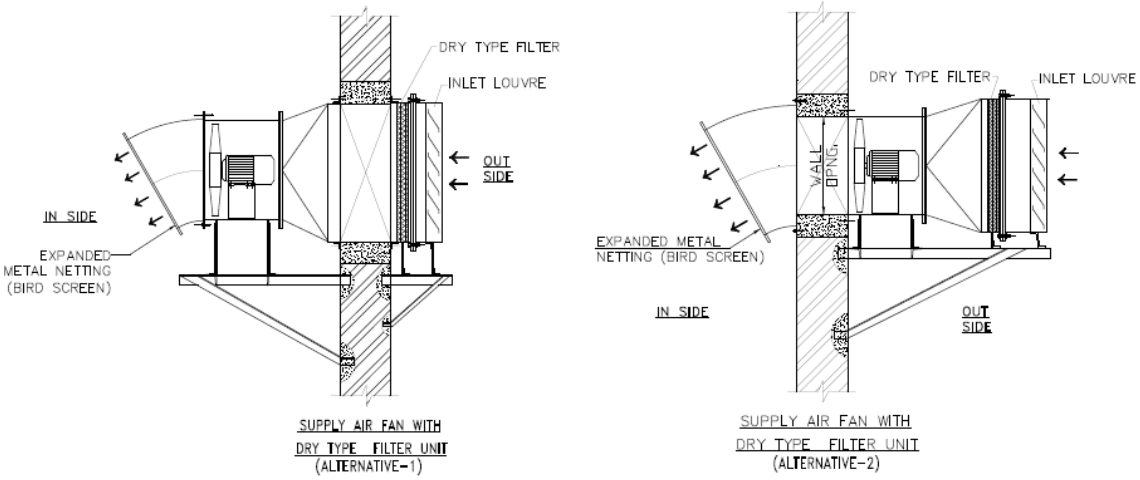

8. EXCLUSIONS

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 equipment.

b) False ceiling, drop ceiling & underdeck insulation

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.

Material Handling Equipments

1.0 ELECTRIC HOIST AND MANUAL HOIST (CHAIN PULLEY BLOCK)

Required number of electric hoist / manual hoist of adequate capacity, to meet the erection and maintenance requirements are to be provided for the various areas.

Manual hoists (hand operated) shall be designed to duty class 2 as per IS 3832 and electric wire rope hoist shall be designed as per IS: 3938 (latest).

The stipulations of all statutory codes like Indian Electricity Act, Indian Electricity Rules, Factory Acts, Local Municipality act etc. shall however prevail over the specification requirements, in case any conflict arises between this specification and the statutory codes.

Maintenance tools and tackles shall be as per data sheet attached.

DESIGN CRITERIA

1.0.0 Hoists shall be provided in all areas where any equipment/ component weighing above half ton is installed and needs to be handled for maintenance purposes. Number of monorail beams shall be such that the centre line of the hoist and the centre line of equipment to be handled shall be not more than half meter. The location and number of hoists is to be finalized during detailed engineering. Final arrangement is subject to approval of Customer.
The hoist capacity shall be selected considering 25% margin over the weight of heaviest component /equipment to be handled. The hoist parameters (i.e. lift & travel) are subject to change/s, to suit the final layout of the area in which it is intended to be installed.

Electric hoist shall be provided for capacity >1T.
Chain pulley block (Manual hoist) - 500kg to <=1T, wherever feasible, considering layout constraints.

For hand operated hoists, the hoists shall be suitable for operation from floor level. Hand chain shall be provided for long travel of trolley and the Hoisting mechanism. The operator shall be able to control the movement of the electrical/ manual hoist with the help of floor operated pendant

MINIMUM LIFTING REQUIREMENT

S.N.	AREA DESCRIPTION	QTY (nos)	CAPACITY (T)	TYPE
1	AC Plant Equipment Room Area			
2				
3				

Note:
1. Area, type, capacity mentioned are minimum requirement and shall be finalised during detail engineering without any commercial implication
2. Travel and Lift are layout dependent and shall be finalised during detail engineering without any commercial implication
3. Additional electric/manual hoist required during detail engineering shall be provided as per design criteria given above without any commercial implication.

2.0 SCOPE OF SUPPLIES

Equipment and services to be furnished by the bidder for the ELECTRIC HOIST/ MANUAL HOIST with accessories as per the details given in the technical specification and data sheet. Any equipment / accessories not specified in the specification but required to make the ELECTRIC HOIST/ MANUAL HOIST complete and efficient operation shall also be under the bidder's scope of work.

Compliance with this specification shall not relieve the bidder of the responsibility of furnishing material and workmanship to meet the specified working/duty conditions.

2.1.0 Electric hoist shall include but not be limited to the following: -

a) Equipment offered shall be suitable for indoor duty conforming to Class II of IS: 3938.
b) Equipment shall be designed to operate in non- hazardous area.
c) Electric hoists shall be pendent operated.
d) Both hoisting and trolley movement shall be motor driven.
e) Wheels shall be single flanged type.
f) Hook shall be swivelling type and fitted with a safety latch.
g) Control panel shall be hoist mounted.
h) Power feeding to the electric hoists shall be thru' PVC shrouded DSL.
i) Brakes shall be fail to safety.
j) Load/overload testing of the hoists shall be carried out as per IS: 3938.
k) All material, castings and forgings will be of tested quality & certificates shall be made available for review as per approved QAP
l) Lifting lug, eye bolts etc., for handling hoist parts.
m) Erection hardware.

2.2.0 Erection and Commissioning spares (ELECTRIC HOIST)
The Bidder shall also supply erection & commissioning spares along with his main equipment as per his experience, for replacement of damaged or unserviceable parts during the execution of the project at site, to avoid delay in the project schedule. This shall form part of the main equipment supply. The Purchaser shall retain the unutilized commissioning spares. The initial fill of lubricants, oil etc. shall also be supplied by the bidder.

2.3.0 Services to be provided by the bidder
Packing, forwarding and transportation to site, storage and handling at site.

2.4.0 Erection and Commissioning

2.5.0 Functional test (Overload testing, load testing at rated speed, travel and hoisting motion checks as per relevant Indian standards)

2.6.0 Obtaining clearance and acceptance certificate from the concerned competent authority after site test as applicable. Necessary fees/expenditure as required shall be borne by the supplier.

3.0 Inspection and Testing

As per enclosed reference quality plan and as per IS 3938 (latest revision). Prime inspection agency shall be Consultant/ End Customer. Equipment supplied shall be strictly in accordance with nomenclature & technical specification. Any additional testing requirement/CHP (Customer Hold Point) at any stage of inspection deemed necessary by Consultant/ End Customer during detailed engineering shall be carried out without any commercial or technical implication.

4.0 Works Excluded

Supply of ISMB monorail.

5.0 PAINTING SPECIFICATION

As per painting details specified elsewhere in specification.

6.0 PACKING

In general packing shall be wooden box packing.

7.0 TESTING AT VENDOR'S WORKS

Hoist along with its drives, controls and other accessories shall be demonstrated for the rated capacity against the rated speed of motions and for the service conditions specified as specified in QAP and as per IS 3938 for electric hoist and IS 3832 for manual hoist.

The bidder shall have the full responsibility for the safe and efficient operation of the hoist with associated accessories as a single unit.

If the shop performance tests indicate the failure of any of the components to achieve the guaranteed performance, the deficiency shall be made good at bidder's cost.

Demonstration tests shall be carried out each time after the rectification /modification is carried out.

8.0 MAKE OF SUB - VENDOR ITEMS

Makes of bought out items will be as per list specified in the specification. No other make will be acceptable, until and unless specifically got it approved by the purchaser/ end client. (Refer annexure-I)

9.0 TESTING AT SITE

A) ELECTRIC HOIST:
As required for statutory clearance for operating at site i.e., overload test, load test and other tests as per IS 3938.

