

NEYVELI LIGNITE CORPORATION LTD

2x500 MW NEW NEYVELI TPP

VOLUME II B & III

TECHNICAL SPECIFICATION
FOR
AIR CONDITIONING SYSTEM

Specification No. PE-TS-400 & 402-553-A001 Rev 00

NOVEMBER 2014



BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NEW DELHI


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TITLE 2x500 MW NEW NEYVELI INDEX <u>AIRCONDITIONING SYSTEM</u>	SPECIFICATION NO. PE-TS-400 & 402-553-A001	
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2X500 MW NEW NEYVELI TPP

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VOLUME II B

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VOLUME II B


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**INTENT OF SPECIFICATION
2x500 MW NEW NEYVELI TPP
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SECTION-A

INTENT OF SPECIFICATION


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**INTENT OF SPECIFICATION
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1.0 INTENT OF SPECIFICATION

- 1.1 The specification is intended to cover Engineering, design, manufacture, inspection & Testing at manufacturers works/subvendor's work, Painting at manufactures works, duty packed for transportation, delivery to site, unloading storage & handling at site, erection & commissioning, carrying out acceptance tests at site, final painting and handing over to customer the complete **Air conditioning system** on turnkey basis as per details in different sections / volumes of this specification for **2X500 MW NEW NEYVELI**.
- 1.2 The contractor shall be responsible for providing all material, equipment & services, which are required to fulfil the intent of ensuring operability, maintainability, reliability and complete safety of the complete work covered under this specification, irrespective of whether it has been specifically listed herein or not. Omission of specific reference to any component / accessory necessary for proper performance of the equipment shall not relieve the contractor of the responsibility of providing such facilities to complete the supply, erection and commissioning of **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 high standards of design, engineering and workmanship and shall be capable of performing the required duties in a manner acceptable to purchaser who will interpret the meaning of drawings and specifications and shall be entitled to reject any work or material which in his judgement is not in full accordance herewith.
- 1.4 The extent of supply under the contract includes all items shown in the drawings, notwithstanding the fact that such items may have been omitted from the specification or schedules. Similarly, the extent of supply also includes all items mentioned in the specification and /or schedules, notwithstanding the fact that such items may have been omitted in the drawing.
- 1.5 The general term and conditions, instructions to tenderer and other attachment referred to elsewhere are made part of the tender specification. The equipment materials and works covered by this specification is subject to compliance to all attachments referred to in the specification. The bidder shall be responsible for and governed by all requirements stipulated herein.
- 1.6 While all efforts have been made to make the specification requirement complete & unambiguous, it shall be bidders' responsibility to ask for missing information, ensure completeness of specification, to bring out any contradictory / conflicting requirement in different sections of the specification and within a section itself to the notice of BHEL and to seek any clarification on specification requirement in the format enclosed under Vol-III of the specification **within 10 days of receipt of tender documents**. In absence of any such clarifications, in case of any contradictory requirement, the more stringent requirement as per interpretation of Purchaser/Customer shall prevail and shall be complied by the bidder without any commercial implication on account of the same. Further in case of any missing information in the specification not brought out by the prospective bidders as part of pre-bid clarification, the same shall be furnished by Purchaser/ Customer as and when brought to their notice either by the bidder or by purchaser/ customer themselves. However, such

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TITLE

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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 in the enclosed schedule; otherwise, it will be presumed that the vendor's offer is strictly in line with NIT specification.
- 1.9 Any commercial documents / deviations shall not be considered during technical evaluation. Moreover any technical deviations included in commercial deviation either explicit or implicit shall be considered null and void even if agreed by BHEL during commercial evaluation stage.
- 1.10 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.
- 1.11 In case all above requirements are not complied with, the offer may be considered as incomplete and would become liable for rejection.
- 1.12 Unless specified otherwise, all through the specification, the word contractor shall have same meaning as successful bidder /vendor and Customer/ Purchaser/Employer will mean BHEL and /or NNTPS including their consultant as interpreted by BHEL in the relevant context.


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**SECTION: B
PROJECT INFORMATION**


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SECTION - 2

2 GENERAL PROJECT INFORMATION

2.1 Introduction

The project site at Neyveli has distinct location advantages, being at pit-head distance from the source of lignite supply from Mines, making it convenient for transportation of lignite by belt conveyor. Water source is readily available from the nearby mines lake. Besides, other infrastructure such as access road, railway connection etc, already exist.

2.2 Power Plant Site

The power plant site is located at Neyveli, opposite to the now defunct Fertilizer and Briquetting & Carbonization Plant, near TPS-1 Expansion and TPS-II.

2.3 Project & Site Information

- | | | | |
|---------|---------------------------------|---|--|
| (i). | Owner/Purchaser | : | Neyveli Lignite Corporation Limited (NLC Ltd), Neyveli, Cuddalore District, Tamil Nadu State, India |
| (ii). | Consultant | : | Lahmeyer International (India) Pvt. Ltd (LII), Gurgaon, NCR, India. |
| (iii). | Project Title | : | 2x500 MW Neyveli New Thermal Power Station (NNTPS) |
| (iv). | Location | : | 200 kms south of Chennai and 50 kms south-west of Cuddalore |
| (v). | Latitude | : | 11° 34' 00" N to 11° 35' 00" N |
| (vi). | Longitude | : | 79° 26' 00" E to 79° 27' 00" E |
| (vii). | Elevation above MSL | : | + 67 m |
| (viii). | Nearest Railway Station | : | Neyveli, |
| (ix). | Nearest Sea Port | : | Chennai, at a distance of 200 km |
| (x). | Nearest Airport | : | Chennai, at a distance of 200 km |
| (xi). | Road Access/Approach to Site | : | Connected by Chennai-Thanjavur NH 45C road and state highway connecting Cuddalore – Virudhachalam via Neyveli. Both NH and state high way roads are well connected to NLC township roads. The approach road is approximately 15 kms from Chennai–Thanjavur NH – 45C road |
| (xii). | Site Meteorological Data | | |
| | • Max ambient temperature | : | 42.8° C |

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- Min Ambient Temperature : 26.9° C
 - Wet bulb temp : 29° C
 - Max. Relative Humidity : 92 % in the month of September
 - Min. Relative Humidity : 23 % in the month of May
 - Rainfall : About 1265.7 mm annually (average)
 - Wind direction : South West to North East direction
 - Wind Speed : 97.2 km/hr (maximum recorded)
4.3 km/hr (average wind speed)
 - Seismicity : As per IS: 1893 (part 4) (Zone-II)
Importance factor: 1.75.
- (xiii). Languages spoken in the region : English, Tamil

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TECHNICAL SPECIFICATIONS**

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SPECIFIC TECHNICAL REQUIREMENT


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1. FUNCTION

The purpose of the system is to provide air-conditioning system for different areas of 2x500 MW NEW NEYVELI under the scope of BHEL.

2. SYSTEM DESCRIPTION

2.1 MAIN POWER HOUSE BUILDING (AC PLANT-1)

- a) AC PLANT-1, combined for unit-1 & 2, in main power house building is provided to cater the air conditioning requirements of the following areas:-
- Central Control Room.
 - Electrical Equipment Room.
 - UPS (Uninterrupted Power Supply) room and Battery Charger room.
 - Steam and water analysis system rooms (SWAS) Panel Rooms (dry panel).
 - Shift incharge room.
 - Various floors of service building
- b) The air conditioning plant shall comprise of 2 x 250 TR capacity VAM as working and 1 x 250 TR capacity centrifugal machine as standby. The condenser cooling water shall be circulated through these units by means of 3 x 50% horizontal split casing centrifugal pump sets and 3 x 50% FRP cooling towers. The chilled water produced by the chilling units shall be circulated to the air handling units by means horizontal centrifugal pump sets. These AHU shall be located in AHU rooms near by the air-conditioned areas in Power House and Service bld. The conditioned air from AHUs shall be distributed to the air-conditioned areas by galvanised sheet steel ducting and extruded Aluminium 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 the return air shall be collected above the false ceiling and led back to the AHU rooms which acts as mixing plenum for return and fresh air.
- c) Controls for the AC plant shall be PLC based (common PLC for AC & ventilation system and shall be in AC vendor scope).

2.2 ESP Control room for Unit-1 and Unit-2 (AC plant-2)

The air conditioning plant shall comprise of (2 x 100TR) water Cooled Screw chillers (1 working + 1 standby). The condenser cooling water shall be circulated through these units by means of 2 x 100% horizontal/back pull out type split casing centrifugal pump sets and 2 x 100% FRP cooling towers. The chilled water produced by the chilling units shall be circulated to the air handling units by means horizontal/back pull out type centrifugal pump sets. These AHU shall be located in AHU rooms located near by the air-conditioned areas in each ESP building. The conditioned air from AHUs shall be distributed to the air-conditioned areas by galvanised sheet steel ducting and extruded Aluminium grilles / diffusers with volume control dampers and supporting frames. The return air shall be collected above the false ceiling and led back to the AHU rooms which acts as mixing plenum for return and fresh air.

2.3 SPLIT TYPE AIR CONDITIONERS

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


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Local Distribution Boards containing Switch / MCB shall be provided for Split Air Conditioners, and FCUs. Each split unit shall also be provided with suitable rating stabiliser.

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

BEE rating of the split ACs shall be 5 star.

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

3.0

DESIGN CRITERIA

3.1 SYSTEM DESIGN CRITERIA

- a) The inside design conditions to be maintained shall be as under:
 $23 \pm 1^{\circ}\text{C}$ & RH $55\% \pm 5\%$
For winter heating load calculation, 50% of combined light load and equipment / panel load as available in the room shall be considered.
- b) A design margin of 10% on grand total heat shall be considered while designing the AC Plant capacity for each area.
- c) For other design parameters refer to clause 12.4, 12.5 (NTA2), 12.5, 12.6 (NTA1) and other relevant clauses of section C-2, customer specifications.

3.2 SYSTEM CAPACITY AND CONFIGURATION:

- a) **For AC Plant 1:**
2 x 250 TR Actual capacity VAM (Both working) and 1x 250 TR Centrifugal Chiller (Standby) shall be provided.
- b) **For AC Plant 2:**
2 x 100 TR Actual capacity water cooled screw chillers (1 working + 1 Standby) shall be provided.

3.3 LAYOUT CONSIDERATIONS:

AC PLANT-1

- a. 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 Power House Building.
- b. The AHUs for this AC Plant would be located as under:
 - 3 AHUs (3 x 50 %) for areas at 17 m i.e CCR, EER, Computer room, shift in-charge, etc located in AHU Room at 24 M level of Power House Building.
 - 2 AHUs (1W + 1SB) for areas at 8.5 m i.e UPS room, DC Charger room etc, located in AHU Room at 8.5 M level and SWAS room located at 0 m level of Power House Building.

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- 2 x 50% or 1X100% AHU for the ground floor of service building.
- 2 x 50% AHUs for service bld. (from 1st floor to 4th floor).
- c. The Cooling Towers, Make-up water Storage Tank, Expansion Tank , Storage Tanks and Water Softening plant shall be located at 32 M level in BC Bay.
- d. 5 T Capacity Chain pulley block with Monorail arrangement shall be provided for the AC Plant room only for maintenance purpose (By BHEL)
- e. One No 2 T Capacity Chain pulley block with as many hooks as the no of AHUs shall be provided for each AHU room.(By BHEL)

a) AC PLANT-2

- a. 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 near ESP control room bld- 1.
- b. The AHUs for this AC Plant would be located as under:
 - 2 AHUs (2 x 100 % or 3 x 50 %) for areas at 11 m i.e ESP control room located in AHU Room at 11 M level of ESP-1 Building.
 - 2 AHUs (2 x 100 % or 3 x 50 %) for areas at 11 m i.e ESP control room located in AHU Room at 11 M level of ESP-2 Building
- c. The Cooling Towers, Make-up water Storage Tank, Expansion Tank Storage Tanks and Water Softening plant shall be located at roof of AC plant room-2.
- d. 3 T Capacity Chain pulley block with Monorail arrangement shall be provided for the AC Plant room only for maintenance purpose (By BHEL)
- e. One No 2 T Capacity Chain pulley block with as many hooks as the no of AHUs shall be provided for each AHU room.(By BHEL)

Note: The locations given above are tentative and may change during detail engineering.

3.4 SPECIAL CONSIDERATION

- a) The equipment shall have 10% reserve capacity over and above the selected capacity
- b) Further design margins in various equipment shall be as per relevant clauses of section C-2, customer specifications.
- c) All equipment shall be of high quality and high efficiency meeting the stipulated power consumption as defined elsewhere in the specifications.

4.0 EQUIPMENT DESCRIPTION

4.1 WATER COOLED VAM:

- a) Refer to clause 12.6.1, 12.6.1.1 NTA-2 and other relevant clauses of section C-2, customer specifications.
- b) The minimum COP and IPLV of VAM shall not be 1.00 and 1.05 respectively as per ARI 560.

(Handwritten signatures and initials)
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- c) Accessories (valves, pressure gauges, water flow switches, controls and instruments etc shall be provided with each screw chiller as per customer approved PID

4.2 WATER COOLED CENTRIFUGAL CHILLER

- a) Refer to clause 12.6.1.2 NTA-2, and other relevant clauses of section C-2, customer specifications.
- b) The minimum COP and IPLV of Screw/Scroll/centrifugal chiller shall not be 5.4 and 6.17 respectively as per ARI 550.
- c) Accessories (valves, pressure gauges, water flow switches, controls and instruments etc shall be provided with each screw chiller as per customer approved PID

4.3 WATER COOLED SCREW CHILLER

- d) Refer to clause 12.7.7 NTA-1, and other relevant clauses of section C-2, customer specifications.
- e) The minimum COP and IPLV of Screw/Scroll/centrifugal chiller shall not be 5.4 and 6.17 respectively as per ARI 550.
- f) Accessories (valves, pressure gauges, water flow switches, controls and instruments etc shall be provided with each screw chiller as per customer approved PID

4.4 CONDENSER AND CHILLED WATER PUMP SETS

- a) Refer to clause 12.6.3 (i) (NTA-2), 12.7.19 (NTA-1) and other relevant clauses of section C-2, customer specifications.
- b) Pumps flow shall be selected as under:-
i) For condenser water pump @ 1.08 CMH/TR
ii) For chilled water pump @ 0.84 CMH/TR
- c) Accessories (valves, pressure gauges, water flow switches, controls and instruments etc shall be provided with pump as per customer approved PID

4.5 AIR HANDLING UNIT (Double SKIN TYPE)

- a) Refer to clause 12.6.1.3 (NTA-2), 12.7.10 (NTA-1) and other relevant clauses of section C-2, customer specifications.
- b) For filter efficiency refer clause 12.6.3 (iv) NTA-2 and other relevant clauses of section C-2, customer specifications.
- c) Accessories (valves, pressure gauges, water flow switches, controls and instruments etc shall be provided with pump as per customer approved PID
- d) Drain piping from the AHUs up to nearest drain point.

4.6 COOLING TOWER

- a) Design wet bulb: 28° C.
- b) Cold water temp: 32° C.
- c) Hot water temp: 36° C.
- d) Refer to clause 2.01.07, 5.12.00, and other relevant clauses of section C-2, customer specifications.