Test for Operation -After the supply has been connected, tests shall be carried out to prove the following:
a) The satisfactory operation of each controller, switch, contactor, relay and other control devices and in particular the correct operation of all limit switches under the most unfavorable conditions;
b) The correctness of all circuits and interlocks and sequence of operation; and
c) The satisfactory operation of all protective devices.

Overload Test -After test but before the hoist is put into service, it shall be tested with overload relays appropriately set, to lift and sustain a test load of 125 percent of the working load. During the overload test, the hoist shall sustain the load under full control. The specified speeds need not be attained but the hoist shall show itself capable of dealing with the overload without difficulty.

B) MANUAL HOIST:
As required for statutory clearance for operating at site with following minimum test i.e., overload and load test.

10.0 TECHNICAL DATA SHEET:

A) Technical data sheet-A for ELECTRIC HOIST:

Sr. No.	DESCRIPTION	TECHNICAL PARTICULARS
		Electric hoist with electrically operated trolley
1	**Design, duty, fabrication and testing of the crane confirm to standard / code number**	As per IS: 3938 (latest edition), Class-II duty
2	**Area of installation, quantity, rated capacity (Safe Working Load) of cranes**	As per Annexure A
3	**Margin**	The crane/hoist capacity shall be selected considering 25% margin over the weight of heaviest component/ equipment to be handled.

4	**Overload Test**	125% of Rated capacity (Safe Working Load)
5	**Deflection test of crane**	NA
6	**Operation from**	Pendant station - It shall locate the push buttons for controlling the various motions of the crane and shall be hung from the crane trolley to a height of approximately 1 metre above the operating floor
7	**Design Ambient temperature**	50° C
8	**PERFORMANCE**	
8.1	Crane speed with full load	
8.1.1	Main hoist	3
8.1.2	Trolley travel (CT)	15
8.1.3	Longitudinal bridge travel (LT)	NA
8.2.1	Acceleration values	NA
8.2.2		CT motion (trolley travel) as per IS: 3938
9	**Lift in Metres**	The lifting rope shall be of sufficient length to permit the main hook to reach the zero level.
9.1	Main Hoist	Shall be suitable as per approved layout
9.2	Hook Approaches	To suit the lifting requirement.
	COMPONENT DETAILS	
10	**Trolley**	
10.1	Type	Fabricated steel / Cast steel
10.2	Material	Rolled structural steel with side plates extended beyond wheel flanges to protect wheels. Material of construction as per IS: 2062 (Grade A/B).

10.3	Whether jacking pads for lifting trolley provided or not	Yes
11	**Rope drums**	
11.1	Material (Indicate IS)	Cast steel or mild steel.
11.2	Flange / flangeless	Flanged
11.3	Numbers provided	One
11.4	Type of grooves	Machined grooved identical Right hand and Left hand of proper shape for the rope used. Additional grooves shall be provided as per IS 3177/3938 in rope drum
12	**Rope details**	
12.1	Construction / Core	The wire ropes shall be of suitable diameter as per Suppliers design of crane. The rope shall confirm to I.S. 1835, 1804 and 2266. The rope shall be parallel right hand lay having 6 x 37 constructions with hemp core. However, this should be in relation with Drum diameter as per IS: 3177. The rope selection procedure shall be as per IS 3177 cl. no. 8.3.2.
12.2	Tensile designation (Rope Grade)	1770 or 1960 (in N/sq. mm)
12.3	Factor of safety	Not less than 5
13	**Sheaves details**	
13.1	Material	The sheaves (Pulleys) shall be of carbon steel casting having chemical and mechanical properties as per IS: 1030 (Class 11).
13.2	Type of guards provided	Fabricated from Sheet steel
14	**Gear box details**	
14.1		Forged steel as per IS 3938
14.2	Hoist Motion / Cross Travel	
14.2.1	Type of mounting of gear box	Horizontal / Vertical
14.2.2	Classification	Suitable for M5 duty

14.2.3	Type of gears	Spur / Helical, hardened and tempered with machine cut teeth
14.2.4	Type of lubrication	Oil splash/ grease lubricated
14.2.5	Hardness (BHN) – gear	568+/-20BHN for alloy steel.
14.2.6	Hardness (BHN) – pinion	568+/-20BHN for alloy steel.
14.2.7	Difference in Gear and pinion hardness	Min 20 BHN
14.2.8	Materials (gear/pinions)	Gears shall be of cast or forged steel and pinions shall be forged steel and shall be machine cut. Gear and pinion teeth shall be treated for resistance to wear.
14.2.9	Casings	Fabricated steel gear boxes which shall be dust proof and firmly sealed to prevent oil leakages. Gearboxes shall have covers split horizontally and arranged such that top half can be removed for inspection. The gear boxes shall be fitted with bolted type machined inspection covers.
14.2.10	Noise level	85 db
14.2.11	Standard conforming to	IS: 4460
15	**Wheels details**	**Cross Tavel**
15.1	Material	EN-8/9
15.2	Hardness	IS: 3938. Max hardness 200 BHN
15.3	Type	Wheels in trolley unit travel shall be single flanged with straight / taper/ barrel shaped tread to suit the monorail.
15.4	Numbers provided	As per manufacturer's standard.
15.5	Specification conforming to	IS: 3938
15.6	Arrangement of lubrication	Grease
16	**Lifting hooks**	
16.1	Type	Plain shank trapezoidal section

16.2	Safe lifting capacity	As per Safe Working Load
16.3	Material	Solid, forged, heat treated alloy steel/ carbon steel of rugged construction as per IS:15560
16.4	Standard conforming to	IS: 15560
16.5	Hook can swivel	Yes
16.6	Safety latch on hook provided	Yes
16.7	Locking device on swivelling hook	Provided
16.8	Hook suspension	Ball or roller thrust bearing
17	**Buffers**	**Cross Travel**
17.1	Type	Spring or rubber buffers shall be provided on the trolley
17.2	Numbers provided	4
17.3	Details of end stop	NA
18	**Brakes**	
18.1		**Hoist Motion / Cross Travel**
18.2	Type of brake (ac / dc)	DCEM/ ACEM disc type (fail to safety)
18.3	Number provided per motor	1
18.4	Braking capacity (% of full load torque)	150% / 125%
19	**Drive system for hoisting**	
19.1	Arrangement of drive from motor to rope drum (main)	Through geared steel coupling and gear box
20	**Bearings**	**Hook / Trolley wheels / Rope drum / Gear box / Sheave / Any other assembly**

20.1	Type	Antifriction ball / roller bearings
20.2	Lubrication	Grease lubrication
20.3	Bearing life	10,000 working hours.
21	**Bridge girder**	
21.1	Type & Quantity	NA
21.2	Vertical Deflection and Camber	NA
21.3	Type of connection to end carriage	NA
21.4	**End carriage span material**	NA
22	**Motors**	
22.1	**Hoist Motions**	**MH / CT**
22.2	Type	Motor shall be rated for duty S4, CDF 40% and 150 starts per hour. Service class of motor shall be "M8" as per IS: 3177. Conditions given in IS:3938 for hoist motor shall be followed.
22.3	Enclosure	TEFC
22.4	Numbers furnished	One
22.5	Voltage, phase and frequency	Suitable for rated frequency of 50 Hz with a voltage variation of +/-10% and frequency variation of +/-5% occurring separately or combined voltage and frequency variation of 10%.
22.6	Class of protection	IP-55
22.7	Margin	Motor ratings shall be calculated keeping margin of at least 25% over the maximum power requirement. Further, the hoist motors shall be rated to lift 125% of the design load on the hook at the rated speed.
22.8	Class of insulation	All motors shall be totally enclosed, fan cooled type, having class-B stator insulation and class-F rotor insulation for slip ring motors & class-B insulation for squirrel cage motor with temperature rise limited to class-B operation in all cases.

22.9	Overload protection for motors provided	One main electro-magnetic contactor together with magnetic overload relay (hand reset) for each motor circuit shall be housed in the protection paneL The operation of overload relay shall interrupt the main magneticcontactor. Adequate short circuit protection shall be provided for main and individual circuits.
23.10	Space heater requirements	Not required
24	**Limit switches**	**Main Hoist / Cross Travel**
24.1	In hoisting motion	Each hoist shall be provided with 2 limit switches. 1. A screw type limit switch with self resetting features which will act in case of over hoisting. 2. A gravity operated hand reset type limit switch as a back-up protection against over-hoist
24.2	In CT/LT motion	Track type limit switches shall be provided on the trolley to prevent over travelling in either direction
24.3	Material of contacts	Double break Silver Cadmium
24.4	Control voltage	110V
24.5	Construction	The limit switches shall be housed in robust metallic oil and dust tight enclosure conforming to IP:65. At least 2 NO and 2 NC contacts shall be provided for each limit switch.
25	**Power conductors (DSL)**	Shrouded GI type runway conductor.
25.1	Type	CT travel : PVC shrouded GI conductor bus bar
25.2	Size	Shall be sized with a margin of 10% over load requirement. Voltage drop at motor terminal shall be limited to 3% at extreme positions of cranes. Protective cover over DSL shall be provided.
25.3	Length	Suitable for entire bay length.

26	**Isolation switch & Control Panel**	Isolation switch shall be provided at operating floor. Protective and control panels shall have IP-54 gasketed enclosure, fabricated from sheet steel, minimum 2 mm thick, suitably reinforced to provide structural rigidity. The panels shall be front connected type with front hinged door for access to wiring and terminals. Engraved name plates shall be furnished for all panels and also for the equipment and device mounted thereon. All panels shall be factory wired and terminated on suitable terminal blocks for external cable connection. All internal wiring shall be identified with numbering ferrules at both ends as per relevent wiring diagram. Terminal blocks shall have 20% spare terminals. Control wiring shall be carried out with 1100 Volt grade flexible, heat resistant, insulated switchboard wires with minimum 2.5 sq.mm stranded copper conductor. Each panel shall have internal illumination with fluorescent lamp and thermostat controlled space heater, suitable for operation on 240V I-ph 50Hz supply. Lamps and heater circuits shall have individual ON-OFF switches.
26.1	Material & size	Rolled sheet steel 2mm size
26.2	DOP	IP 55
26.3	Qty	1 no. per hoist
27	**Control for Hoisting operations**	
27.1	Creep speed	NA
27.2	Starting torque of VVVF	NA
27.3	Starting current	NA
27.4	Temperature	NA
28	**Cable**	**Power / Control / Trailing**
28.1	Type	The wiring shall be done with 1100 V grade PVC insulated stranded aluminium conductor cable of suitable size not less than 2.5 mm2 nominal equivalent copper area of cross-section. All control and auxiliary circuit wiring shall be done with 1100 V g rade PVC insulated, 2.5 mm2 stranded copper conductor. Control wire terminations to the panels shall be made with compression type connectors. Multiway terminal blocks shall be fumished for terminating panel wiring and outgoing cable.
28.2	Voltage drop	Cable from main isolating switch (1.5M above operating floor) to motor terminal shall be so sized that the voltage drop does not exceed 3% of rated voltage with cranes at extreme position.

29	**Earthing**	Crane structures, motor frames and metal cases of all electrical equipment including metal conduit and cable guards shall be effectively earthed. Electrical system shall be designed for a fault level of 50 kA. Earthing system adopted shall be type TN-CS.
29.1	Material of earthing	G.I / Copper
30	**Contactors**	AC 4 duty for reversing application. AC 3 duty for non -reversing application.
31	**Switches**	AC 23 for motor application, AC 22 for other application.
32	**Fuses**	HRC
33	**Power supply**	
34	**Transformer**	Dry type, with insulation class B or better.
34.1	Quantity	3 X 100 % for control
34.2	Voltage Rating	Control 415/110V
34.3	KVA rating	Min. 20% over loading to be considered while sizing the rating

B) MANUAL HOIST (CHAIN PULLEY BLOCK):

DATA SHEET-A

Sr. No.	DESCRIPTION	TECHNICAL PARTICULARS
1	**Type**	**Hand operated chain pulley blocks.** Chain pulley blocks shall be with or without the travelling trolley depending upon the layout requirement and intended use.
2	**Area of installation**	As per Annexure A
3	**Design**	IS: 3832
4	**Duty Class as per IS:3832**	Class -II
5	**Hoisting Mechanism**	Through endless chains
5.1	Type	Hand operated gear transmission
5.2	Type of gear	Spur
5.3	Load Chain	
5.3.1	Type	Link type
5.3.2	Material	Alloy steel (grade 40) as per IS 3109 (part-II)
5.4	Hand Chain	
5.4.1	Type	Link type
5.4.2	Material	Mild steel (grade 30) as per IS 2429 (Part I)
5.5	Load Hook & Hook Block	
5.5.1	Type of load hook	Plain shank- Trapezoidal section

5.5.2	Load hooks conforms to (Std./Code)/ Material	IS: 15560/ Forged steel
5.5.3	Type of hook suspension	Swivelling type fitted with a locking device.
5.5.4	Type of make of bearing of hook suspension	Thrust ball bearing
5.6	Gears	
5.6.1	Type	Spur
5.6.2	Material	Alloy steel / carbon steel
5.6.3	Type of bearing used	Antifriction ball bearing / Roller
5.7	Pinions	
5.7.1	Type of bearing used	Antifriction ball bearing / Roller
5.8	Sprockets	
5.8.1	Type of bearings used	Antifriction ball bearing / Roller
5.8.2	Method of lubrications Used	
5.8.2.1	Bearings	Grease
5.8.2.2	Gearing & Pinions	Grease
5.8.2.3	Sprockets	Grease
5.8.3	Brakes	
5.8.3.1	Type	Screw and friction disc type
5.8.3.2		Chain pulley block shall be fitted with an automatic mechanical ratchet and pawl arrangement to prevent self- lowering of load.
6	**Trolley & Bridge Drive**	Through endless chains
6.1	Trolley	
6.1.1	Type	Geared (Manually operated)
6.1.2	Material of frame	Rolled structural steel (IS:2062 Grade A or B)
6.2	Drive Chain	
6.2.1	Type	Link type
6.2.2	Material	Steel Gr.30
6.2.3	Wheel	
6.2.3.1	Number of pairs of wheel in each trolley/bridge	Two/four
6.2.3.2	Flange	Wheels in trolley unit travel shall be single flanged with straight / taper/ barrel shaped tread to suit the monorail.
6.2.3.3	Wheel material	Wheels should be preferably of forged steel construction
6.2.3.4	Type of bearings need	Antifriction
6.3	Gears	
6.3.1	Type	Spur / helical
6.3.2	Material	Alloy/ Carbon steel
6.3.3	Type of bearings used	Antifriction
6.4	Method of lubrication for	
6.4.1	Bearings	Grease
6.4.2	Sprockets	Grease
6.5	Load chain wheel	
6.5.1	Material	SG iron / Steel casting / Pressed sheet steel.
6.6	Hand chain wheel	
6.6.1	Material	SG iron / Steel casting / Pressed sheet steel / Gray iron casting
7	**Hoisting and trolley travel effort**	As per IS 3832

11.0 Maintenance Tools and Tackles

One (1) complete unused new set of special purpose tools, tackles and accessories along with detailed

instructions and maintenance manual shall be supplied. Tools shall be of suitable sizes for maintenance of electric hoist of each type and capacity. Each tool and wrench shall be stamped so as to be identified easy for its use. The tools shall be supplied in steel toolbox and with a copy of instruction manual. The items supplied shall be of the best quality, specially protected against rusting. The following shall be provided as minimum requirement:

S. No.	Description	Qty.
1	Complete set of ring spanners	1 Set
2	Complete set of screwdrivers (Min. 6 nos of suitable sizes)	1 Set
3	Adjustable Spanner	1 No.
4	Insulated pliers	1 No.
5	Wrench spanner	1 No.
6	Grease Gun	1 No.
7	Oil Gun	1 No.
8	Hand Lamp	1 No.
9	Line tester	1 No.