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4.7 SHEET METAL WORK

- a) Refer to clause 12.6.3 (v) (NTA-2), 12.7.21 (NTA-1) and other relevant clauses of section C-2, customer specifications.
- b) Supply air diffusers / grilles (Frame and Louvers of Diffuser/Grilles shall be of extruded aluminium of 1.2 mm thick section, duly powder coated) with volume control dampers. Return air Diffusers will have no Volume control Damper.
- c) For fire damper refer to clause 2.07.00, 3.09.00 and other relevant clauses of section C-2, customer specifications.

4.8 INSULATION WORK

- a) Refer to clause 12.6.3 (x) (NTA-2) and other relevant clauses of section C-2, customer specifications

4.9 STRIP HEATER & HUMIDIFICATION PACKAGE

- a) Common set of electrical strip heaters package of suitable capacity complete with contactor, air stat, humidistat (room or mounted on strip heater control box), safety thermostat, heater box with insulation etc. for winter heating and monsoon reheat, mounted inside the AC plenum/duct for each AHU Room.
- b) One No. Pan humidification system comprising heater, humidistat, water tank, low level switch over flow, draining, make up connection, float valves etc for each AHU Room.
- c) Refer to clause 12.7.10 (xviii), 12.7.24 NTA-1 and other relevant clause of section C-2, customer specifications

4.10 PIPING VALVES ETC

- a) Refer to clause 12.6.3 (ii) & (iii) NTA-2, and other relevant clauses of section C-2, customer specifications

4.11 For other items refer to to relevant clauses of section C-2, customer specifications

5.0 CONTROL PHILOSOPHY

The operation of the AC Plant & the associated AHUs shall be done from the PLC based control panel located in the AC plant room. Control panels will incorporate start-stop push button lockable at stop position, controls & interlocks. The AC Plant compressor can be started only when its associated cooling tower fan, condenser & chilled water pumps are in operation. Standby selection of drives shall be done through Selection Switch to be located at control panel.

Chiller Package is to be provided with skid mounted microprocessor based control panel.

The operation of the packaged air conditioners and split window air conditioners with remote shall be done from local start –stop push button.

5.1 The AC Plant shall be provided with the following safety controls.

- 5.1.1 High discharge pressure cut-out (HP).
- 5.1.2 Low suction pressure cut out (LP)
- 5.1.3 Oil pressure cut-out (OP)
- 5.1.4 Condenser water flow switch

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Praveen Kishore
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2X500 MW NEW NEYVELI TPP
AIR-CONDITIONING SYSTEM
SPECIFIC TECHNICAL REQUIREMENT

SPECIFICATION No: PE-TS-400 & 402-553-A001

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- 5.1.5 Chilled water flow switch
- 5.1.6 Anti-freeze thermostat (AFT)
- 5.1.7 Airstat / safety thermostat with heaters of the AHUs.
- 5.1.8 Crank case heater for compressors
- 5.1.9 Overload trip of cooling tower fan motor.

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

- 5.2.1 Automatic capacity control system
- 5.2.2 Automatic unloaded starting device
- 5.2.3 Operating Thermostat
- 5.2.4 Unloading solenoid valves (if applicable)
- 5.2.5 3 Way flow control valve at the AHUs.
- 5.2.6 AHU fan motor shall be provided with overload trip.
- 5.2.7 Strip heaters shall be provided with high Temperature and "no air flow cutout"
- 5.2.8 Humidity & Temperature indicator/sensor in control equipment room for monitoring shall be provided and the system will be hooked up with D.C.S.
- 5.2.9 Local push button shall be provided for operating Split Air-Conditioners with remote.

5.3 Interface with DCS

- a) Following hardwired signals shall be provided in the DCS for monitoring purpose
 - I. Temperature & Humidity.
 - II. AC Plant On / Off Status.
 - III. Pump Run / Trip.
 - IV. AHU Run / Trip.
 - V. General AC Plant Warning.
 - VI. All data for chiller machine.
- b) Peripherals serial link shall be provided for the transfer of important signals to DCS in the central control room.

6.0 GENERAL

- i) For motorized fire damper / 3 Way valve actuators, power supply shall be derived by vendor from respective control panels. BHEL will not provide any feeder for fire damper / 3 Way valve. Suitable transformer shall be provided by bidder (if required) to derive the power input.
- ii) 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

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sheet/ technical particulars etc. Are subject to Customer & BHEL approval during detail engineering stage.

- iii) All drawings and documents shall be computer based.
- iv) All commissioning spares & consumable for trouble free operation shall be provided.
- v) Quality requirements in the Technical specification are minimum requirements for inspection and testing. Vendor to note that quality plans are subject to Customer & BHEL approval during detail engineering stage. Standard QP format is enclosed in the technical specification.
- vi) Makes of equipment / items shall be subject to Customer / BHEL approval during detail engineering stage.
- vii) 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.
- viii) Inserts or any support arrangement for fixing ducting, fans, piping etc. shall not be provided by BHEL.
- ix) Fixing frame works for diffuser and grilles in the scope of air-conditioning plant supplier.
- x) Anchor fasteners shall be used by vendor for fixing duct, pipes etc, wherever applicable.
- xi) Necessary supports / frames as required for supporting the duct / piping / equipment etc. As lump sum basis is in the scope of air-conditioning plant supplier and no unit rates shall be applicable for these items.
- xii) Drain piping from AC equipment to nearest drain point within room to be provided by the air-conditioning plant supplier. Drain piping shall also be provided in the plant room and cooling tower area to the nearest drain.
- xiii) The tools and plants required for erection of equipment shall be arranged by air-conditioning plant supplier.
- xiv) Tools & tackles as required for regular maintenance shall be supplied by air-conditioning plant supplier.
- xv) Instruments required for performance testing of various equipment/ system of the package shall be arranged by air-conditioning plant supplier at site.
- xvi) Instrument for testing shall be calibrated by air-conditioning plant supplier before taking up testing.
- xvii) Air-conditioning plant supplier to furnish drawings/ documents as per the dwg. / documents distribution as per project requirement.
- xviii) 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.
- xix) All electrical equipment shall be suitable for the power supply fault levels and other climatic conditions indicated in project information / synopsis / specifications enclosed.
- xx) The bidder's proposal shall be for equipment in accordance with the tech. Specification.
- xxi) The bidder shall furnish complete tech. Particulars in data sheet and schedules as specified elsewhere in the specification.
- xxii) Tender drawings enclosed form the part of specification and the bidder shall check the space requirements.
- xxiii) For this Project, 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.
- xxiv) Temperature gauges shall be provided with thermo wells and fixing arrangement.


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- xxv) Pressure gauges shall have provision for air venting. Three way valves shall be used which shall have air venting provision.
- xxvi) Matching sockets / stubs (weld type) for flow switches and other instruments shall be supplied.
- xxvii) 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%.
- xxviii) Besides the system guarantee as above, bidder shall guarantee major technical parameters of various equipments as per design basis / details furnished.
- xxix) The guarantee tests shall cover but not limited to the following rated parameters for smooth operation of air-conditioning system.
- Design dry bulb temperature and relative humidity of conditioned air, Auxiliary power consumption, Vibration and noise level etc
 - Tests to prove guaranteed performance of the air conditioning plant shall be carried out at site after proper installation. The site test shall include performance testing of equipment for 72 continuous hours in summer or monsoon and 24 continuous hours in winter. Bidder, as may be required to carry out site tests shall arrange all instruments, tools etc.
 - All calibrated instruments to be used for the tests at manufacturer's works/site shall be arranged by the bidder. Any Electrical/C&I items and accessories like junction box, glands etc. shall be included by vendor in his scope. Only those items shall be provide free of cost which are categorically listed in the Electrical scope sheet of technical specification (C3).
- xxx) Any Electrical/C&I items and accessories like junction box, glands etc. shall be included by vendor in his scope. Only these items shall provide free of cost which are categorically listed in the Electrical scope sheet of technical specification (C3).
- xxxi) Laying of cable between PLC of fire protection system and PLC of AC system shall be in AC system supplier scope.

7.0 EXCLUSIONS

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

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


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TECHNICAL SPECIFICATION
2X500 MW NEW NEYVELI

SPECIFICATION No: PE-TS-400 & 402-553-A001

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CUSTOMER TECHNICAL SPECIFICATION


Praveen Kothari

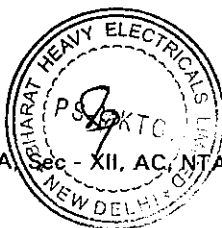
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**VOLUME II A
SECTION – XII
AIR CONDITIONING SYSTEM**

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TG, Vol - IIA, Sec - XII, AC, NTA2





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12.1 General

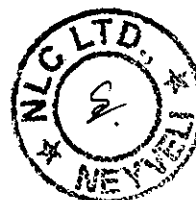
Contractor will provide for various buildings/rooms air conditioning system, evaporative cooling system, ventilation system, cooling fans, exhaust fans (negative pressure) as the case may be as indicated in the list below:

The heating load for A/C and ventilation system will be designed for the actual heat dissipation values.

12.2 Codes and Standards

Apart from the specific equipment standards and specifications the following broad references/standards will be considered while designing the system:

S.No	Code	Description
1	ASHRAE	American Society for Heating, Refrigeration and Air conditioning Engineers
2	ISHRAE	Indian Society for Heating, Refrigeration and Air conditioning Engineers
3	ARI	Air Conditioning and Refrigeration Institute
4	ECBC	Energy conservation Building Code 2007
5	NBC	National Building Code of India 2005
6	ARI 430	Central station Air Handling Units
7	ARI 410	Forced Circulation Air-Cooling and Air Heating coils
8	ARI 550	Water chilling package using the Vapor compression cycle
9	BIS 277	Galvanized Steel Sheets
10	BIS 325	Three phase induction motors
11	BIS 655	Metal Air ducts
12	BIS 7613	Method of testing panel type air filters for air-conditioning and Ventilation process
13	BIS 3588	Electric axial fans
14	BIS 4894	Centrifugal fans
15	UL 555	Fire dampers
16	BIS 7098 Part-1	Power cables
17	BIS 1554 Part-1	Control cables
18	BIS 4237	MCC
19	BIS	For Control panels as applicable



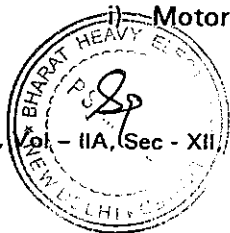


12.3 Scope

The scope defined here is indicative and are minimum requirements for the basic Air Conditioning System specified here under. Any other items needed to make the system complete, safe and sound in operation will be included under the scope of work by the Contractor at no extra cost to the Employer. The scope of supply will not in any way be less than as indicated below:

- a) 2x 250 TR capacity vapour absorption machines and 1x 250 TR capacity centrifugal compressor type chilling machines for main plant TG building including control rooms & Service building.
- b) Chilled and condenser water pumps and drives. (Three (3) Nos. Back pull out / Split Casing Centrifugal Condenser Water Pump Sets (2W + 1 SB) each complete with all accessories as described here in after, having capacity not less than 270 CMH each.) & Three (3) Nos. Back pull out / Split Casing Centrifugal Chilled Water Pump Sets (2W + 1SB) each complete with all accessories as described here in after, having capacity not less than 210 CMH each.
- c) FRP Cooling towers Three (3) Nos. Fibre glass reinforced plastic (FRP) construction Cooling Towers (2W + 1SB) each 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., having suitable capacity.
- d) Air Handling Units Three (3) Nos (2 no working and 1 no standby) 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, Electrical Equipment Room, Computer Room etc at 17.0 M level of TG Building.
- e) Two (2) Nos (1 no working and 1 no standby) 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 24V DC Charger & DCDB and UPS ACDB etc at 8.5 M & SWAS Room at 0.0 M level of TG Building.
- f) One (1) Nos (1 no working) 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 Ground floor of Service Building.
- g) Two (2) Nos (2 no working each floor) 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 (from first floor to fourth floor) of Service Building.
- h) Fresh air fan units and PAN humidifiers
- i) Motor operated fire dampers

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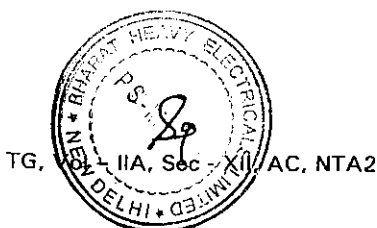
- j) Complete piping, ducting, insulation, valves, fittings, grills, diffusers and accessories.
- k) Strip heaters of adequate capacity for winter and re-heating purpose.
- l) Complete steam piping, De-superheating station, 2X100% Metering pumps, valves etc.
- m) Expansion tank, Condensate storage tank, 2 x 100% condensate pumps, etc.
- n) All instruments, control, interlock will be as detailed in Control & Instrumentation section.
- o) Split / Packaged air conditioners with all accessories for the air conditioning of control rooms of specified buildings.
- p) Supply of complete mandatory spares as specified elsewhere.
- q) Set of commissioning spares as may be required during erection and commissioning.
- r) All steel / cast iron inserts, plates, bolts, nuts, sleeves, metallic-fasteners etc. to be grouted in concrete work and used to hold/ support the equipment/piping / ducting being supplied and erected. Any additional system/ equipment required making the system complete.
- s) Initial charge of all Refrigerants, lubricants and grease, etc up to the completion of trial operation will be provided. Further, all consumables required for PG tests will also be in Contractor's scope of supply.
- t) Grouting, dressing and final finishing of all foundations of various equipment, etc. Repairing and making good/ sealing of cutouts / openings in floors, roofs and walls provided by the Employer or prepared by the Contractor, for executing the works under this package and making them water tight as directed by the Consultant.
- u) Painting for all equipments / items as detailed in relevant clauses of technical specification.
- v) 1x100% Duty fresh air fan with pre-filter & fine filter in all AHU Rooms.
- w) A.C drive motors for all the above equipment
- x) MCC, starter panel, electrics, instrumentation etc.

12.4 Design Criteria

12.4.1 Design Inputs

i. Outdoor Design Conditions:

The outdoor design conditions considered for the site as per ISHRAE Handbook are as follows



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Season	Dry Bulb Temp. (°C)	Wet Bulb Temp. (°C)
Summer	43	25.6
Winter	10	6.1
Monsoon	31.1	26.6

ii. Indoor Design Conditions:

The indoor design conditions are as follows:

Dry bulb temperature : 23°C ± 1°C

Relative humidity : 55 ± 5%.

Sl. No	Premises	Inside dry bulb temp. °C	Relative Humidity %
1.	Unit control rooms including DAS, UPS & relay rooms, SWAS room and other rooms that need air conditioning	23 ± 1°	55 ± 5%
2.	Rooms in service building which include conference room, laboratories and other rooms that need air conditioning	23 ± 1°C	55 ± 5%
3.	Shift In-charge rooms, rooms for senior executives and other office rooms in service building (Area to be Air-Conditioned in service building – approx. 3600 m ²)	23 ± 1°C	55 ± 5%

Air conditioning system will be designed generally as per ASHRAE / ISHRAE Methodology to provide specified environmental condition for equipment and/or personnel during all modes of plant operation and also as specified in this chapter. Filtering, cooling, heating, humidification/dehumidification of the supply air and its distribution as required will be done to maintain the specified condition within the specified limits.