Note: -The tools shall be supplied in one tool box. Bidder shall ensure that the tools & tackles mentioned in above list are sufficient to handle all sizes/capacities of hoists & in case any other /additional tool is required for handling/maintenance any size/capacity of hoist the same shall be included in this list.

12.0 DRAWING/DOCUMENT SUBMISSION

The successful bidder shall submit the following drawings / documents during detail engineering for customer's approval /information:

A) ELECTRIC HOIST

Sl. No.	BHEL DRG.NO	DRAWING TITLE
1	PE-V0-415-553-A100	Manufacturing Quality Plan with Sub vendor list
2	PE-V0-415-553-A101	GA Drawing for Electric Hoist, DSL arrangement and painting details
3	PE-V0-415-553-A102	Schematic Circuit Diagram
4	PE-V0-415-553-A103	Mechanism Sizing Calculation
5	PE-V0-415-553-A105	O & M Manual

B) MANUAL HOIST (CHAIN PULLEY BLOCK):

Sl. No.	BHEL DRG.NO	DRAWING TITLE
1	PE-V0-415-553-A200	Manufacturing Quality Plan
2	PE-V0-415-553-A201	GA Drawing for Chain Pulley Block with detail BOM with painting details
3	PE-V0-415-553-A202	O & M Manual

Notes:

1. The above drawing list is tentative and shall be finalized with the successful bidder after placement of order.

2. Drawings shall be prepared in Auto-Cad latest edition. Required no. of hard and soft copies (editable) of the drawings shall be furnished as per requirement specified elsewhere in the specification.

3. All the drawings and documents including general arrangement drawing, data sheet, calculation etc. to be furnished to the customer during detailed engineering stage shall include / indicate the following details for clarity w.r.t. Inspection, construction, erection and maintenance etc.:-

   a) All drawings and documents shall indicate the list of all reference drawings including general arrangement.

   b) All drawings shall include / show plan, elevation, side view, cross - section, skin section, blow - up view; all major self-manufactured and bought out items shall be labeled and included in BOQ / BOM in tabular form.

   c) Painting schedule shall also be made as a part of general arrangement drawing of each equipment / items indicating at least 3 trade names.

   d) All the drawings required to be furnished to customer during detailed engineering stage shall include technical parameters, details of paints and lubrication, hardness and BOQ / BOM in tabular form indicating all major components including bought out items and their quantity, material of construction indicating its applicable code / standard, weight, make etc.

   e) Drawings/ documents to be submitted for purchasers review/ approval shall be under Revision A, B, C… etc. while drawings /documents to be submitted thereafter for customer's approval after purchaser's approval shall be under R-0, 1, 2, 3 ….etc.

13.0 MANDATORY SPARES:

MANDATORY SPARES FOR ELECTRIC HOIST AND MANUAL HOIST (AS APPLICABLE)

A. Mechanical spares for Electric Hoist

	Mandatory Spares for Electric Hoists (for each type and rating)	
1	Brake linings	Two (2) sets of each type
2	Rope guide and rope tighter	One (1) of each type
3	Limit switch	Two (2) of each type and size
4	Bearings for long travel wheels	Two (2) sets
5	Bearings for gear boxes for each type of hoist	Two (2) sets
6	Break liners for all the brakes	100% of total population of each type & size
7	Oil seals	100% of total population of each type, size rating

8	Brake springs for all brakes	100% of total population of each type, size rating
9	Wire ropes for hooks	100% installed on each crane and hoist
10	Solenoid coils for brakes	Two (2) sets
11	Overload relay for motors	Two (2)
12	Limit switches for hoists and travel mechanisms	Two (2) sets
13	Spare motors for hoists	Two (2)
14	Long travel machinery	
14.1	Gear wheel	One (1) set
14.2	Internal clip	Two (2)
14.3	Pinion	One (1)

B. Mechanical spares for Manual hoist

	Mandatory Spares for Chain Pulley Blocks (for each type and rating)	
1	Load chain wheel	One (1)
2	Load chain stripping fork	Five (5)
3	Hand chain wheel	Two (2)
4	Ratchet pawl	One (1)
5	Locking ratchet wheel	Two (2)
6	Guide roller	Two (2)
7	Brake disc	Two (2)

Note:-

1. “One (1) Set” is defined as 100% requirement for one hoist for the entire hoists of similar size & capacity.

ANNEXURE I: MAKES AND SUB VENDOR LIST

Package Name	Vendor Name
ELECTRIC HOIST	Alpha Services
	CONSOLIDATED HOISTS PVT LTD
	CENTURY CRANE ENGINEERS PVT. LTD.
	TECHNO INDUSTRIES
	EDDY CRANES PVT. LTD.
	Grip Engineers Pvt. Ltd.,
	TRACTEL TIRFOR INDIA PVT. LTD.
	Mangla Hoists Pvt Ltd
	BRADY & MORRIS ENGINEERING CO. LTD.
	REVA INDUSTRIES LTD.
	UNIVERSAL HOIST-O-FABRIK
CHAIN PULLEY BLOCK	UNIVERSAL HOIST-O-FABRIK
	CENTURY CRANE ENGINEERS PVT. LTD.
	BAKELITE ELECTRICAL MFG. CO. PVT. LTD.
	TRACTEL TIRFOR INDIA PVT. LTD.
	BRADY & MORRIS ENGINEERING CO. LTD.
	TUOBRO FURGUSON (INDIA) PVT LTD
	TECHNO INDUSTRIES

Note: No other make will be acceptable, until and unless specifically got approved by BHEL/Customer / Customer's consultant during detail engineering only. Acceptance/non acceptance of same shall not have any

impact on manufacturing, delivery schedule and on cost of the Electric hoists/CPB.

MAKES OF SUB VENDORS ITEMS AS APPLICABLE TO ELECTRIC HOIST:

Sl no.	ITEM	MAKES
1.0	STEEL	SAIL/IISCO/TATA STEEL / JINDAL
2.0	HOOKS	MOOZUMDAR / SIMRITI FORGING / HARMAN MOHTA / STEEL FORGING & ENGG. CO., KOLKATA /
3.0	GEAR COUPLINGS	ALLIANCE / HICLIFF / OEM
4.0	WIRE ROPE	USHA MARTIN Black / BOMBAY WIRE ROPES / FORT WILLIAMS / UNITED WIRE ROPE/BHARAT WIRE ROPES.
5.0	BEARINGS	SKF/ FAG
6.0	MOTORS	SIEMEN/ ABB /NGEF/ CROMPTON /KIRLOSKAR /GECA / BHARAT BIJLI / MARATHON / LHP.
7.0	BRAKES	STROM CRAFT/ ELECTROMAG /SPEED-O- CONTROL / EMCO LENZE
8.0	CONTACTOR	SIEMENS / L&T /TELE MECHANIQUE / BCH
9.0	OVER LOAD RELAYS	SIEMENS / L&T / TELE MACHANIQUE / ABB
10.0	HRC FUSES	SIEMENS / L&T/ ENGLISH ELECTRIC/GE Power
11.0	ISOLATING SWITCH	SIEMENS/ L&T / CONTROL & SWITCH GEAR
12.0	SWITCH FUSE UNITS	SIEMENS/ L&T/ CONTROL/ & SWITCH GEAR/ GEC A
13.0	TIME DELAY RELAYS	SIEMENS/ L&T/ ABB/ BCH/ GEC A
14.0	TRANSFORMERS	INDCOIL/AE / LOGICSTAT/ PRAGATI / KAPPA / SOUTHERN ELECTRIC
15.0	BULB & FLOURESCENT TUBES/FITTINGS	PHILIPS/ BAJAJ/ CROMPTON
16.0	CABLE LUGS (HEAVY DUTY)	DOWELLS
17.0	CABLES	
a)	POWER CABLES	NICCO / UNIVERSAL / INCAB / FORT GLOSTER TORRENT / CCI / ICL / RADIANT / FINOLEX/ POLYCAB/KEI/HAVELL
b)	CONTROL CABLES	NICCO / UNIVERSAL / INCAB / FORT GLOSTER / DELTON / FINOLEX / TORRENT / CCI / ICL / RADIANT POLYCAB / KEI/ HAVELL.
c)	TRAILING CABLE	UNIVERSAL/ FGL/CCL/HVP/KEI/RADIANT.
18.0	CABLE GLAND	COMMET / SIEMEN / SUNIL&CO.
19.0	PUSH BUTTONS	SIEMENS / L&T / BCH /TEKNIC/VAISHNO
20.0	LIMIT SWITCHES	SPEED-O-CONTROL / ELECTROMAG / JAI BALA JI / KAYCEE / BCH
21	SELECTOR SWITCHES	KAYCEE/ SULZER
22	PENDENT PUSH BUTTON STATION	OEM
23	INDICATING LAMPS	TECKNIC / BCH / SIEMENS / STANDARD/ VAISHNO
24	MCB	MDS / INDO COPP / STANDARD
25	PANELS	OEM/BCH
26	DSL	SUSHEEL/STROMAG
27	TERMINAL BLOCKS	ELMEX/CONNECTWELL/WAGO (FOR CONTROL ONLY)
28	VVVF	YASAKAWA(L&T)/ABB/SIEMENS/SCHNIDER
29	CASTING	KOLHAPUR STEEL / GNAT FOUNDARY / KIRTI ALLOYS
30	Tools & tackles	Reputed make