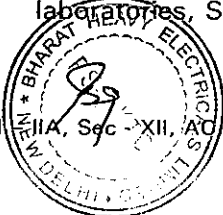
12.4.2 Assumptions

- i. Lighting load has been assumed to be minimum of 2 Watts / Sq. Ft
- ii. Computer load has been assumed as 150 watts per Computer.
- iii. Fresh air changes per hour is taken as 1.5 or 35 m³/hr per person, whichever results in higher air flow would be considered.

12.5 Sizing Criteria

The design methodology is in line with ASHRAE / ISHRAE guidelines and norms. The following input data for lighting heat load, equipment heat load, occupancy as well as resulting capacity will be considered for sizing the system.

The sizing may be considered for Unit control rooms including DAS, UPS & relay rooms, SWAS room, Rooms in service building which include conference room, laboratories, Shift Incharge rooms, rooms for senior executives, other office rooms



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in service building, and other rooms require air conditioning facilities for unit-I and unit-II will be air conditioned by providing chilled water based (vapour absorption and vapour compression type) air conditioning system. Normally vapour absorption type will function and the vapour compression type will be kept as stand by. In case of non availability of steam or during maintenance of vapour absorption type machine, vapour compression type will function.

The following air velocities will be considered for the air conditioning systems. However, standard sizes of equipment and accessories will be adopted satisfying the following limiting conditions.

- | | | | |
|------|----------------------------------|---|--|
| i) | Main ducts | - | 6 – 8 m/sec |
| ii) | Branch duct | - | 4 – 6 m/sec |
| iii) | Supply / Return air grills | - | 2 – 3 m/sec |
| iv) | Louvers for air inlet | - | 1.5m/sec (maximum.) |
| v) | Water velocity in piping | - | shall not exceed 1.5 m/s in suction side & 2.5 m/s in discharge side of the pump |
| vi) | Dry panel filter (Face velocity) | - | 2.5 m/sec (maximum.) |
| vii) | Centrifugal fan at inlet/outlet | - | 8 – 10 m/sec |

12.5.1 Areas to be Air-Conditioned

- a) Main Plant areas such as :
 - Central Control Rooms & Control Equipment Rooms
 - UPS & Battery Charger rooms
 - Shift incharge/engineers room
 - Steam and water analysis system room (SWAS)
- b) Service Building Senior executives rooms, Various Office Areas, conference room, Entrance Lobbies, Reception area etc,

12.6 Air Conditioning System

12.6.1 Centralized Air Conditioning Plant

For 2 units each of 500 MW, it is envisaged to adopt centrally located chilled water system with water cooled condensers Vapor compression system using R134a is also considered.

During initial commissioning of the air conditioning system of the control room, electric chillers will be operated. Once the power plant is commissioned and adequate, continuous supply of steam is available (which is heat input to the VAM chiller), VAM chillers will be put into continuous operation. Electric chillers will be stopped and will be used as standby to VAM chillers.

For the VAM (Vapor Absorption Machine) chiller water is the refrigerant and LiBr (Lithium bromide) is the absorbent. This is basically a heat operated after cooled



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system. This system will be in normal operation after the availability of adequate steam continuously.

12.6.1.1 Vapor Absorption Machine

- i. (2x 250TR) capacity VAM type air conditioning system with LiBr/H₂O as refrigerant using steam as a primary source of power is envisaged for station building main control rooms and service building.
- ii. VAM will be steam fired, packaged, factory assembled and tested and will be complete in all respects. The steam required for the unit will be tapped off from the auxiliary steam header in such a way that even when any of the unit is under shutdown operation of the unit can't be jeopardized. It will comprise of high temperature generator, low temperature generator/condenser assembly, evaporator/absorber assembly with eliminators, regenerative heat exchangers, purge recovery units, absorbent pumps, refrigerant pumps, all interconnecting piping, valves and other accessories, micro processor based control panel/PLC panel, safety & interlocks, required charge of lithium bromide solution and refrigerant for all units, cooling/heating switch valves, structural mounting base for all components etc.
- iii. High Temperature Generator will consist of tubes of Stainless Steel or as per manufacturer's standard and will be supported properly in the shell and complete with required accessories and safety devices. The shell will be fabricated from MS plate as per IS: 2062 and tube sheet coming in contact with steam will be of boiler quality as per IS: 2002 Gr. B/SA-516 and of welded construction.
- iv. Low Temperature Generator cum Condenser will be housed in common welded carbon steel shell with one compartment for generator and the other for condenser with eliminators between the two sections to avoid Lithium bromide carry over, separate tube bundles for each section, required accessories and safety devices etc. The tubes of generator will be as per manufacturer's standard. The tubes of condenser will be cupro-nickel or as per manufacturer's standard.
- v. Evaporator cum Absorber will be complete in all respects with necessary supports and accessories housed in a common fabricated carbon steel shell. The material of construction of evaporator and absorber tubes will be as per manufacturer's standard. Method of construction will be similar to that of the high temperature generator. The assembly will be complete with necessary supports, base and safety provisions.
- vi. Regenerative Heat Exchangers will be designed for maximum heat exchange between the low temperature absorbent from the absorber and the high temperature absorbent released from the generator. There will be one low temperature and one high temperature heat exchangers as well as one for the condensate drain.

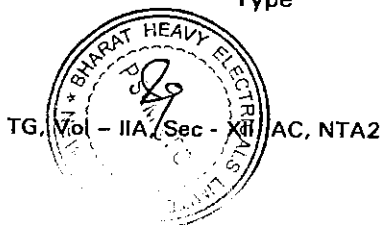


- vii. Purge Recovery Unit will be sized to remove all non-condensable gases by vacuum into the storage provided for this purpose. They should be ejected into the atmosphere by the suitable vacuum pumps (2 x 100% capacity) for each VAM unit. The unit will include all the necessary piping and valves.
- viii. The condensate from the unit will be collected in a condensate storage tank and will be disposed off through pumps (2 x 100% capacity).
- ix. The refrigerant and absorbent pumps will be canned motor type and will be complete with motor of adequate capacity (each of 2 x 100% capacity). The material of construction for shaft and impeller of the pumps will be as per manufacturer's standard. Both the pumps will be complete with isolating valves, to enable on-line maintenance. Circulation fluid will be used as cooling and lubricating medium.
- x. Necessary corrosion inhibitor will be of non-toxic type. Chromate based inhibitors will not be used.
- xi. Necessary interconnection of the vapour absorption units with the vapour compression system will be provided for flexibility of operation.
- xii. The whole unit will be given anticorrosion (both internal and external) treatment and three coats of epoxy painting over a coating of suitable primer.

12.6.1.2 Vapor compression type machines

- i. (1 x 250TR) Capacity (as standby) water cooled chilled water type air conditioning system with centrifugal compressor using R134a refrigerant is envisaged for station building main control rooms and service building.
- ii. Each AC plant will comprise of compressor with drive motor, Condenser, Water Chiller/evaporator, Chilled water pumps, Condenser Cooling Water pumps (if applicable) FRP type cooling towers, other accessories such as supporting structure, vibration isolators, insulation, piping, valves, instrumentation, microprocessor / PLC based Control panel, etc. The screw/centrifugal compressor based chilling unit to be supplied will be ARI /Eurovent/Equivalent standard certified.

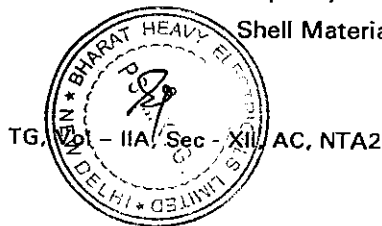
S.No	Type	Water-cooled type
1	Chilling Unit / Condensing unit	
	Vibration isolators	Steel spring/ Neoprene rubber cushy foot/ neoprene serrated rubber pad type with isolation efficiency not less than 85%.
a	Compressor Type	centrifugal



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S.No	Type	Water-cooled type
	Type of drive	Motor driven, through direct/V-belt along with Direct on line (DOL)/Star delta/Double delta Starter
	Capacity	Minimum capacity will be suitable for the identified/selected evaporating temperature and condensing temperature
b	Condenser	
	Type	Water cooled shell and tube type
	Fluid	Shell side – Refrigerant Tube side - Water
	Capacity	To match with respective compressor and to provide atleast 2 deg. C sub-cooling. To store full charge of refrigerant
	Design fouling Factor	Not less than 0.0002 (in MKS units)
	Shell material	Mild steel (IS: 2062)
	Tube material	Replaceable seamless copper
	Fin material	Copper
	Accessories	As required such as Purge and drain connections, relief valves, liquid line shut-off valves, refrigerant filling charging, flow switches, Isolating valves, Pressure & temperature indicators at inlet and outlet etc
	Refrigerant	The refrigerant will be R-134a
	Steel Structure	The complete condensing/ chilling unit will be mounted on steel structure and will be provided with necessary vibration isolators
	Inlet temperature	34°C
	Leaving temperature differential	Max 5°C
c	Evaporator	
	Type	Shell and tube type
	Superheating of	At least 2°C
	Design Fouling Factor	Minimum 0.0001 (MKS units)
	Fluid	Shell side – Water Tube side - Refrigerant
	Capacity	To match with respective plant capacity
	Shell Material	Mild steel (IS : 2062)



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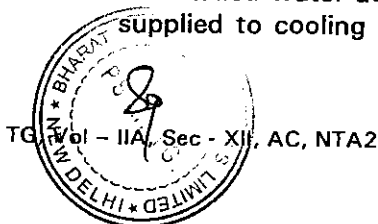
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S.No	Type	Water-cooled type
	Tube Material	Plain tube internally /externally finned copper (for absorption chiller) as per the manufacturer's standard practice
	Fin material	Integral
	Accessories	Purge and drain connections, Isolating valves, flow switches, Pressure & temperature indicators at inlet and outlet, Anti-freeze thermostats, thermostatic expansion valve or float assembly as applicable, pilot solenoid valve, Relief valves, Operating thermostats for capacity control, supporting frame etc
	Steel Structure	The complete condensing/ chilling unit will be mounted on steel structure and will be provided with necessary vibration isolators
2	water cooled type condensing unit	
	Type	water cooled reciprocating / scroll type
	Vibration Isolators	Steel spring/ Neoprene rubber cushy foot type with isolation efficiency not less than 85%.
a	Compressor	
	Type	The Compressor will be centrifugal, serviceable, either open type or semi-hermetic type with load, unload and automatic capacity control (minimum 3 steps).
	Type of drive	Motor driven, direct or through V-belt
	Refrigerant	The refrigerant will be R-134a
	Accessories	High/Low pressure cutouts, oil pressure switches, relief valves, pressure gauges at each stage, lube oil and control oil pressure gauges, suction & discharge stop valves, Muffler, Crank case heaters, oil filters, magnetic oil separators, temperature indicators for lube oil/heaters, oil level indicators, safety thermostat for crank case heater, vibration isolators, etc.
	Motor rating	10% more than the power required by the compressor at 50 deg C design ambient temperature
	Capacity	Minimum capacity will be suitable for the identified/selected at evaporating temperature and condensing temperature and will be indicated

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The chilled water at 6°C from the vapour absorption / VCR chiller units would be supplied to cooling coil located in AHU and the water at 12°C (approx) returned





from cooling coil would be returned to the vapour absorption / VCR chiller units for recirculation in the system. The warm air will be cooled by chilled water in the cooling coil and supplied to the conditioned area. The conditioned air from AHU will be supplied to the air-conditioned area through supply air ducts and diffusers are laid in between ceiling and false ceiling. The warm air from the conditioned area will be collected in between the false ceiling and ceiling. The space between ceiling and false ceiling will act as a return air path. Steam (saturated) required for generator will be supplied by purchaser at the terminal point indicted in the Scope and Terminal Points Chapter .of this Volume. Further piping, valves and other accessories for insulated supply pipe to generator and Insulated return pipe (with instrument like pressure & temp gauge) to recover condensate from VAM outlet nozzle to condenser hot well. will be in Contractor's scope. Electric strip heaters with controls will be provided in the common supply air ducting from AHU's for monsoon reheating or winter heating purposes. Pan type humidifiers will be provided in the AHU room. Fine filter will be provided in the common supply air ducting. The room temperature will be achieved by thermostats sensing the temperature in the return air path. Humidity will be controlled by electric heaters and pan type humidifiers through room humidistat.

Make up water for the air conditioning system to be supplied to the cooling tower sumps and to the expansion tank (Insulated) from service water. 1x100% of fresh air fan with filter units will be located in the each AHU room for the fresh air circulation. Air distribution system comprises ducting, diffuser / grilles, thermal and acoustic insulation for ducting.

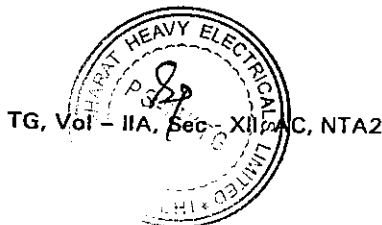
12.6.1.3 Air Handling Unit

Each AHU will consist of casing, fan impeller section, cooling coil section, damper section, steel frame with vibration isolators (minimum efficiency of 85%) for the complete AHU, isolation dampers at the suction and discharge of each AHU will be provided in case return air duct is directly connected to AHU. However, in case AHU room is used for return air, isolation dampers are required to be provided only at AHU discharge of each AHU. Pre-filter at the suction and fine (micro-vee type) and absolute (HEPA type) filters (wherever applicable) at the discharge of each individual AHU, and heater section in the common discharge of AHUs.

The casing of AHUs will be of double skin construction. Double skin sandwich panels (inside and outside) will be fabricated using minimum 0.63 mm (24g) galvanized steel sheet, with 25mm thick polyurethane foam insulation of minimum 38 Kg/Cum density in between. Suitable reinforcements will be provided to give structural strength to prevent any deformation/buckling.

All filter plenum will be provided with a walking platform inside the plenum chamber for filter cleaning purpose. Inspection door will be provided at the plenum chamber and a removable type ladder will be attached to plenum.

Fan impeller Section:



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- Fan impeller type. : Forward/ backward curved blade & centrifugal
- Casing material : GI /Mild steel spray galvanized with minimum thickness of 3 mm.
- Fan bearings : Self aligning type, permanently lubricated, heavy duty with a design life of 10,000 operating hours.
- Critical speed : First critical speed of rotating assembly will be at least 25% above the operating speed.
- Drive : Motor driven with removable belt guard
 - i. Pan humidifier with tank and header in common discharge plenum will be provided. A make up water line with float valve will be provided for Pan humidifier tank.
 - ii. Main control panel, local control panel and local push button station.
 - iii. Insulated Expansion tank.
 - iv. Piping, valves and specialties for chilled water and condenser cooling water systems.
 - v. Thermal insulation for chilled water systems.
 - vi. Drain for each AHU with thermal insulation and necessary drain piping up to the nearest floor.