MAKES OF SUB VENDORS ITEMS AS APPLICABLE TO MANUAL HOIST:

Sl no.	ITEM	MAKES
1.0	STEEL	SAIL/IISCO/TATA STEEL / JINDAL
2.0	HOOKS	STEEL FORGINGS/ KARACHIWALA/SMRITI/NASIK FORGE.
3.0	STEEL FORGINGS	CHOWDHARY/WESTERN INDIA FORGINGS/ HINDUSTAN STEEL FORGINGS/ RUBY FORGINGS OR AS APPROVED BY

		BHEL.
4.0	BRAKES	OEM

NOTE:

1. THE SUB VENDOR LIST ABOVE IS INDICATIVE ONLY AND IS SUBJECT TO BHEL AND CUSTOMER APPROVAL DURING DETAILED ENGINEERING STAGE WITHOUT ANY COMMERCIAL & DELIVERY IMPLICATION TO BHEL.

SECTION: I

SUB-SECTION: C 2

CUSTOMER SPECIFICATIONS

SECTION: I

SUB-SECTION: C 2A

CUSTOMER SPECIFICATIONS
TECHNICAL REQUIREMENT

VOLUME III-G

SECTION-2

TECHNICAL SPECIFICATION

FOR

AIR CONDITIONING SYSTEM

VOID

CONTENTS

VOID

1.0 INTRODUCTION

1.1 This specification is intended to cover the Design, Engineering, Manufacture, Fabrication, Assembly, Inspection, Testing at Manufacture's works, Packing, Transportation, Delivery, Receipt, Unloading, Storage and handling at site, supervision of Erection, Testing, Commissioning and Field Acceptance/Performance Guarantee test of Air Conditioning System for Bhusawal TPS Unit-6: 1 X 660 MW Project at Bhusawal, Maharashtra.

2.0 CODES & STANDARDS

The design, manufacture, fabrication, installation and testing of equipment covered by this specification shall comply with latest edition of the appropriate equivalent international standards, all currently applicable statutes, regulations and safety codes in the locality where the equipment shall be installed. Minimum following standards or equivalent Indian/ International standard shall be followed:

2.1	IS-660	:	Safety code for mechanical refrigeration
2.2	IS-5111	:	Testing of refrigerant compressors
2.3	ANSI-B 9.1	:	Safety Code for mechanical refrigeration
2.4	ARI-520	:	Standard for positive displacement refrigeration compressor & condensing units
2.5	IS-2494	:	Endless V-belts for industrial purposes
2.6	IS-3142	:	V-Grooved pulleys for Endless V-belts Specification
2.7	ASHRAE-23-67	:	Methods of testing for rating positive displacement refrigerant compressor and condenser units.
2.8	IS-2825	:	Code for unfired pressure vessels
2.9	ANSI-B-9.1	:	Safety code for mechanical refrigeration
2.10	ASHRAE-22-72	:	Methods of testing for rating water cooled refrigerant condenser

2.11	ARI-480	:	Standard for refrigerant cooled liquid coolers remote type
2.12	ASHRAE-26	:	Method of testing for rating liquid coolers.
2.13	IS-4503	:	Specification for shell and tube type heat exchanger
2.14	ASME-SEC-VIII, Div.1	:	Unfired pressure vessels code
2.15	ANSI-B-31.5	:	Piping
2.16	IS-659	:	Safety code for air conditioning
2.17	ASHRAE-33	:	Methods of testing for rating forced circulation air-cooling and air heating coils.
2.18	IS-5120	:	Technical requirements for rotodynamic special purpose pumps
2.19	IS-5639	:	Specification for pumps handling chemicals and corrosive liquids
2.20	IS-5659	:	Specification for pumps for process water
2.21	IS-6536	:	Pumps for handling volatile liquids
2.22	API-610	:	Centrifugal pumps for general safety services.
2.23	HIS	:	Hydraulic institute standards of USA
2.24	IS-655	:	Specification for Metal Air Duct
2.25	IS-277	:	Galvanized steel sheets – Specification
2.26	IS-737	:	Wrought aluminium and aluminium for sheet and strip for general engineering purposes.
2.27	ARI-210	:	Standard for unitary air conditioning equipment

2.28	ARI-270	:	Standard for application, installation and services of unitary equipment
2.29	ASHRAE-37	:	Standard methods of testing for rating unitary air conditioning & heat pump equipment.
2.30	BS-848	:	Methods of performance test for fans
2.31	ACM-210	:	Test code for air moving devices
2.32	BS-2831	:	Methods of test for air filters used in air conditioning.
2.33	IS-3069	:	Glossary of terms, symbols and units relating to thermal insulation materials
2.34	IS-4671	:	Expanded polystyrene for thermal insulation purposes
2.35	IS-8183	:	Bonded mineral wool
2.36	IS-702	:	Specification for Industrial bitumen
2.37	IS-4894	:	Centrifugal fans
2.38	ACMA	:	Standard 210 rest code for air moving devices
2.39	IS-1239	:	Steel tubes, tubulars and other wrought steel fittings
2.40	ASHRAE 23	:	Standard method of testing and rating -67 Standard air conditioner-67 standards
2.41	ARI-450-6	:	Standard for water cooled refrigerant condensers
2.42	ARI-410	:	Standard for air cooling and air heating coils
2.43	IS-3588	:	Specification for electrical axial flow fans
2.44	IS-8188	:	Treatment of water for cooling towers – code of practice
2.45	IS-210	:	Grey iron casting – Specification

2.46 IS-2062 : Specification for Steel for general structural purposes

3.0 EXTENT OF PACKAGE

The package shall comprise the Air Conditioning system of the following buildings as applicable:

3.1 Plant Control Room and control equipments room

3.2 Generator Excitation panel Room of STG Buildings

3.3 Automatic Voltage Regulation Room, if any, in the STG Buildings

3.4 Service Building

3.5 Control room in ESP Cum VFD Control Buildings

3.6 CW- ACW Pump House control room

3.7 Fuel Oil Heating & Pressurizing Pump House control room

3.8 Wagon Tippler Control Room

3.9 Chemical and fuel testing laboratory

3.10 DM Plant Control Room

3.11 MCC Cum Control Room of HCSD System

3.12 Coal handling plant Control room

3.13 Ash handling plant Control room

3.14 Stores in-charge room

3.15 Security & Time office Building computer punching room

3.16 Weighbridge Control Room

3.17 Other areas, which contain PLC based control equipment or Local control panel or Control & Instrumentation requiring air conditioning system.