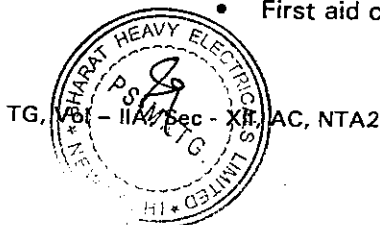
The Centralized Air Conditioning Plant consists of:

1. TG Building

- Central control room
- Electronic equipment room
- Electric relay room
- Engineer room
- Shift in charge room
- Meeting room
- I and C on site lab
- UPS DCDP room for unit 1
- UPS DCDP room for unit 2
- Instrument Panel Room
- Condensate polishing unit (PLC) control room
- Excitation equipment room

2. Service Building

- Office room
- Office cabins
- First aid centre



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- Entrance /Reception/ Waiting Lounge
- UPS room
- Relay testing lab
- C and I lab
- Discussion area
- Electrical room
- Conference room

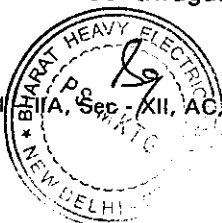
12.6.2 Packaged Air Conditioners

- a) Suitable capacity (2 W + 1S) air-cooled non ductable Split type air conditioning system will be envisaged for areas far away from the TG hall ducting layout. Split / Packaged air conditioners will in general consist of the following:
- i. Casing
 - ii. Compressor
 - iii. Condenser
 - iv. Evaporator and condenser cooling fan
 - v. Cooling coil
 - vi. Filters
 - vii. Piping, valves, refrigerant strainer etc.
 - viii. Controls, instruments, control panel/starter panels.
 - ix. Vibration isolator pads, ducting (if applicable) etc as required
- b) Each water-cooled PAC unit will comprise of refrigerant compressor with motor, water cooled type condenser and cooling coil with air handling fan and associated controls and accessories.
- c) Cooling water for the condensers of PAC units will be supplied from cooling towers located on top of the building, one number of standby package unit with related accessories like cooling water pump and cooling towers will be included; and after heat pick-up, this water will be circulated back to cooling tower by the condenser cooling water pumps for cooling and recirculation. Make up water will be provided by Purchaser at the terminal point indicated in the relevant chapter of this specification.
- d) Cooled and dehumidified air from the PAC units of the respective A/C area will be circulated by means of supply air ducting and diffusers from PAC units to A/c area. This air after heat pickup from the A/c area will be sucked through return air diffusers/grilles located in false ceiling into PAC units by means of air handling fan suction for cooling and recirculation. Fresh air will be supplied through fresh air fan filter arrangement located in PAC plant room.

12.6.3 Balance Equipment Specification

- i. Centrifugal Pumps

TG, Vol



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- a) Type : Horizontal Centrifugal, Axially split type casing pump
 b) Impeller : Closed type
 c) Material of Construction
- Casing : 2% Ni Cast Iron : IS:210 Gr. FG-260
 - Impeller : Bronze IS:318 Gr-2
 - Wearing rings : Bronze
 - Shaft : SS 316
 - Shaft sleeve : SS 316
 - Lantern ring : Brass / Bronze
 - Packing : Asbestos free
 - Base Plate : Carbon steel as per IS:2062
 - Speed : Maximum 1500 rpm

ii. Material of Construction for Piping & Fittings

Piping for Chilled and Condenser water lines : Heavy grade-IS:1239 or Equivalent upto150 NB and IS:3589 or Equivalent for pipes beyond 200 NB

Drain piping : Same as above & galvanized as per IS:4736

Refrigerant piping : Seamless steel tubes conforming heavy grade IS:1239 or copper tubes as per IS:2501 (copper material as per IS:191 hard copper grade)

Fittings

- 1) The steel fittings will conform to ASTM A234 Gr. WPB and dimensional standard to ANSI B 16.9/ANSI B16.11 / equivalent for sizes 65 NB and above.
 - 2) For sizes 50 NB and below, the material will conform to ASTM A-105
 - 3) All steel flanges will be of slip on type and will conform to ANSI B 16.5
 - 4) For pipe sizes above 350 NB, fabricated fittings from sheets of adequate thickness may be used. The bend radius in case of mitre bends will be minimum 1.5 times the nominal pipe diameter and angle between two adjacent sections will not be more than 22.5 deg and will be as per
 - 5) BS:2633/BS:534.
 - 6) Fittings, flanges and pipe joints of refrigerant piping will conform to ANSIB31.5
- 1) Seamless Carbon steel pipe conforming to ASTM-106 Gr B will be used. Steam pipe line will be provided with necessary steam traps, vents and

Steam piping / spray piping / fitting



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drain connections.

- 2) All pipe fittings will be seamless construction (forged) as per ASTM A 105.
- 3) Necessary hangers, supports and auxiliary structures for pipe supports will also be provided by the Contractor.
- 4) It is the sole responsibility of the Contractor to obtain clearance from IBR for the design, manufacture, erection and testing of pipes, valves, fittings, specialties etc. In order to obtain the above approvals, all necessary documentation etc. required to be furnished/arranged will be done by the Contractor.
- 5) In order to take care of thermal movement, due to the temperature of the fluid being handled, loops in vertical or horizontal plane may be provided to make the system flexible. However, in no case a U-type should be provided in the vertical plane. Further, the supporting system on this line should be such that it does not arrest the free movement of the pipe

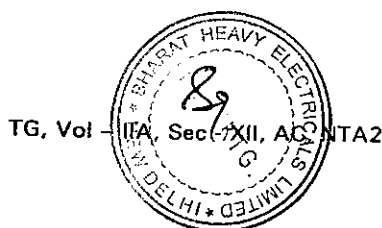
iii. Valves

- Valves will have full sizes port and suitable for horizontal and as well as vertical installation. Valves for regulating duty will be of globe type suitable for controlling throughout its lift.
- Gate, Globe and stop check valves will have bonnet back seat to facilitate easy replacement of packing with the valves in service.
- All safety /relief valves will be so constructed that the failure of any part does not obstruct the free discharge.
- Manual gear operators be provided for valves of size 250 NB and above.
- All valves with rising stem will have position indicators. All valves will be provided with locking arrangement.
- All water line valves will be of Cast Iron body for sizes 65 NB and above conforming to IS: 14846 and Gun Metal construction for sizes less than 65NB conforming to IS:778. Cast Iron parts will conform to IS:210 Gr. FG 220. However, butterfly valves will confirm to latest revision of BS:5155 or equivalent standard of required class/rating.

iv. Air Filters

Pre Filter

a) Fabric Type



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Filter medium will be suitable fibrous material (e.g. choir, extruded sections of polyethylene, etc.) packaged into a frame of galvanized sheet steel of 20 gauge thickness. Filter element will be felt filter fabric of suitable material recommended by the manufacturer.

The filter will be capable of being cleaned of the accumulated dust by tap water flushing. V-fold galvanized wire mesh interspaced with a flat layer of galvanized wire mesh for Metallic type pre-filters.

b) Metallic Panel Type

Filter medium, aluminium alloy will be supported on galvanized expanded metal casing. Frame will be fabricated from aluminium alloy of minimum 16 gauge thickness conforming to IS:737 or 18 gauge.

c) Efficiency

Average arresance of 65 - 80 % when tested in accordance with BS: 6540/ASHRAE - 52 - 76.

d) Minimum thickness : 50 mm

e) Face Velocity : Not more than 2.5 m/sec.

f) Pressure drop at rated flow : Initial pressure drop Less than 5 mmwc
: Final pressure drop Upto 7.5 mmwc

Fine Filters (Microvee type)

Construction By pleating a continuous sheet of filter medium into closely spaced plates separated by heavy corrugated aluminium spacers.

Frame Aluminium alloy of (minimum 16 gauge conforming to IS:737) with handles.

Other requirements a) A neoprene sponge rubber sealing will be provided on either face of the filter frame.

b) Capable of being cleaned by air or water flushing

Efficiency Average arresance of 80-90% when tested in accordance with BS:6540/ASHRAE-52-76.

Minimum thickness 150 mm or 300 mm.

Face Velocity Not more than 1.2 m/sec for 150 mm and not more than 2.4 m/sec. for 300 mm.

Pressure drop Initial pressure drop - Not to exceed 10 mm WC at rated flow ; Final pressure drop-Up to 25 mm WC

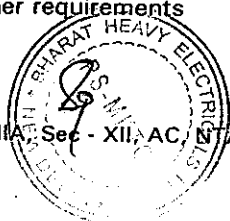
Location i) At the discharge of each individual AHU.
ii) At the discharge of each Fresh air

Absolute Filter / Hepa Filter

Media 100% sub-microscopic glass fibers

Frame Aluminium alloy of (minimum 16 gauge conforming to IS: 737) with handles

Other requirements A neoprene sponge rubber sealing will be provided on either face of



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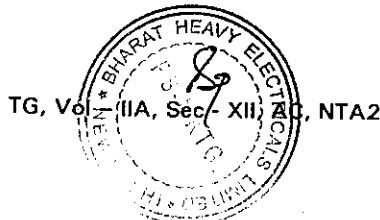
	the filter frame
Efficiency	99.97 % down to 0.3 micron when tested in accordance with BS: 3928 (Sodium flame test)/FED-209B.
Minimum thickness	300 mm
Face Velocity	Not more than 1.2 m/sec.
Pressure drop	Initial pressure drop - Not to exceed 25 mm WC at rated flow Final pressure drop – Up to 75 mm WC.
Location	At the discharge of each individual AHUs feeding to Common control room, control equipment rooms, battery charger rooms and SWAS room of main plant building.

v. Duct Fabrication and Supports

Duct fabrication will be as per the latest relevant BIS standard.

- The ducts with larger side greater than 2250 mm will be supported by 15mm MS rods and 50x50x3mm MS double Angles while those below 2250 mm will be supported by 10mm MS Rods and 40x40x3 MS angles. The duct supports will be at a distance of not more than 1200 mm. The MS rods will be hung from building steel wherever available, with provision of necessary auxiliary or special steel members or by hooks or by dash fasteners fixed to the ceiling slab. All items of duct support including MS rods, MS angles and double angles, auxiliary or special steel members, hooks, dash fasteners coach screws and all other supporting material required will be provided by Contractor.
- Where ever ducts are running outside the building and or at locations where it is not possible to support the ducts from Employers ceiling/floor due to non-availability of the same, the base steel frame/truss work for supporting the ducts between two columns will also be provided by the contractor including all auxiliary steel members, hooks, rods etc for supporting the duct work with the base frame/truss
- Where the sheet metal duct connects to the intake or discharge of fan units a flexible connection of at least 150 mm width will be provided of closely woven, rubber impregnated double layer asbestos/canvas or neoprene coated fibre glass.
- All curves, bends, off-sets and other transformations will be made for easy and noiseless flow of air. The throat of every branch duct will be sized to have the same velocity as in the main duct to which the branch duct is connected.
- Wherever duct passes through a wall, the opening between masonry and duct work will be neatly caulked or sealed to prevent movement of air from one space to the adjoining space.
- Wherever pipe hangers or rods pass through the ducts, light and streamline easement around the same will be provided to maintain smooth flow of air.

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- Access doors will be provided in the duct work or casing on the both sides of the equipment to be serviced. All access doors will be of adequate size and will be lined with substantial felt edging to prevent air leakage. Access doors will be of built up construction, structurally strong and each will have at least two hinges. Access doors will have two rust proof windows ash of approved type. All doors will be set so as to flush with insulation or plaster finish on the duct.
- vi. Splitters and dampers will be provided for equipment/area isolation and for proportional volume control of system. The same will be minimum 16 gauge GS sheet of quadrant type with suitable locking device, mounted outside of duct in accessible position.
- vii. Diffusers, Grills & Dampers
Supply air diffusers/grills with volume control dampers be provided for all air conditioned areas.
- Return air diffusers of air conditioned areas will be without volume control dampers.
 - The diffusers/grills will be of extruded Aluminium of minimum 1.2 mm thick with powder coating.
 - Supply air grills will be of double deflection type and return air grills will be of single deflection type.
 - All volume control (VC) damper will be operated by a key from the front of the grills/diffusers and will be of GI sheet.
 - The thickness of VC dampers will be of minimum 20 gauge and thickness of louvers will be of minimum 22 gauge.
 - Suitable vanes will be provided in the duct collar to have uniform and proper air distribution. Bank of Baffles wherever required will also be provided.
 - Fire dampers will be motor operated type and will have fire rating of minimum 90 minutes.
 - All plenum chambers of connections to fans, dampers etc will be constructed in 18 gauge GS sheet and supported on MS angle frames
 - All ducting surfaces coming in contact with corrosive fumes or gases will be painted with three coats of epoxy paint over a coat of suitable primer.
- viii. Air Distribution For Air Conditioning System
- 1 Rectangular Duct: GSS supply air ducting and return air ducting with Zinc coating 200 gms /sq.m or better.
 - 2 The supply air ducting to be designed based on equal friction method to have an initial velocity not exceeding 7.5 m/s and friction rate 0.8 Pa/m.
 - 3 The return air ducting to be designed based on equal friction method to have an initial velocity not exceeding 7.5 m/s and friction rate 0.66 Pa/m.



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- 4 Duct aspect ratio for rectangular ducts. Not exceeding 1:4.
- 5 Maximum neck velocity for supply air diffusers will be 2.0 m/s.
- 6 Maximum neck velocity for return air diffusers will be 1.5 m/s.
- 7 Maximum face velocity for supply air grills will be 2.0m/s.
- 8 Maximum neck velocity for return air / exhaust grilles will be 1.5 m/s.
- 9 Maximum airflow velocity across flat type pre filters (90% efficiency down to 20 microns) will be 1.75 m/s.
- 10 Maximum velocity across louvers will be 2.0 m/s.
- 11 Fusible link type fire dampers (de energized to close) to be provided in the supply air duct, return air ducts, all wall and floor crossings to isolate the area in the event of fire. The space around the ducts and pipes to be sealed with fire retardant material.
- 12 Volume control dampers will be provided in all branch ducts and in the main ducts from AHU/PAC to throttle the air volume.

ix. Cooling Tower

Three numbers induced draft cooling towers (2 working + 1 standby) with accessories are to be provided for the plant. The capacity of the cooling towers will be designed for the requirements of the Vapour Absorption System or vapour compression system which ever is higher.

Cooling tower will be designed, manufactured and performance tested as per CTI codes.

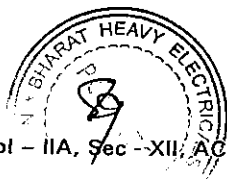
The capacity of all the cooling tower will be adequate to take care of the cooling water requirements for the vapour absorption or vapour compression system which ever is higher for air conditioning system.

Inside fills will be of PVC.

Eliminators will be provided in removable sections and installed in the cell of the tower. The number of deflections in the eliminators will be so arranged as to limit the drift loss to 0.01% of the circulated water.

Cooling tower basin will have accessories and connections for make up, quick fill, drain screens and over flow. Float valve and limit switch interlocked with solenoid valves will be provided in the make up water

The water distribution system will be either open basin with gravity feed nozzles or pipe system with nozzles requiring not more than 0.42 kg/sq.cm. water pressure at rated capacity. The nozzles will be spaced to give even distribution of water. The system will be self-draining, non-clogging and designed for flexible operation and ready accessibility. Suitable measuring



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orifices will be provided. All main piping connections will be brought out and will end in flanges to facilitate connections.

All the fasteners will be of stainless steel. Rubber/Neoprene gaskets must be used on all bolted joints as a seal against water leakage.

The cooling tower will be provided with fan (FRP blade), drive motor, etc. Motor will be of weather proof construction. Fan speed will be limited to 750 rpm.

Nozzles for cooling tower will be of brass/gunmetal/ stainless steel

Make up Water Tank

Make up water tanks will be provided for cooling tower of air conditioning systems. Tanks will be MS & inner surface spray galvanised. Make up water line with float valve & backup ball valve, quick fill line with ball valve, drain line with ball valve, over flow & vent line, level gauge will be provided. Low level switch will be provided at make up water tank & interlocked with condenser water pump.

x. Insulation

i) Acoustic insulation

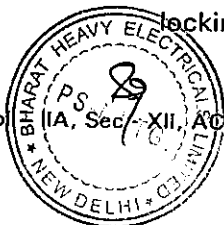
Acoustic insulation will be provided in the supply air duct up to 3m from AHUs.

For applying acoustic insulation inside duct hot bitumen/ cold adhesive will be provided at the clean inside surface of duct. Then 25mm thick mineral wool will be provided. To hold the insulation 30 SWG perforated aluminium sheet will be provided and riveted with duct. Perforation will be of 5mm and 8 to 10mm centre to centre distance.

ii) Thermal insulation

Thermal insulation will be provided on a portion of supply air duct outside the conditioned premises, pan humidifier, chilled water piping, drain pipes connected with insulated equipment etc. Thermal insulation of tail end duct will be provided to avoid condensation of moisture on the outside surface of the duct. The return air duct outside conditioned premises will also be insulated.

For applying thermal insulation, the outside surface of the duct/ pipe will be cleaned first and then hot bitumen/ cold adhesive should be applied on the clean surface. Then 50mm thick insulation material (mineral wool mat) with wire netting on outside will be provided. Then polythene with 50mm overlap will be sealed with adhesive. The polythene will be covered with 26 SWG aluminium sheet. All joints will be locked with self locking screw at a pitch of max. 100mm



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iii) Chilled Water Pipe Insulation

Method of application of insulation

- Pipe line will be cleaned and bitumen/cold adhesive compound will be applied.
- Fire proof PUF half pipe section insulation material 30mm thick of 48 kg/m³ density with 26G Aluminium cladding for indoor piping will be provided. For outdoor piping sand cement (4:1) plaster in two layers totalling 15mm in thickness will be provided over the insulation sections by reinforcing with 22G GI wire netting. A water proofing compound will be added to the cement before it is applied. Finally the cemented surface will be painted with two coats of cement based paint of white colour.

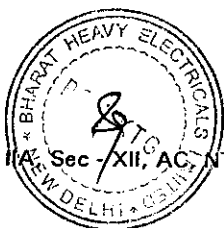
No combustible material, lining etc. will be used anywhere in the entire chilled water system

Insulating materials required to be incorporated in the works for insulation of pipes and equipment etc. will be of non combustible, self extinguishing type.. The Contractor will produce test certificate in support of this requirement. No obnoxious gases will emit from the insulation in case the insulation accidentally catches fire.

iv) Insulation Thickness

Following will be the minimum thickness for various equipments and pipelines.

- | | |
|---|---|
| 1. Refrigerant line | 75 mm thick |
| 2. Chiller | 75 mm thick (in two layers) |
| 3. Expansion tank | 50 mm thick |
| 4. Chilled water circulating pumps | 50 mm thick |
| 5. Chilled water piping | 50 mm thick minimum, polystyrene polyurethane foam, Phenolic foam |
| 6. Inside surface of AHU & Cooling Coil Section | 25 mm thick |
| 7. Supply air duct | Aluminium foil backed 50 mm thick rigid Polyurethane foam / Phenolic foam |



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8. Acoustic insulation (Up to 50 mm thick fibre glass rigid board 6 m from AHU mouth)
9. Acoustic insulation for 150 mm thick RB glass wool, Computer rooms and perforated GI channel, expanded metal netting and perforated aluminium sheet of 30 G thick. A gap of 25 mm will be given between wall and insulation material.

12.7 Layout Requirements

While designing the layout of the equipment and system, the following points will be covered / considered :

- Co-ordinates and location of the building.
- Equipment layout with description
- Piping layout.
- Maintenance access and neatness of layout.
- Interference
- Equipment handling and removal facility
- Cable trenches and conduits
- Battery limit with elevation of utility services
- location of MCC, IPBS, DB etc.
- Floor drain
- Floor wise ducting layout.

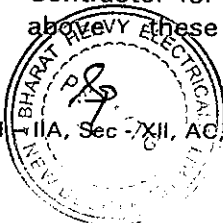
12.8 Maintenance Requirements

While designing the equipment and systems, the following maintenance aspects will be taken into consideration.

- Sufficient space for maintenance in the layout.
- Access to the equipment.
- Inspection and maintenance doors for equipment.
- Provision of chain pulley blocks with monorail for the equipment.

12.9 Data, Drawings And Information To Be Submitted After Award Of Contract

A broad description of drawings / documents / data to be submitted by the Contractor for purchaser's / consultant's approval are outlined hereunder. Over & above these drawings/documents/data, Contractor will submit other



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drawings/documents which in purchaser's/consultant's opinion may require approval.

General arrangement drawings of all the equipment indicating overall dimensions, complete technical parameters with all accessories and bill of materials and materials specification

-Foundation drawings of all the equipment indicating total weight of the equipment, load data, section view of the foundation, pocket sizes, foundation bolts and insert details.

Equipment / layout drawings with sections

Schematic drawings of all the systems indicating different supply points quantities of air supplied, capacity and total pressure of system etc. Schematic flow diagram / drawing for each system, showing ducting, piping, fittings, valves, interlocking arrangement etc. as applicable.

Cross sectional drawings of Fans, pumps, chillers, heat exchangers along with parts list for ordering of O&M spares.

Detailed engineering calculation for selection of different equipment & pressure balance calculation etc.

Hydraulic flow diagram (for water system) with pressure drop calculations.

Process, instrumentation and control diagram including interlocks.

Complete piping layout drawing, showing overall dimensions of individual units, piping network, valves etc.

Performance data & characteristic curves for different fans, pumps and other equipment etc.

A brief write-up on the control an interlocking schemes of each system.

-List of bought out items along with their make, catalogue & literature.

Duly filled in data sheet for different equipment / items.

Operation, maintenance and service manuals.

The following documents will be submitted during inspection / despatch of equipment.

- a) Manufacturer's test certificates for all equipment.
- b) Type and test certificates and performance record at works for compressors, fans, pumps, motors, filters etc.

12.10 Inspection And Testing

- a) Inspection and testing at the manufacturer's works/premises in general has been described in general condition of contract.





However, for this technical specification, following guideline will also be followed.

- b) All equipment will be tested as per relevant Indian Standards. List of all tools and test procedures proposed by manufacturer will be submitted to purchaser for prior approval.

12.11 Guarantee

The Contractor will guarantee the performance of ventilation and air conditioning systems on the following accounts:

- No undue vibration of the equipment
- Smooth running of the rotating parts of all machines. The equipment will be statically & dynamically balanced.
- No over heating of bearings.
- No leakage in the ducting / piping system and equipment.
- Ensuring specified parameters of various equipment.
- Any other relevant test parameters found necessary.
- Designed air flow at various points of system.
- Ensuring specified inside design conditions.

12.12 Performance Test

After erection of equipment with all necessary allied work ventilation and air conditioning systems will be commissioned. The systems will be set at required conditions.

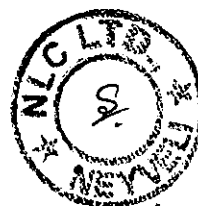
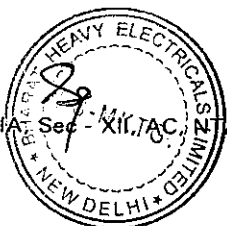
The Contractor will submit the procedure of testing and assuring the compliance with technical parameters. Performance test will be carried out to prove the following guaranteed parameters.

AIR CONDITIONING SYSTEM

Sl. No.	Parameter	Guaranteed figures
1	Air conditioned premises	Temp : 23 ± 1°C RH : 55 ± 5%

12.13 Painting Scheme

Painting of the equipments/components of this system will be as per chapter on painting of this volume




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VOLUME - II A
SECTION - XII
AC & VENTILATION SYSTEM

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12.1 General

Ventilation and air conditioning facilities will be provided for the various plant premises to ensure proper working environment both for men and machine and to maintain necessary environmental conditions for proper storage of plant, equipment and materials.

This specification will be read in conjunction with other parts / volumes (Vol. I, , II, , III, IV, V, VI & VII of the NTA1-SG portion) of the specification where other related project requirements have been given.

The intent of specification is to cover provision of ventilation and air conditioning facilities including all accessories for steam generator package on turnkey basis for 2 x 500 MW power plant at Neyveli Tamilnadu, India, as per the detailed scope of work described in clause 12.3.

12.2 Codes & Standards

All equipment, systems and works covered under this specification will comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed and the following publications, norms / guidelines, standards, acts and rules.

- Publications of Bureau of Indian Standards (BIS).
- American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE).
- American Conference of Governmental Industrial Hygienists (ACGIH) publications, U.S.A.
- American Refrigeration Industries (ARI).
- Publications of International Standards Organisation (ISO).
- VDI stipulation for vibration level.
- Handbook of Air Conditioning System Design by 'Carrier Air Conditioning Company'

The following codes & standard will be followed:

- IS: 226 Specification for structural steel (standard quality)
- IS: 655 Specification for metal air duct.
- IS : 277 Specification for galvanised steel sheets
- SMACNA Sheet Metal and Air Conditioning Contractors National Association

The list furnished for standards and norms may not cover certain aspects or products. In such cases, where norms / standards / guidelines other than those listed above are followed, the contractor will furnish a copy of such document (s) in support for the purchaser's perusal and acceptance of this project. Whenever a contradiction is found between the different documents being followed the decision of the purchaser will be final and binding.





Metric system of units will be followed in design, manufacture and supply of all units. Name plates of equipment as well as operating / maintenance instructions will be in English language.

Noise level generated by the equipment supplied will not exceed the permissible limit of 65 dB (A) within the air conditioned served premises. In the air conditioning and ventilation plant room maximum allowable noise level will be 85 dB (A) at a distance of 1m from equipment.

The Contractor will also provide air conditioning and ventilation facilities to any other areas / technological system if envisaged besides those mentioned in this specification by the Contractor this stage or during detail engineering.

The air conditioning and ventilation equipment will be heavy duty type suitable for continuous operation under industrial duty conditions throughout the year.

12.3 Detailed Scope of Work

The scope of work covers the complete equipment / system design, engineering, manufacture / procurement, assembly, shop testing, shop painting, packing, transportation to site, unloading & storage at site, erection, supervision, site painting, testing, commissioning and conducting performance guarantee tests of all the ventilation & air conditioning systems including ducting, piping, dampers, valves, insulation, supports, measuring & control instruments etc.

The service facilities like civil, structural, electrics, illumination, instrumentation, water supply & drainage and handling & hoisting facilities needed for the ventilation and air conditioning systems will be included in the Contractor's scope of work.

Providing first charge of consumables like oil, grease, refrigerant etc. as required till successful completion of trial operation. The quantity and specification of such consumables will be indicated.

Supply of commissioning spares as may be required during erection, start up and initial operation of all the units / systems till successful completion of commissioning. The price for the commissioning spares will be deemed to be included in the contract price for the system.

Supply of tools & tackles required for maintenance of air conditioning and ventilation systems.

12.4 Performance Requirement

All equipment will be designed / selected such that the duty requirements as indicated in this specification can be maintained.





- Branch duct (Ventilation) - 6 – 8 m/sec
- Branch duct (air conditioning) - 4 – 6 m/sec
- Air supply grills - 3 – 4 m/sec
- Return air grills - 2 – 3 m/sec
- Centrifugal fan at inlet/outlet - 8 – 10 m/sec
- Water velocity in piping - 1.5m/sec. (max.)

Air conditioning and ventilation equipment will be located in a separate plant rooms. The plant rooms will be provided with separate approach, fire fighting and handling & hoisting facilities by the Contractor. The equipment will have at least 10% reserve capacity. Design calculations will be submitted for selection of system capacity as well as equipment selection. Air conditioning and ventilation systems will be designed considering the fire safety norms and will be interlocked with the fire detection system of the plant.

Central air conditioning system with chilled water based (vapor compression type) will be provided for ESP control rooms which also houses variable frequency drive panels of ID fans, Shift in charge rooms and other rooms require air conditioning facilities. Under deck insulation will be provided for all exposed roofs in the air-conditioned premises.

Chilled water expansion cum make up tank of adequate capacity will be provided at the highest point in the chilled water circuit. The tank will be complete with all accessories like float valve, limit switch with level indicator quick fill, drain, over flow etc. The tank will be thermally insulated.

Window type room air conditioner / Split type air conditioner will be used for air conditioning of the rooms for CEMS, thyristor room (if applicable) for lignite feeder drives and other small rooms located in far away from chilled water plant.

MCC / switch gear room, electrical room, cable gallery and other rooms require fresh air ventilation will be provided with fresh filtered air supply system. The rooms will be pressurized to 2 – 3 mmWC to prevent dust ingress by providing wall mounted gravity dampers.

Fuel oil pump house, air compressor room, bunker bay building, elevator machine rooms, AC plant rooms, chemical feed station, stores, toilet and other rooms generating fumes / heat will be provided with pressurized ventilation exhaust ventilation by installing wall mounted axial flow fan.

12.7 Type and Rating Of Equipment

Equipment Selection Criteria

12.7.1 Air conditioning systems

Air conditioning systems for ESP control room buildings of steam generation unit-I and unit-II will be provided. Common AC plant (if applicable) for ESP control rooms of unit 1 & 2 with 2 nos. screw chillers (1 W + 1 SB). Common AC plant



will be located in ESP building of Unit - 1. The contractor will do the design calculation of their own and furnish to the Owner/Consultant for approval for finalization of the system.

Chilled Water Plant for Air Conditioning System

The chilled water plant (for each ESP control room building) will include Common AC plant for ESP control room unit 1 & 2 with:

- a) 2 nos. screw chillers (1 W + 1 SB)
- b) Chilled water pumps, 2 Nos. (1W + 1R)
- c) Condenser water pumps, 2 Nos. (1W + 1R)
- d) AHUs with accessories, 3 Nos (2W + 1R)
- e) Fan coil units for shift in charge room, quantity as per requirement.
- f) Cooling tower with accessories - 2 Nos (1W + 1S).
- g) Chilled water and condenser water piping with valves, pressure gauge, strainer etc.
- h) Flow components in pipe lines
- i) Thermal insulation of chilled water pipelines.
- j) Humidity control arrangement with strip heater and pan humidifier
- k) Refrigerant piping, valves and fittings
- l) Ducting network with damper, supply air diffuser, return air grills, acoustic and thermal insulation.
- m) Make up air filter with damper in different AHU rooms.
- n) Insulated expansion tank. Tank will be located at the top most location of the entire chilled water piping network.
- o) MCC, starter panel, electrics, instrumentation & controls etc.