Any other building not specifically mentioned but is included in the scope, is also deemed to be included in the scope for Air Conditioning system.

4.0 BIDDER'S RESPONSIBILITES

Equipment, material and services to be furnished shall include, as a minimum, the following:

4.1 Central Chilled Water Air Conditioning System for Plant Control Room, Control Equipment Rooms, Computer rooms, UPS rooms, Shift Charge Engineers' Room, SWAS Panel rooms (dry panels), Battery Charger rooms etc.

4.2 Central Chilled Water Air Conditioning System for Various areas in Service Building (Operation and Maintenance facilities) and staff rooms.

4.3 Air Conditioning System with Water cooled Precision type Packaged Air Conditioners/Split Air Conditioners/Window Air Conditioners and associated accessories/auxiliaries for Various Control room areas of different Auxiliary Buildings, Dining room of Canteen Building.

4.4 All field instruments and interconnecting cables between field sensors and local JB/control panels.

4.5 Anchor bolts with nuts, sleeves, washers, shims, packers, sole plates, sob sole plates for the plant and equipment.

4.6 Equipment earthing at two points up to plant earthing grid.

4.7 Coupling and coupling guard with fasteners.

4.8 Insulation for Air Conditioning Plant and associated equipment.

4.9 Painting as per specification.

4.10 Charge of refrigerant, lubricants and consumables till handing over.

4.11 Tools and tackles required for the plant erection and future maintenance.

4.12 Start-up and commissioning spares.

4.13 Mandatory Spares.

4.14 Erection, testing, commissioning and handing over.

5.0 TECHNICAL REQUIREMENTS

5.1 DESIGN PHILOSOPHY FOR AIR-CONDITIONING SYSTEM:

5.1.1 Design ambient conditions for all air conditioning system shall be as follows:

	Design Temperature	Summer	Monsoon	Winter
(a)	DBT (°C)	50	29.4	15.6
(b)	WBT (°C)	27	27.2	11.1

Calculation for plant capacity shall be furnished which shall have minimum 10% design margin over the theoretical capacity.

5.1.2 All air conditioned areas like various control room, marshalling panel, etc. shall be maintained at 22°C ± (plus or minus) 1°C and relative humidity of 50% ± 5%.

Non Critical air conditioned areas like offices, laboratory, dining room etc shall be maintained at 24°C ± 1°C and relative humidity not exceeding 60%.

5.1.3 Number of fresh air changes per hour shall be minimum 1 or minimum 35 m^3/hour per person whichever is higher.

5.1.4 Lighting load shall be minimum 20 Watts/ m^2 or actual whichever is higher.

5.1.5 The occupancy for general area shall be minimum one person per 10 m^2 and for conference room the same shall be one per 3 m^2. In the control rooms, the occupancy shall be considered one person per 25 m^2 (minimum) or part thereof.

5.1.6 All the equipment of Air Conditioning System shall be designed as per the relevant standards.

5.1.7 In Air Conditioning System, the return air shall be through ducts and use of plenum space for return air shall be avoided.

5.1.8 The supply and return air ducts shall be provided with automatic fire dampers at locations where ducts pass through walls and floors for ease of isolation, maintenance and as well as for emergency operations. The operation of these automatic dampers shall be interlocked with the fire alarm system and shall also be possible manually from the remote control panel.

5.1.9 Necessary make up/ Fresh air supply for complete air conditioning shall be provided.

Fresh Air Unit shall consist of a tube axial flow/centrifugal fan with drive motor, inlet louver with bird screen, dry panel HDPE filters, volume control damper, supports, supporting structures etc for each AHU station/room. 2 x 100% capacity Fresh air unit shall be provided in each AHU room where as for Fan coil unit, there shall be provision for suitable arrangement of fresh air intake from the nearest evaporative cooling units.

5.1.10 All the equipment of Air Conditioning system shall be designed for continuous duty and shall be located indoor.

5.1.11 For maintenance of compressors/chilling units, AHU's (Air Handling Units), pumps, etc, chain pulley block of suitable capacity shall be provided in the AC plant rooms and AHU rooms.

5.1.12 Design chilled water flow shall not be less than 0.7 m3/hr per TR air-conditioning load and design condensing water flow shall not be less than 1 m3/hr per TR air-conditioning load.

5.1.13 Coil face area of Air Handling units shall be designed considering a face velocity of not more than 2.5 m/sec. Velocity of water flow shall be limited to 2.5 m/sec and for gravity flow the same shall be limited to 1.5 m/sec. The air distribution system shall be sized to have a constant frictional drop along its length and velocity through ducts shall not exceed 7.6 m/sec

5.1.14 For refrigerant suction, discharge/hot gas lines and liquid lines, the total pressure drop in the liquid line is equivalent to not more than 1.1°C in saturation temperature. Refrigerant velocity shall not be greater than 0.5 m/sec.

5.1.15 For pumps, continuous motor rating (at 50°C ambient) shall be at least ten percent (10%) above the maximum load demand of the pump in the entire operating range. For fans, compressors and blowers, continuous motor rating (at 50°C ambient) shall be at least ten percent (10%) above the maximum load demand of the fan, compressors, blower at the design duty point. Wherever belt drives are used, the belts shall be sized for 150% of the rated power and there shall be minimum of two belts per drive.

5.1.16 Noise level within the air conditioned space shall be restricted within limits with suitable acoustic attenuation (with duct silencer/acoustic insulation etc.)

5.2 REDUNDANCY OF EQUIPMENTS

Redundancy of various Air Conditioning system equipment shall be as follows:-

5.2.1 Compression machines provided for central chilling plants shall have following standby capacities.

(a) 2 x 100% water chilling units shall be provided for the system catering to the AC requirement of STG Building (Equipment in Control Rooms, Control Equipment Rooms, Computer Rooms, SWAS etc).

(b) 2 x 100% water chilling units shall be provided for the system catering to the AC requirement of Service Building.

(c) 2 x 100% Water cooled Packaged AC units (Precision type) shall be provided for air conditioning of ESP/ VFD Control building.

(d) 2 x 100% horizontal split casing condenser cooling water pumps, 2 x 100% capacity Chilled water pumps and 2 x 100% Fibreglass Reinforced Plastic (FRP) construction cooling towers shall be provided for the chilling plants for STG Buildings and Service Building. These Condenser water pumps and cooling towers shall also serve the PAC units of all the ESP cum VFD Control buildings. Capacities of the condenser water pumps and cooling towers will be selected accordingly.

5.2.2 All A.H.U.'s (Air Handling units) shall have stand by equipment for each area. Minimum total capacity shall be 2 x 100 % for each area.

5.2.3 Chilled water system shall be circulating type, with expansion tank of minimum 1 m^3 capacity. The chilled water system shall use de- mineralized water, with pH raised by means of caustic soda (NaOH) solution dosing into the chilled water expansion tank.

5.2.4 Water cooled Precision type Package type Air conditioners shall be 2 X 60% or 3 X 40% Capacity for Control room, Office & Lab area of DM Plant Building depending on the total cooling load.

5.2.5 Split type Air conditioners shall be 2 x 60% or 3 x 40% Capacity for other Air-conditioned areas depending on the total cooling load.

5.2.6 Fresh air fans for each PAC room shall be 2 x 100 % Capacity.

6.0 TECHNICAL SPECIFICATION FOR AIR CONDITIONING SYSTEM

6.1 CENTRAL AC PLANT SHALL COMPRISE

6.1.1 Screw Compressor with drive motor

6.1.2 Water Cooled Condenser

6.1.3 Water Chiller/evaporator

6.1.4 Chilled water pumps

6.1.5 Air handing units

6.1.6 Other accessories such as expansion tanks, steel structure, supporting frames, vibration isolators, Insulation, piping, valves, instrumentation, Control panel, etc.