Vapor compression machine with screw chiller will be chosen not only to ensure chilled water supply but also to perform efficiently at lower loads and at lower condenser water inlet temperature (particularly during winter season). If needed condenser water temperature control will be provided.

In general effort will be made for connecting the return air path from the control rooms in the gap between the roof and false ceiling and led back to the AHUs. Necessary duct line thermal and acoustic insulation will be provided as required.

Contractor will furnish the capacity range & inlet condenser water temperature range for their machines.

The Vapor compression machine with screw chiller and all pump sets will be installed in the AC plant room and various AHUs in AHU rooms to be located near / adjacent to the served premises.





Central emission monitoring system room (CEMS) & small rooms far away from chilled water plant will be air conditioned by providing suitable Split / window type air conditioner.

The cooling capacity of air conditioning system will be decided on the basis of heat dissipated in the premises, building heat radiation, illumination heat, occupancy heat, make up air heat etc. in the premises. Fresh air quantity will be based on 1.5 air changes / hour. The system will have at least 10% reserve capacity.

The air conditioning system will be provided with heating coil & humidifier for winter heating & humidity control.

12.7.2 Ventilation systems

Unitary Air Filtration (UAF) Unit for SG area (If applicable)

Ventilation system for SG area (i.e MCC/Switch gear rooms, electrical rooms, cable gallery and other rooms need supply air ventilation system inside ESP control room building) with unitary air filtration type air washer system will be provided. Saturation efficiency will be 70 % minimum.

Each UAF will consist 1x100% Centrifugal fan, 2x100% centrifugal circulating water pumps, air intake louvers, filters, evaporative cooling spray nozzles (Brass/gun metal), UAF internals, ducting & piping network and other accessories. Cable galleries will be provided with miltilouvred gravity dampers to have positive pressure and also prevent dust nuisance. With this system the dry bulb temperature within the building will be maintained at a temperature not exceeding ambient temperature. The UAF capacity is to be decided based on:

Total internal heat load within the building, inclusive of electrical bay and maintenance bay and considering the heat dissipated by various electrical switchgear, equipment hot surfaces, steam piping as well as the dissipated heat, solar transmission through the building wall and glass, and any other sources of heat.

- Air change per hour (ACPH) as per design basis requirement
- Saturation Efficiency of air-washer will be 70% with spray system.

12.7.3 UAF for SG Area Building- Design and constructional details

- i) UAF unit complete with air louver, single bank spray header with Polypropylene nozzles spraying water on flooded type water repellent filters, moisture eliminator, inspection window, marine light, maintenance cutaway etc. Saturation efficiency of UAF unit will not be less than 70%.
- ii) Centrifugal pumps (one running & one stand by) complete with drive motors and accessories such as suction screen, pot strainer with bypass line valves, bends and fittings, inlet / outlet pressure gauge with isolating cock, complete make-up water plumbing with float valve, quick fill connection internal fitting



and supports, drain piping with valve, over flow connection, discharge piping etc will be provided.

- iii) Piping for feed and make up water and also GI ducting grilles with volume control damper for UAF units will also be included.
- iv) The sheet thickness for air washer tank will be 6mm and for the body of the air washer will be 5 mm. The casing and tank will be made of mild steel plate IS-2062 with epoxy protective paints inside and outside for corrosion protection. The distributor will be made of galvanised sheet steel and eliminators will be made of PVC.
- v) The face velocity of air washer chamber will not be more than 2.5 m/sec.

12.7.4 Water Flooded Filter

- i). The filter media will be of cleanable metallic type with efficiency 90% down to particle size of 10 microns when flooded with water.
- ii). The filter media will be firmly secured on frame of rust proof material.

12.7.5 Moisture Eliminator Sets

- i). Moisture eliminator sets used for the unitary air filtration units will be vertical and minimum 3 break type of PVC.
- ii). Face velocity of air for the eliminator sets will not exceed 2.5 m/sec, Saturation efficiency of UAF ventilation system will not be less than 70 % for SG Area.

12.7.6 Design and Construction Details of Air Conditioning Systems

The equipment will be normally as per general specification of the project. However, brief description of main equipment is given below:

12.7.7 Vapor compression based Chiller

- i) The packaged chilled water unit will be completely factory assembled and designed for continuous duty. Each package chiller unit will essentially comprise of rotary twin screw compressor, shell & tube type water chiller, refrigerant circuit, water cooled condenser, electric drives, instruments and controls and other standard accessories assembled in steel cabinet. The compressor will be semi-hermetically mounted on anti-vibration pads & dynamically balanced. Each chiller will have multiple screw compressors with independent refrigerant circuit.
- ii) The chiller will be supplied with full operating charge of refrigerant R-134a & lubricating oil. Chiller performance will be ARI certified as per ARI standard 550. Cooler (evaporator) will be dry expansion type.
- iii) Condenser will be shell & tube type construction dual refrigerant circuit water-cooled type. Unit will be equipped with suitable integral finned type, solid drawn, seamless copper tubes. The tubes will have internal turbulator. Fins will be made of Aluminium. Condenser shell will be constructed and tested in



- x) Minimum superheat of 3o C under design condition will be considered while selecting the chillers.

Following controls and safety devices / accessories will be incorporated in the chillers.

- Cooling and Anti freeze thermostat
- Flanged water inlet and outlet connection with flanges and shut off valves, including industrial type thermometer.
- Relief valve, purge valve, drain valve
- Pressure and temperature gauges at the water inlet and outlet.
- Refrigerant charging connection in the valve
- Flow meter and switches on the water line.
- View port

12.7.8 Split type Air-Conditioner

Split air conditioning unit will mainly comprise of two sections, viz. Indoor and Outdoor section. Indoor section comprises of cooling coil, fan, filter and supply air grills. Outdoor section comprises of air cooled condenser, blower, hermetically sealed compressor. Sealed refrigerant piping interconnects the indoor and outdoor sections. Outdoor unit will be installed in open space for easy heat dissipation from condenser. Indoor section will be high ceiling suspended or wall mounted type as per requirement. Remote control unit, thermostat and other standard accessories for successful installation of split type air conditioner will be included in the scope of Contractor. Any additional services required will be included in line with requirement. Split air conditioner unit will conform to IS:1391-1992 Part II.

12.7.9 Window Air-Conditioner

Window type air conditioner will comprise of hermetically sealed compressor, air cooled condenser, refrigerant piping, fan, instruments and controls, supply air grills with direction deflectors etc. enclosed in an insulated steel cabinet. Provision will be made in the front panel of the unit for controlling room ventilation and fresh air supply. Air filter installed will be of HDPE easily cleanable type. The front panel will be suiting to the interior décor of the room.

12.7.10 Air Handling Unit

- i) The Air handling unit (AHU) will comprise of the following sections. The AHU will be provided with suitable control, instrumentation and accessories including switch fuse unit.
- (a). Filter section
 - (b). Coil section
 - (c). Damper section
 - (d). Blower section



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- (e). Heater section
- ii) Air handling unit will be made of GI sheet and rigid angle iron frame. Removable panels with double skin and sand witted insulation will be provided to make internal parts easily accessible for service and inspection, polyurethane foam (puf) insulation will be provided to prevent heat transfer to colder sections.
 - iii) Filter section should comprise of two filter banks, one, for pre-filtration and other for fine filtration.
 - iv) Velocity of air will not exceed 2.5 m/sec for pre filter and 1.5 m/sec for fine filter. Fine filter elements will be of superior compressed fill with adequate wool quantity.
 - v) Recommended pressure drop across filters when they are completely loaded is 12 mm WC.
 - vi) Filter framework will have lifting handles and locking metal wedges. Filter frame will be fabricated from MS sheet of suitable thickness in welded construction. All leakage areas should be sealed with suitable sealing compound.
 - vii) Cleaning efficiency of pre and fine filter will be according to manufacturer standard practice. Filter panels will be cleanable and reusable type.
 - viii) Coil section will have cooling coil manufactured from solid drawn copper tube with mechanically bonded aluminium fins. Face velocity of coil will not exceed 2.5m /sec. and pressure drop across the coil will be as minimum as possible.
 - ix) Damper section will be face and bypass damper. Damper should be suitable for automatic operation actuated by modutrol motor and modulating thermostat. Damper should have proportioning louvers so arranged that when face damper closes, bypass damper opens. No external bypass of air is acceptable
 - x) Manual dampers at the outlet of all the AHUs of air conditioning system will be provided.
 - xi) Centrifugal fan will be limit load characteristics.
 - xii) Impeller and shaft assembly of fan will be statically and dynamically balanced.
 - xiii) Centrifugal fan will conform to IS: 4894. Fan and motor assembly will be mounted on a common vibration proof base frame and the assembly will be provided with vibration arrestors, at the commissioning stage the vibration amplitudes will be measured to ensure that the vibrations are within the permissible limit.
 - xiv) Critical speed of the fan will be minimum 125% of the operating speed.
 - xv) Fan outlet will be fitted with canvass connections to isolate the vibration and outlet damper for the control of capacity.
 - xvi) Fan for AHUs will be provided taking care of pressure drop in the prefilter, fine filter, ducting losses in coil and other losses if any.





- xvii) For fresh air requirement to AHU of ESP cum VFD Control room and for other areas, fresh air arrangement comprising of sheet metal fresh air duct will be provided with goose neck connection at intakes so as to serve as rain protection cover and bird guard. Filter element to match duct size and louvered damper complete with operation linkage to suit manual operation is to be provided. Fresh air filter element will be similar to that specified for prefilter earlier in the specification.
- xviii) Heater section will consist of bank of electrically operated strip heaters to provide monsoon reheating as required and also winter heating for total air quantity to maintain specified inside design conditions. Selection of strip heater should be such that face velocity across heater is maintained at 2 to 3 m/sec. Heater bank frame should be electrically insulated for human safety. Heater will be flame proof/spark proof/tubular construction. Heater will be interlocked with AHU fan.

12.7.11 Cooling Tower

Induced draft type FRP cooling towers (1W + 1S) will be provided for the cooling of condenser water for chilled water air conditioning system. The cooling tower will be provided with fan & motor. The motor of fan will be of weather proof construction.

Cooling tower will be designed, manufactured and performance tested as per CTI codes. The capacity of the cooling tower will be adequate to take care of the cooling water requirement for the chilled water air conditioning system. The cooling tower will be mounted on RCC pillars near the air conditioning plant room. Inside fills will be of PVC.

Cooling tower basin will have accessories and connections for makeup, quick fill, drain screens and over flow. Float valve and limit switch interlocked with solenoid valves will be provided in the makeup water. The water distribution system will be either open basin with gravity feed nozzles or pipe system with nozzles requiring not more than 0.42 kg/sq.cm. water pressure at rated capacity. The nozzles will be spaced to give even distribution of water. The system will be self-draining, non-clogging and designed for flexible operation and ready accessibility. Suitable measuring orifices will be provided. All main piping connections will be brought out and will end in flanges to facilitate connections.

All the fasteners will be of stainless steel. Rubber/Neoprene gaskets must be used on all bolted joints as a seal against water leakage.

Nozzles for cooling tower will be of brass/gunmetal/stainless steel/ suitable material conforming to applicable standards. The cooling tower will be complete with ladder for maintenance and service requirements.

12.7.12 Insulation

- i. Acoustic insulation

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Acoustic insulation will be provided in the supply air duct up to 3m from AHUs. For applying acoustic insulation inside duct hot bitumen/ cold adhesive will be provided at the clean inside surface of duct. Then 25mm thick mineral wool will be provided. To hold the insulation 30 SWG perforated aluminium sheet will be provided and riveted with duct. Perforation will be of 5mm and 8 to 10mm centre to centre distance.

12.7.13 Thermal insulation

Thermal insulation will be provided on a portion of supply air duct out side the conditioned premises, pan humidifier, chilled water piping, drain pipes connected with insulated equipment etc. Thermal insulation of tail end duct will be provided to avoid condensation of moisture on the outside surface of the duct. The return air duct outside conditioned premises will also be insulated.

For applying thermal insulation, the outside surface of the duct/ pipe should be cleaned first, then hot bitumen/ cold adhesive should be applied on the clean surface. Then 50mm thick insulation material (mineral wool mat) with wire netting on outside will be provided. Then polythene with 50mm overlap will be sealed with adhesive. The polythene will be covered with 26 SWG aluminium sheet. All joints will be locked with self locking screw at a pitch of min 100mm.

12.7.14 Instruments and Controls

Following will be provided as applicable.

- a) HP / LP cut out switch
- b) Cooling and Antifreeze Thermostat
- c) Pressure gauge and temperature gauge (6" dial type) in condenser water line and chilled water line
- d) Water flow switch with interlock
- e) Chilled water supply and return line valves, by pass valve, pressure and temperature gauges at supply and return line, AHU end
- f) Refrigerant and water line strainers
- g) Condenser purge, charging & relief valve
- h) Refrigerant compressor HP, LP, OP gauges
- i) Non return valve at pump out let
- j) Any other instruments required for the system

12.7.15 Make up Water Tank

Make up water tanks will be provided for cooling tower of air conditioning systems. Tanks will be MS & inner surface spray galvanised. Make up water line with float valve & backup ball valve, quick fill line with ball valve, drain line with ball valve, overflow & vent line, level gauge will be provided.

12.7.16 Centrifugal Fan



These are used for ventilation system. The fans will be of limit load design. The fan will be of rugged steel construction and suitable for industrial duty condition. Fan housing will be of welded construction and provided with flanges at inlet and outlet sides for duct connections. The housing will be provided with lifting eye for ease of handling and bolted type access door.

The fan unit will be reasonably noise and vibration free in operation. The noise level for fan and motor assembly at 1 meter distance will be limited to 85 dB (A). The fan will be single inlet single width (SISW) type as per requirement. The fan will be both statically and dynamically balanced.

12.7.17 Dry Panel Filter

Dry panel type air filter will be of high efficiency cleanable type, constructed out of HDPE (6 ply) supported by layers of GI wire gauge. It will be corrugated to the depth of filter casing in order to increase the ratio of filtration area to frontal area. It will be covered by strong GI/MS frame and have space to ensure uniform distribution of air. Filtering panel will be of standard size which can be mounted on angle frame in multiple number as per capacity of the fan. Face velocity of air will not exceed 2 m/sec. The resistance of air filter will not exceed 10 mmWC when dirty. Efficiency of the filter will not be less than 90% down to 10 microns. The whole filter and frame assembly will be fixed in a sheet metal casing of not less than 3.15 mm thick M S sheet.

12.7.18 Axial Flow (Tube Axial) Fan

These fans will be of heavy duty type. Fan impeller blades will be of aerofoil section of cast aluminium alloy. The impeller will be directly mounted on the motor shaft and the assembly will be mounted inside rigid tubular casing. Cable termination provision will be made on tubular casing. The connecting flanges will be provided at both ends of tube. Tube casing will be of minimum 2.5 mm thick M S sheet. The noise level for fan and motor assembly at 1 meter distance will be limited to 85 dB (A).

Axial Flow (Propeller) Fan

These are used for general ventilation of premises emitting heat / fumes. These will be of heavy duty and wall mounted type. Fan impeller blade will be aerofoil section and mounted directly on the motor shaft. Air entry from motor side. Louver shutter will be provided at the out let side of the fan to prevent back draft. Consequent loss in capacity will be taken in to account while selecting the fan. The noise level for fan and motor assembly at 1 meter distance will be limited to 85 dB (A).

Adjustable louver grills (Supply air Grills)

1.25mm MS sheet / 1mm GI sheet will be used for the manufacture of grill. All grills will be true to shape and will be checked with a level gauge before being secured in position. No distortion or warping is permitted.

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Self Acting Damper (Gravity Damper)

Self acting dampers are provided to maintain pressurisation inside the premises. The damper will be of gravity type designed such as not to allow infiltration of air from outside. The damper will be multi blade type made of aluminium flaps of not less than 24G thickness and MS frame. These will be designed such that these will operate when the pressure inside the premises exceeds 2-3 mm WC. It can operate in fully open or partial open positions.

12.7.19 Centrifugal pump

The pumps will be designed, manufactured and tested as per IS: 1520-1980 (R.A. 1993), IS: 5120-1977 (R.A.1997) Amendment 2000, IS: 9137-1978 (R.A. 1993), IS6595-1993 (Part II) or as per other international standards acceptable to the Purchaser and will be suitable for the duty conditions and capacities as indicated in this specification.

The power rating of the pump motor will be larger of the following 110% of the power required at the duty point.

For parallel operation, motor rating should be sufficient enough for running of single pump also.

i. Shaft

The shaft will be of EN-8 or C-40 or equivalent and will be designed for critical speed. The ratio of critical speed to speed of shaft will be not less than 1.2 for solid shafts.

ii. Shaft sealing

Mechanical type Shaft seals will be provided to prevent leakage out of, or into, a pump over the range of specified operating conditions. The seals will be suitable for variations in inlet conditions that may prevail during start-up and shut down. They will be accessible for inspection and replacement without disturbing any part of the installation.

12.7.20 Bearing

Two bearing assemblies will be provided, one within the frame to carry radial load only and the other to carry both radial and axial thrust. Bearings will be of manufacturer standard design, antifriction type, oil / grease lubricated. Suitable thrust bearings will be provided in the pump to take total thrust of the pump including hydraulic thrust. Thrust bearings will be of oil lubricated type with suitable cooling arrangement. Motor thrust bearing will be designed without water cooling arrangement. Suitable tapped holes will be provided for refilling of oil in the bearing housing.

12.7.21 Duct Work

Ducting will be fabricated from GI sheet as per IS: 655 standards. The ducting will be properly reinforced and braced to prevent sagging, buckling or vibration.



However minimum thickness of GI sheet will be 1mm considering the industrial duty conditions.

Flanges of sheet metal duct will be of angle iron type riveted with GI sheet on duct perimeter. Flange joints should be made air tight with use of felt gaskets. Spacing of duct flanges will be about 3 meters.

Turning guide vanes are to be provided inside the duct wherever change of direction occurs, to minimise eddy formation. The interior of all ducts will be smooth for free flow of air. Bends / elbows wherever used in duct work will have radius not less than the depth of duct work in change of direction. Collar is to be provided to duct bottom to connect with throat of supply air diffuser.

Access eye / measuring hatch for measurement of air quantity will be provided in ducting at convenient location. Duct work will be complete with flanges, stiffeners, fasteners, hangers, nuts, bolts, washer & gaskets etc.

12.7.22 Supply Air Diffusers

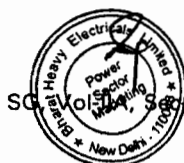
Supply air diffusers will be square / rectangular / circular in shape. The throat of a diffuser will be connected with collar piece provided at the duct bottom for holding the diffuser as well as for supply of air. No part of diffuser will project into the main duct. Each diffuser will be provided with volume control damper. Each diffuser will comprise of fixed plate, damper blade, damper blade operating knob, spindle, connecting rod etc and will be removable core type dully powder coated. The diffuser bottom should flush / match with the false ceiling. False ceiling will not bear the load of any diffuser. The load of any diffuser will be borne by the duct and collar. Each diffuser will be powder coated with appropriate colour to match with the colour of the false ceiling. The diffusers will be true to shape and will be checked with level gauge before being secured in position. No distortion or warping is permitted.

12.7.23 Return Air Duct

The air supplied in the served premises will return above false ceiling through return air grills / the return air slit of 50mm / 75mm (as required) all around false ceiling along the walls of the served premises. From there it will pass into the AHU room through a return air duct. Insulated return air duct of suitable size will be provided for smooth flow of return air. The return air duct will be connected to the AHU so that the AHU room will not be conditioned and this will avoid the heat load of the AHU room. Return air opening will be provided above false ceiling in the partition wall between served premises and AHU room.

12.7.24 Strip Heater Box

Strip heater box will comprise of finned heater, mounting plate, heater box/ casing made of 20 SWG G.I. sheet, cable terminal, terminal box with handle, 40x40x3 MS angle flange/ frame. Strip heater box will be placed/ inserted in supply air duct. Safety thermostat will be mounted on strip heater package to prevent



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overheating. Strip heater box assembly will be a pre-fabricated unit with all its terminals and controls pre-wired.

12.7.25 Multi-louvre Damper

Multi-louvre damper will be provided at the out let of AHUs and below flexible connection in the supply air ducting. The damper blades/ louvres will be provided with external operating links for manual operation of the damper to control air flow. The damper will be made of GI sheet with MS frame. The fully close / open / partial closing position of the damper will be marked on the damper casing.

12.7.26 Thermometer and Pressure Gauge

Wet bulb and dry bulb thermometer will be provided and installed in the control room to measure the premises temperature.

Dial type (100 mm) mercury in steel thermometer will be provided for measuring the water temperature at inlet & outlet of condenser. The range of thermometer will be 0-100 °C.

Dial type (100 mm) pressure gauges will be provided at inlet as well at outlet of condenser water lines.

12.7.27 Return Air Grills

Return air grills will be square / rectangular / circular in shape. The throat of a diffuser will be connected with collar piece provided at the duct bottom for holding the grills. No part of grills will project into the return air duct. The bottom of grills should flush / match with the false ceiling. Each grills will be powder coated with appropriate colour to match with the colour of the false ceiling. The grills will be true to shape and will be checked with level gauge before being secured in position. No distortion or warping is permitted.

12.7.28 Condenser cooling water piping with accessories

Medium class GI piping is to be used as per IS: 1239 for interconnecting water piping network. Velocity of water in the pipe line will be limited to 1.5 m/sec. Butterfly valve will be provided in water pipeline for control and regulation purposes. Butterfly valve and non return valve will be provided in the delivery side of pumps.

Pot strainer will be provided in the water pipe line at inlet of condenser with by pass connection with isolation valves. Pipe fittings like bends, elbows, flanges, sockets, nipples etc. will be as per relevant IS/BS standards.

Drain piping network is to be included as required for condensate drain, with isolation valves at proper places. All piping will be tested to hydrostatic test pressure of at least one and half times the maximum operating pressure for period of not less than 24 hours. System may be tested in sections and such section will be securely capped.

12.7.29 Performance Parameters



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Vapor Compression Machine	
b) Shell diameter and length (mm) c) Tube material d) Fouling factor e) No. of tubes	
4. Air handling unit / fan coil unit. a) Make & Model No. with specific capacity of each type b) Type of unit (Horizontal/vertical) c) Overall dimensions (mm)	DDE
5. Fan Section a) Air quantity (m ³ /hr) with specific capacity of each type b) Total/static pressure (mmWC) c) Fan speed (RPM) d) Fan dia (mm) & number e) Balancing (Static and dynamic) f) Fan motor (kW)	DDE
6. Cooling coil a) Coil fin materials b) Tube dia (mm) and thicknes	DDE
7. Filter section Pre filter a) Type & make b) Gross filter area (m ²) c) Velocity through filter (m/sec) d) Pressure drop through filter when dirty & when clean (mmWC) e) Efficiency	DDE
8. Split Air Conditioners / Window Air Conditioners a) Make & Model b) Quantity c) Capacity in TR (Nominal / Actual)	DDE

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Vapor Compression Machine	
<ul style="list-style-type: none"> vii. Impeller viii. Casing ix. Pump speed (rpm) x. Shaft power xi. Drive details xii. Motor make xiii. Motor kW xiv. Class of insulation xv. Frame size 	
<p>11. Dry Panel Filter</p> <ul style="list-style-type: none"> f) Make & Model. g) Capacity in m³/h. h) Pressure drop in mmWC. i) When clean ii) When dirty i) Effective cross sectional area in m² 	DDE
<p>12. Cooling tower</p> <ul style="list-style-type: none"> a) Make & Model b) Type c) Quantity d) Overall size of cooling tower e) Capacity of cooling in TR. f) Water flow m³/h 	DDE



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SCHEDULE-9

9 PERFORMANCE GUARANTEES

9.1 General

1. The contractor shall guarantee that the equipment offered shall meet the ratings and performance requirements stipulated for various equipment covered in the Contract specifications.
2. The contractor shall demonstrate and establish performance guarantee for various equipment and achieve performance guarantee values as per Contract Specification, at site in the presence of the Purchaser/Consultant for each unit individually.
3. Details of performance guarantee tests and method of computation of performance values shall be as per Technical Specification.
4. The Contractor shall supervise and direct the operation during performance tests and shall take complete responsibility in this regard.
5. During performance tests, the Purchaser shall make available necessary normal operating & maintenance personnel.
6. The Contractor shall provide and install all measuring instruments required for checking the guaranteed performance which are not included among the permanent measuring instruments of the system/sub-system. Such instruments shall be furnished by the Contractor on a temporary basis for the duration of the performance guarantee tests.

9.2 Performance Guarantee Values, Categories, Demonstration of Performance/Acceptance Tests and Liquidated Damages for Shortfall in performance / Non-Performance

1. Performance and ratings of the various offered equipment, as covered in this specification, shall be guaranteed by the Bidder.
2. The guaranteed performance parameters furnished by the bidder in its offer, shall be without any tolerance values and all margins required for instrument inaccuracies and other uncertainties (permitted as per agreed test codes) and other uncertainties shall be deemed to have been included in the guaranteed figures.
3. The successful Bidder (Contractor), during performance guarantee / acceptance test, shall demonstrate all the guarantees as covered in this Schedule. Bid price quoted by the Bidder shall include all costs associated with the tests.
4. Ambient conditions for guaranteed efficiency of steam turbine generator shall be as follows:

(a) Ambient Air Temperature : 27°C

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(b) Relative Humidity : 71%

Note! No credit shall be given to the Bidder, in the bid evaluation or in the evaluation of the results of the guarantee tests for performance predictions / guarantee etc. if the values considered by the bidder for parameters indicated above are lower (or better) than those specified above.

5. The performance guarantee tests shall be conducted by the successful Bidder/ Contractor for each unit individually and liquidated damages for non-performance as indicated under this schedule will be levied separately for each unit.

9.3 Performance Guarantee / Acceptance Test

1. The final test (performance guarantee / acceptance test) shall be conducted at site by the Contractor in presence of the Purchaser / Consultant. Such test will be completed, within a period of 3 (three) months after the successful completion of Trial Operation. Any extension of time beyond the above three months shall be mutually agreed upon.
2. Instrumentation used, their accuracy class, their numbers & location etc. for carrying out performance guarantee / acceptance / demonstration tests shall be as per relevant codes and shall be subject to Purchaser’s approval. In addition the values of parameters shall also be logged from the information system provided under Purchaser’s DDCMIS (under Purchaser’s scope) Tests will be conducted at specified load points.
3. Any special equipment, tools and tackles required for the successful completion of the performance guarantee / acceptance / demonstration tests shall be provided by the Contractor at his cost.

4. Guarantees Category wise

If equipment / system fail to meet the guarantees, all necessary modifications and / or replacements shall be carried out by the successful Bidder(contractor) without any extra cost to the Purchaser so that the equipment / system comply with the guaranteed requirements. However, if even after above modifications / replacements, the contractor is not able to demonstrate the guarantees within 90 days or within a reasonable period allowed by the Purchaser (reckoned from the date on which the tests have been completed) the Purchaser will have the right to the following:

- (a) To reject the equipment / system / plant and recover the payment already made

OR

to accept the equipment / system / plant after levying Liquidated Damages (LD) as specified in this Schedule (These are termed as “**Category – I**” Guarantees)

- (b) To reject the equipment / system / plant and recover the payment already made. (These are termed as “**Category – II**” Guarantees and

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conformance to the performance requirement is mandatory. Category - II Guarantees do not attract LD)

In addition to the above the Contractor shall demonstrate performance parameters indicated in Cl.9.4.3, under Demonstration Guarantees, during the PG Tests

9.4 Schedule of Guarantees

9.4.1 Category-I, Guarantees: Liquidated Damages

S.No	Description	Parameter for Performance Guarantee	Liquidated Damages
1.	Turbine Cycle Heat rate in kcal / kWh	For increase in every kcal/ kWh or part there of in the guaranteed value.	Rs.2,27,10,000/- (Indian Rupees Two Crores Twenty Seven Lakhs Ten Thousand only)
2.	Continuous TG output of 500 MW	For deficiency in every kW or part there of by which the output, determined by the test, falls short of the guarantee figure.	Rs. 1,17,000/- (Indian Rupees One Lakh Seventeen Thousand only)
3.	Total Auxiliary Power Consumption including MDBFP	For every kW increase or part thereof from the Guaranteed value	Rs. 1,99,000/- (Indian Rupees One Lakh Ninety Nine Thousand only)
4.	Total Auxiliary Power Consumption excluding MDBFP	For every kW increase or part thereof from the Guaranteed value	Rs. 1,99,000/- (Indian Rupees One Lakh Ninety Nine Thousand only)

9.4.2 Category-I, Guarantees: Performance Guarantees Attracting Liquidated Damages

S. No	Particulars	Unit	Value inclusive of design, manufacture and all other Tolerances including measurement uncertainty
(i)	Gross Heat Rate: Turbine Cycle Gross Heat rate in kcal / kWh under rated steam conditions at 81 mm Hg (abs) design back pressure with zero make up at 500 MW unit load, design CW temperature and CW flow	kcal/ kWh	
(ii)	TG Output: Continuous TG output of 500 MW under rated steam condition at 81mm Hg (abs) design back pressure with 3% make-up (including 0.5% blow down and 2.5% non recoverable auxiliary steam) and design CW temperature and CW flow.	MW	