6.1.7 Separate closed loop cooling water system with induced draught cooling towers of FRP construction. Water pumps shall be used for condenser cooling. Make-up shall be supplied from filtered water system. The desired pressure shall be 8.0 kg/cm² (g).

6.2 COMPRESSOR

The compressor shall be Rotary Screw type, either hermetic or semi-hermetic directly driven and suitable for R-134a refrigerant. It shall be provided with automatic unloaded starting device and automatic capacity control. Standard accessories like High/Low pressure cut-outs, Oil pressure switches (if applicable), suction and discharge stop valves, muffler, oil filters, oil Separators, Anti recycle device, vibration isolators etc shall be provided. All operating and safety controls of the compressor shall be Microprocessor based.

6.3 CONDENSER

AC Plant shall be fitted with one horizontal shell and tube, R-134a duty condenser incorporating water-cooled type integrally bonded copper tubes and easily removable cast iron end covers to aid tube clearing. The shell casing shall be formed from M.S. plate, fusion welded. The design-fouling margin shall not be less than 0.0002 (in MKS units). The tube material shall be replaceable seamless copper. Fins shall be made up of copper. It shall be designed to provide at least 2°C sub-cooling.

6.4 CHILLER/ EVAPORATOR

The chiller/evaporator shall be cleanable, horizontal, shell and tube water heat exchanger containing refrigerant circuits constructed from integral seamless copper tubes and suitable for R-134a refrigerant. The shell casing shall be made of MS plates, fusion welded. The shell casing and heads shall be insulated. Evaporator capacity shall be equal to the total refrigeration capacity required, designed as per ASME Section-VIII/TEMA Class-C standards. The evaporator shall be designed with at least 2°C super-heat under rated designed condition. The average tube velocity and fouling factor shall be 2.5 m/sec and 0.000013 (hr –°C- mm^2) /kcal respectively.

The complete condensing/chilling units shall be mounted on steel structure and shall be provided with necessary vibration isolators.

6.5 REFRIGERANT CIRCUITS

Each refrigerant circuit shall include hot gas muffler, all necessary stop valves, strainer, drier and sight glass, electronic expansion valve, evacuating and charging valve, solenoid valves. All suction lines shall be insulated with close fitting cellular insulation

6.6 CHILLER UNIT

The water chilling units shall be provided with a built-in Microprocessor based control panel. This panel shall provide safety against high & low refrigerant pressure, low oil pressure, freezing of chilled water, overload, winding heating and single phasing and phase reversal of compressor by means of high & low pressure transmitter, oil pressure transmitter, temperature sensors & transmitter, O/L relays, thermistor relays, etc. It shall also provide capacity control by sensing low chilled water return temperature through operating thermostat or through VFD, flow switches for the condensers and chillers, compressor unloaded starting device.

The Chiller Unit shall be complete with Common base frame for compressor, condenser, chiller unit fabricated of M.S. angles, channels etc, anchor bolts, nuts, hot gas piping, cold gas piping, liquid refrigerant piping, all of seamless steel or ERW steel pipes, insulation of cold gas piping with minimum 39 mm thick Nitrile Rubber foam/XLPE or equal finished with

24G aluminium sheet cladding liquid valves, muffler if needed, gauges and instrument piping, filters, drier, moisture indicator isolating valves etc as may be required for safe and trouble free operation. The entire chiller package assembly shall be installed with spring type vibration isolation devices.

6.7 CHILLED WATER AND CONDENSER WATER PUMPS

These shall be horizontally split casing type centrifugal pumps and shall have Cast Iron casing and bronze impeller. The pumps shall be direct driven and mounted on a common base frame with motor. The operating speed of the pump should be maximum 1500 rpm.

6.8 AIR HANDLING UNIT (AHU)

6.8.1 Each AHU shall consist of Casing, Fan 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 filter (micro-vee type) at the discharge of each individual AHU, and heater section in the common discharge of AHU.

Motorized Fire dampers shall be provided for isolation of the system during emergency at common supply air (AHU outlet) from each AHU and at common return air ducts (inlet to AHU).

The casing of AHU shall be double skin construction. Double skin sandwich panels (inside and outside) shall be fabricated using minimum 0.63 mm (24g) Galvanized sheet steel, with 25 mm thick polyurethane foam insulation in between and 6 mm thick water sump. Suitable reinforcements shall be provided to give structural strength to prevent any deforming/ buckling.

Cooling coil shall be of seamless copper tubes with aluminium fins and shall be provided with suitable drains and vents connections.

Local control panels shall be provided for AHU's with following instruments and controls mounted on it.

(a) Hand switches

(b) Indicating Lamps

(c) Differential pressure gauges

(d) Electric Thermostat/Pneumatic thermostat

(e) Temperature Indicator

(f) Humidity Indicator

(g) Temperature Controller

(h) Any other instruments needed for controls

(i) Solenoid valve

(j) Any other loose instruments required

6.8.2 Three Way Control Valve

These valves shall be sized by the bidder and relevant back-up information such as CV rating, pressure drop assigned across the control valves etc shall be forwarded to the Owner. The 3-way control valves shall be controlled pneumatically.

6.8.3 Fan Section

(a)	Fan impeller	:	Forward/backward curved blade & centrifugal type
(b)	Impeller material	:	Mild steel spray galvanized with minimum zinc deposition conforming to Class 275 of IS: 277.
(c)	Fan casing	:	GI sheet steel of 3 mm minimum thickness
(d)	Fan bearings	:	Self-aligning type, permanently lubricated, heavy duty with a design life of 10,000

operating hours.

(e) Operating range : Fans to be designed to operate within 9% and 25% of the system throttling line.

(f) Critical speed : First critical speed of rotating assembly shall be at least 25% above the operating speed

(g) Drive : Motor driven, with removable belt guard.

6.8.4 Pan Humidifier:

Pan humidifier with tank and heater in common discharge plenum shall be provided. A make up water line with float valve shall be provided for pan humidifier.

6.9 LOCAL CONTROL PANEL (LCP)

6.9.1 The following control panels are to be used for control metering, process and safety interlocks, indication and audio-visual annunciation.

(a) One for the Central Chilled Water Plant.

(i) One for each AHU.

Such Local Control Panels shall provide:

(b) ON/OFF control of each drive and equipment

(ii) Status indication of each drive by indicating lamps

Following Safety Controls:

(a) With LCP of Central Plant

(i) Overload trip of Condenser Cooling Water and chilled water pump motors

(ii) Overload trip of cooling tower fan motor

(b) With LCP of each AHU room

(i) Overload trip of AHU/FCU fan motor.

(ii) High temperature and/or "no air flow cut out" with strip heaters.

(iii) Closing of Fire Dampers in case of fire

The LCP in each AHU room shall also perform operating control of three way control valve with the sense of return air thermostat and on/off control of strip heaters and the pan humidifier.

6.9.2 Audio-Visual annunciation shall be provided at the Local Control Panel of central AC plant room through annunciation windows. A set of "Accept", "Reset" & "System Test" push buttons shall be incorporated. One hooter for any kind of malfunctions shall be provided on the top of the panel for audio effect of the complete system.

6.9.3 Following Audio-Visual Annunciations are to be provided in the LCP of central AC Plant:

(a) Low Oil Pressure of Compressor, if semi sealed

(b) Low Condenser Water Flow

(c) Low Suction Pressure of Compressor

(d) High Discharge Pressure of Compressor

(e) Compressor Motor Overload

(f) Low Chilled Water Flow

(g) Low Chilled Water Temperature

(h) Chilled Water Pump Motor Overload

(i) Condenser Water Pump Motor Overload

(j) Cooling Tower Fan Motor Overload

(k) AHU Motor Overload (for each AHU)

(l) Fresh Air Fan Motor Overload

Note

10% spare annunciation windows shall be provided over and above the annunciation as listed. Provision of additional annunciation (s) may be decided depending on Bidder's requirement. The spare windows shall be equipped with all devices as provided for active windows.

6.10 PACKAGED AIR CONDITIONER (PRECISION TYPE)

6.10.1 Compressor

The compressor shall be hermetically sealed scroll type medium speed, single acting type designed for R-407c/410A duty. The compressor shall be complete with crank case heater (to be energised when compressor is on 'OFF' cycle).

The compressor shall have proper lubrication system. Safety devices viz. high-pressure switch, low pressure switch, low oil pressure (if applicable) shall be provided and such devices shall be electronically operated. Manual reset on safety cut out shall be provided. The horsepower for the compressor motor shall be adequately sized or 110% of the rated power required for the unit including drive loss.

Capacity control device shall be provided.

6.10.2 Condenser

All condensers shall be of shell and tube type with water in the tubes and refrigerant in the shell.

Each PAC unit shall be fitted with one shell and tube condenser incorporating water-cooled type integrally bonded copper tubes and easily removable cast iron end covers to aid tube clearing. The shell casing shall be formed from M.S. Plate fusion welded. The design- fouling margin shall not be less than 0.0002 (in MKS units). The tube material shall be replaceable seamless copper. Fins shall be made up of copper. It shall be designed to provide at least 2°C sub-cooling.

6.10.3 Evaporator Cooling coil

The cooling coil shall be direct expansion type with multi-row deoxidised copper tubes with aluminium fins. Air velocity across the coil shall be limited to 2.5 m/sec. The coils shall be pressure tested and thoroughly dehydrated before assembling.

The coil shall be placed to make the system draw through type. Refrigerant feed control shall be by thermostatic expansion valve. Temperature control shall be through microprocessor based control panel.

The cooling coil shall be able to produce the capacity required under specified coil condition and air quantity. Heat load calculation to check the system selection shall be carried out and submitted by the Bidder.

6.10.4 Evaporator Fan

The fan shall be heavy duty DIDW centrifugal type statically and dynamically balanced with forward curve blade, indirect drive designed for high efficiency and quiet operation with automatic belt tension adjustment mechanism. Fan wheels and casing shall be constructed of steel and mounted on steel shaft. The bearings shall be ball bearing type mounted on vibration absorbing rubber mounts.

The fan motor shall be mounted within the cabinet. Motor base shall be adjustable for alignment. Motor horsepower shall be sized for 120% of the

rated power required including the drive loss.

The supply fan shall be sized to deliver the required air quantity against the total external static pressure required for the system application, after taking care of all internal static pressure requirements of the units.

6.10.5 High Efficiency Filter

A set of High efficiency filters shall be located inside the PAC unit cabinet.

The filters shall be high efficiency of 95% down to 5 microns. The filters shall be of cleanable type construction of reinforced glass fibre or cotton fabric or fabric-like material sandwiched in between two galvanized wire netting arrangement in an uniformly corrugated form to increase the surface area.

The filters shall have G.I. frames of adequate thickness suitable for long use in an industrial plant. The filters may be in panels of size about 600 x 600 for easy handling.

The filter panels shall be mounted on the ladder type angle iron holding frames.

The frames shall be designed strong enough to take the load of double the pressure drop in dirty condition of the filters. Face velocity of air across the filters shall not exceed 1.5 m/sec. The maximum limitation of Pressure drop across the filters shall be 6 mm WC at clean and 12 mm WC at dirty condition.

6.10.6 Humidifier

The humidifier shall be of Electrode type and shall be placed inside the PAC unit cabinet. The humidifier shall be electronically controlled through the built-in microprocessor based control panel of the unit. A provision of make-up water connection with the humidifier shall be kept with the Unit cabinet.

6.10.7 Electric Strip Heater

The PAC unit shall be provided with built-in electric strip heater electronically controlled through the built-in microprocessor based control panel of the unit. Such control includes both operating and safety controls with the sense of air temperature at the RA path and at the downstream side of the heater respectively.

6.10.8 Casing and Cabinet

All components shall be housed in a welded sheet metal cabinet of double skin of not less than 22 G thick MS powder coated sheets. The gap between two skins is filled up with at least 25 mm thick PUF/EPS insulation. Different sections shall be constructed with frame work and connected with each other in an air tight manner through gaskets, thermal barriers and sealant.

Removable panels shall be constructed of framed 1.6 mm steel sheet with angle iron framing. Units shall be provided with 316 L.S.S. fasteners for easy removal and access for servicing. Air handling section of evaporator shall be provided with an acoustic lining of 25 mm thick fibre glass covered with RP tissue paper and perforated aluminium sheet on the inside surface of the unit casing. Insulated condensate drain pan shall be provided within the unit. The unit shall be factory assembled, wired, with inter connecting refrigerant piping and built-in microprocessor based control console and tested as per the relevant code.

The return air opening shall be on the front face with a matching grille of same colour finish.

6.11 SPLIT AIR CONDITIONER

6.11.1 General

The air conditioner units shall be split type, factory assembled, and environmental friendly refrigerant to be used as a coolant. Body shall be as per Bidder's standard. The units shall have compressor and cross flow type blowers. The indoor unit shall be mounted on wall inside the room. The indoor unit consists of the evaporator coil, capillary tube, inbuilt control

panel, air filter, supply and return air grills. Outdoor unit shall be mounted on outside wall or on terrace.

6.11.2 Inlet louvers

The louvers shall be oscillating type leading to even air distribution.

6.11.3 Compressors

The out door unit consist of Reciprocating type compressor which is suitable to 415 V/3 phase supply. Compressors shall be of reputed make and suitable for continuous operation. Compressors for higher capacity (more than 3TR) SAC units shall be scroll type.

6.11.4 Cooling Coil

Cooling coils of air-cooled condensers shall be of the fin and tube type having copper fins firmly bonded to copper tubes. Capacity of the coils shall be as required. Tubes shall be 10.0 mm O.D. and 0.4 mm thickness with 8 fins/inch. The face velocity of air shall not exceed 152 m/min. Cooling coil shall be inner grooved copper, hydrophilic blue fins.

6.11.5 Evaporator Coil

Evaporator coils shall be of the fin and tube type having copper fins firmly bonded to copper tubes. Capacity of the coils shall be as required. Suction tubes shall be 15.8 mm and liquid connection shall be 10 mm approx. The face velocity of air s not exceed 150 m/min.

6.11.6 Supply Air Fans

Fans shall be of suitable type, cross flow and non-overloading type with forward curved blades.

Fans shall be driven by electric motors.

6.11.7 Filters

The filter media of SAC units for Dining room of Canteen Building shall be

made of Activated carbon electrostatic fibre filter to eliminate the odour of all indoor smells and traps fine dust and smoke particles.

Filter media of SAC units for other areas shall be HDPE.

6.11.8 Temperature and control

The dry bulb temperature of control room shall be maintained within the specified tolerance limit by step capacity control of individual AC unit. A thermostat placed in the unit results in substantial power saving and precision cooling.

The thermostat set point shall be staggered so that units operate in lead-lag operation. The temperature control shall be part of the unit.

In auto mode, the spilt air conditioner shall adjust its performance automatically depending on the room temperature and heat generated.

6.11.9 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 Codes and Standards as mentioned elsewhere in this specification.

6.11.10 Installation

Spilt air conditioner shall be installed as per Equipment Supplier's recommendations for better performance of the system. Air conditioner indoor unit shall be mounted on wall with suitable mounting arrangement. The Bidder shall provide R.C.C. foundation or suitable foundation frame as per relevant IS standards for outdoor unit and the bidder shall supply the isolation pad.

6.12 DUCT WORKS

This specification is intended to cover the fabrication, delivery at site, testing and commissioning of complete ductwork along with its accessories and auxiliaries pertaining to Air conditioning system.