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S. No	Particulars	Unit	Value inclusive of design, manufacture and all other Tolerances including measurement uncertainty
(iii)	Total Auxiliary Power Consumption including MDBFP: This shall include all the following working electrical drives of TG & auxiliaries running at continuous output of 500 MW, 3% make-up and 81 mmHg (a) back pressure (with in the bidders scope), design CW temperature and CW flow (a) Condensate Extraction Pumps (CEP) (b) Motor Driven Boiler Feed Pump (MDBFP) (c) Condenser Air Evacuation pump (d) Control oil Pump (e) DMCW Pumps (f) ACW pumps (g) LP Drain Condensate Pump (If provided)	kW	
(iv)	Total Auxiliary Power Consumption excluding MDBFP: This will include all the following working electrical drives of TG & auxiliaries except motor driven BFP running at continuous output of 500 MW, 3% make-up and 81 mmHg (a) back pressure (with in the bidders scope) design CW temperature and CW flow. (a) Condensate Extraction Pumps (b) Condenser Air Evacuation pump (c) Control oil Pump (d) DM CW (e) ACW pumps (f) LP Drain Condensate Pump (If provided)	kW	

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9.4.3 Category-II, Guarantees (conformance to Guarantees is mandatory)

S. No	Particulars	Unit	Value Inclusive of design, manufacture and all other tolerances including measurement uncertainty
a)	Final feed water temperature	°C	To be optimized and quoted by Bidder
b)	Total cooling water requirement in the condenser at a cooling water temperature of 34°C	°C	Bidder to quote
c)	Dissolved oxygen at Condenser outlet and Deaerator outlet.	cc/litre	0.015 & 0.005 respectively
d)	Generator and excitation system	-	Bidder to quote

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S. No	Particulars	Unit	Value Inclusive of design, manufacture and all other tolerances including measurement uncertainty
	parameters		
e)	Excitation system response ratio and field forcing capability	-	Bidder to quote
f)	Temperature rise in the Generator and excitation system	°C	Bidder to quote
g)	Hydrogen leakage	m ³ /day	Bidder to quote
h)	Maximum continuous generator capability under all normal operating condition (e.g. frequency varying between 50 Hz -5% to + 3%).	kW	Bidder to quote
i)	The max. permissible noise level shall not exceed 85 dB (A) at a distance as specified in the specification.	dBA	85
j)	Each CEP shall be guaranteed for capacity, head, efficiency, NPSH and power input to motor at best efficiency point at shop. The best efficiency point shall correspond to 100 % TGMCR conditions.	As applicable	Bidder to quote
k)	Each BFP shall be guaranteed for capacity, head, efficiency, NPSH and power input to motor at best efficiency point at shop. The best efficiency point shall correspond to 100 % TGMCR conditions.	As applicable	Bidder to quote
l)	Air-conditioning System: Inside conditions of air conditioned premises		Temp : 23 ± 1°C and RH 55 ± 5%
m)	Ventilation System: Temperature Saturation efficiency Pressurization		Temp:Not more than ambient temp Not less than 90% 2 to 3mm WC
m)	TG Hall EOT Crane: Full load and 25% over load on hoisting and long and cross traverse motion	Tonnes (T)	Full load and 25% over load
o)	Condensate Polishing Unit: Design flow rate through the polisher units, Ionic Concentrations of Effluent, Dissolved solid and Suspended solids.	As required	
p)	DG sets : • MCR Generation	kVA	Bidder to quote

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S. No	Particulars	Unit	Value Inclusive of design, manufacture and all other tolerances including measurement uncertainty
	• Fuel consumption	m3/h	Bidder to quote
q)	Elevators: Speed and load test		As per IS

9.4.4 Demonstration Guarantees

S. No	Particulars	Unit	Value Inclusive of design, manufacture and all other tolerances including measurement uncertainty
a)	Gross Heat rate at VWO, 100% MCR, 80% MCR and 60% MCR conditions for 0% make-up and 0% auxiliary steam	kcal/kWh	Bidder to quote
b)	Gross Heat rate at VWO, 100% MCR, 80% MCR and 60% MCR conditions for 3% make-up and 0% auxiliary steam	kcal/kWh	Bidder to quote
c)	HP Turbine exhausts pressure & temperature.	mm of Hg / °C	Bidder to quote
d)	Pressure drop between first HP Heater inlet and top HP Heater outlet flanges	kg/cm ² (a)	Bidder to quote
e)	Combined pressure drop in condenser tube, water box, and inlet and outlet piping. This shall be measured in between intake and discharge point of the CW. system and also at the Bidder's terminal points with cleanliness factor of 0.90.	kg/cm ² (a)	Bidder to quote

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9.5 Liquidated Damages for Non Performance

- Should the results of the formal test show that the Steam Turbine Generator has failed to meet its guarantee, the Contractor shall carry out the modification at its own cost, if considered necessary, to meet the guaranteed values. In such a case the performance and guarantee tests shall be repeated by the Contractor within one (1) month from the date the equipment is ready for retest. If the specified guarantees are not established within 90 days of notification by the Purchaser, the Purchaser may at his discretion reject the equipment and recover the payments already made or accept the equipment after assessing the liquidated damages payable at the rates specified in Cl 9.4.1 of this Schedule for each steam turbine generator. The recovery of such amount shall be from the amounts due to the Contractor. These liquidated damages shall be prorated for fractional parts of the deficiencies.

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2. Specific performance guarantees which attract liquidated damages are detailed in Cl.9.4.1 of this schedule. The Bidder shall furnish declarations in the manner prescribed in the bid proposal schedules (Vol-IB) for these guarantees.
3. Other performance parameters as detailed in Clause 9.4.2 and 9.4.3 of this schedule, which do not attract liquidated damages, shall be termed as demonstration parameters. Demonstration parameters / capabilities shall be demonstrated during the trial operation period/guarantee tests of the respective system/equipment as per the detailed test procedure to be approved by the Purchaser/Consultant.

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TECHNICAL SPECIFICATION
2X500 MW NEW NEYVELI

SPECIFICATION No: PE-TS-400 & 402-553-A001

VOLUME II B

SECTION C3

REV. 00

DATE: AUGUST 2014

SECTION: C3

ELECTRICAL SPECIFICATION


Praveen Kothari

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TITLE :
ELECTRICAL EQUIPMENT SPECIFICATION
FOR
AIR CONDITIONING SYSTEM

2x500 MW NEYVELI NEW
THERMAL POWER STATION (NNTPS)

SPECIFICATION NO.
PE-TS-331-552-A000
VOLUME NO. : II-B
SECTION: C
REV NO. : 00 DATE: 02/08/14
SHEET: 1 OF 1

- 1.0 EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER:**
- a) Services and equipment as per “Electrical Scope between BHEL and Vendor”.
 - b) Any item/work either supply of equipment or erection material which have not been specifically mentioned but are necessary to complete the work for trouble free and efficient operation of the plant shall be deemed to be included within the scope of this specification. The bidder without any extra charge shall provide the same.
 - c) Supply of mandatory spares as specified in the specifications of mechanical equipments.
 - d) Erection and commissioning spares.
 - e) Erection & Maintenance tools & tackles.
 - f) Electrical load requirement for Air conditioning System.
 - g) All equipment shall be suitable for the power supply fault levels and other climatic conditions mentioned in the enclosed project information.
 - h) Bidder to furnish list of makes for each equipment at contract stage, which shall be subject to customer /BHEL approval without any commercial and delivery implications to BHEL.
 - i) Various drawings, data sheet as per required format, quality plans, calculations, test reports, test certificates, operation and maintenance manuals etc shall be furnished as specified at contract stage. All documents shall be subject to customer /BHEL approval without any commercial implications to BHEL.
 - j) Motor shall meet minimum requirement of specification AC/DC motors.
- 2.0 EQUIPMENT & SERVICES TO BE PROVIDED BY PURCHASER FOR ELECTRICAL & TERMINAL POINTS:**
Refer “Electrical Scope between BHEL and Vendor”.
- 3.0 DOCUMENTS TO BE SUBMITTED ALONG WITH BID**
- 3.1** Bidder shall confirm total compliance to the electrical specification without any deviation from the technical/ quality assurance requirements stipulated. In line with this, the bidder as technical offer shall furnish two signed and stamped copies of the following:
- a) A copy of this sheet “Electrical Equipment Specification for Air conditioning System” and sheet “Electrical Scope between BHEL and Vendor” with bidder’s signature and company stamp.
 - b) List of Erection and Commissioning spares.
 - c) List of Erection & Maintenance tools & tackles.
 - d) Electrical load requirement.
- 3.2** No technical submittal such as copies of data sheets, drawings, write-up, quality plans, type test certificates, technical literature, etc, is required during tender stage. Any such submission even if made, shall not be considered as part of offer.
- 4.0 LIST OF ENCLOSURES**
- 4.1 Electrical scope between BHEL & vendor.- 2 sheets
 - 4.2 Std. Technical specification for LV motors.- 5 sheets
 - 4.3 Std. Technical specification for Cabling installation.- 6 sheets.
 - 4.4 Data Sheets (A) for 415V Electric Motors.- 2 sheets.
 - 4.5 Data Sheets (C) for 415V Electric Motors- 2 sheets.
 - 4.6 Quality plan for motor below 55kW.- 2 sheets
 - 4.7 Quality plan for motor above 55kW.- 9 sheets
 - 4.8 Load data format.- 1 sheet

(Handwritten signatures and stamps)
Praveen Kishore
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Vishnu Jha

Scope sheet for Scope between BHEL & Vendor

PROJECT: 2x500 MW NEYVELI NEW THERMAL POWER STATION (NNTPS)

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1	415V MCC	BHEL	BHEL	1. 415 V AC/240 V AC supply shall be provided by BHEL based on load data provided by vendor at contract stage for all equipment supplied by vendor as part of contract including power supply equipment (battery charger etc) required for the PLC/control panel (as applicable) for the system supplied by vendor. 2. Interposing relays (RE 302 of Jyoti make or equivalent), if required for PLC and microprocessor based systems, shall be provided by BHEL in MCCs. Requirement of these relays shall be furnished by vendor during detailed engineering stage.
2	Local Push Button Station (for motors)	BHEL	BHEL	Located near the motor.
3	Power cables, control cables and screened control cables for a) both end equipment in BHEL's scope b) both end equipment in vendor's scope c) one end equipment in vendor's scope	BHEL BHEL BHEL	BHEL Vendor BHEL	1. Sizes and quantity of cables required shall be informed by vendor at contract stage (based on inputs provided by BHEL). Finalisation of cable sizes shall be done by BHEL. Vendor shall provide lugs & glands accordingly. 2. Laying of cables by BHEL except for cabling in vendor scope. 3. Termination at BHEL equipment terminals by BHEL. 4. Termination at Vendor equipment terminals by Vendor.
4	Any special type of cable like compensating, co-axial, prefab, MICC, fibre optical etc.	Vendor	Vendor	
5	Cable trays, accessories & cable trays supporting system	BHEL	BHEL	
6	Cable glands and lugs for equipments supplied by Vendor	Vendor	Vendor	1. Double compression Ni-Cr plated brass cable glands 2. Solder less crimping type heavy duty tinned copper lugs for power cables 3. Solder less crimping type heavy duty copper lugs for control cables.
7	Conduit and conduit accessories for cabling between equipments supplied by vendor	Vendor	Vendor	Conduits shall be medium duty, hot dip galvanised cold rolled mild steel rigid conduit as per IS: 9537. Makes of conduits shall be subject to customer/ BHEL approval at contract stage.
8	Lighting	BHEL	BHEL	
9	Equipment grounding & lightning protection	BHEL	BHEL	
10	Below grade grounding	BHEL	BHEL	
11	LT Motors with base plate and foundation hardware	Vendor	Vendor	Makes shall be subject to customer/ BHEL approval at contract stage.
12	Mandatory spares	Vendor	-	Vendor to quote as per specification.
13	Recommended O & M spares, E & C spares, erection &	Vendor	-	As per specification

Scope sheet for Scope between BHEL & Vendor

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
	maintenance tools & tackle.			
14	Any other equipment/material/service required for completeness of system but not specified above (to ensure trouble free and efficient operation of the system).	Vendor	Vendor	
15	a) Input cable schedules (C & I) b) Cable interconnection details for above c) Cable block diagram	Vendor Vendor Vendor	- - -	Cable listing for C & I systems for vendor supplied equipment shall be furnished during detail engineering by vendor in soft copies in the BHEL cable schedule format.
16	Equipment layout drawings	Vendor	-	For ensuring cabling requirements are met, vendor shall furnish layout drawings (both in print form as well as in AUTOCAD) of the complete plant (including electrical area) indicating location and identification of all equipments requiring cabling, and shall incorporate cable trays routing details marked on the drawing as per PEM interface comments. Electrical equipment layout drawing shall be to BHEL approval.
17	Electrical Equipment GA drawing	Vendor	-	For necessary interface review.
18	Junction Boxes	Vendor	Vendor	

NOTES:

1. Make of all electrical equipments/items supplied shall be reputed make & shall be subject to approval of BHEL/customer after award of contract.
2. All QPs shall be subject to approval of BHEL/customer after award of contract without any commercial implication.


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 Manoj Kumar



TITLE :
GENERAL TECHNICAL REQUIREMENTS

FOR

CABLING INSTALLATION

SPECIFICATION NO.
PE-SS-999-507-E111

VOLUME NO. : **II-B**

SECTION : **D**

REV NO. : **00** DATE : 26.08.09

SHEET : 1 OF 1

GENERAL TECHNICAL REQUIREMENTS

FOR

CABLING INSTALLATION

SPECIFICATION NO.: PE-SS-999-507-E111 REV 0


Praveen Khatwa


S.A. Mohan


V. Srinivas



TITLE :
GENERAL TECHNICAL REQUIREMENTS

FOR

CABLING INSTALLATION

SPECIFICATION NO.
PE-SS-999-507-E111
VOLUME NO. : **II-B**
SECTION : **D**
REV NO. : **00** DATE : 26.08.09
SHEET : 1 OF 5

1.0 INTENT OF SPECIFICATION

1.1 This specification covers the activities mentioned below, as applicable to various areas of power station:

- b) Laying and termination of cables.
- c) Testing and charging of cables.
- d) Supply and erection of miscellaneous items for completion of the cabling system.
- e) All associated work for completion of cabling system.
- f) Receipt of cables and cabling materials supplied by purchaser/others.
- g) Site handling and storage of material.
- h) Minor civil works.

1.2 The scope of supply of cabling materials as a part of cable installation work includes supply of all accessories including, but not limited to, cable clamps, ferrules, cable tags, nuts, bolts, and consumables like anti-corrosive paints, welding electrodes etc. required to complete the cabling system. All other sundry materials for minor civil work shall also be supplied by vendor.

1.3 WORKS EXCLUDED FROM VENDOR'S SCOPE

- a) Major civil works like excavation and concreting of concrete trenches, plate embedments on cable trenches, ceiling and floors.
- b) Civil works for ducting for crossing of roads & rail tracks.
- c) Conduits and pipes embedded in walls, floors etc.

2.0 CODES AND STANDARDS

2.1 Installation of cabling work shall comply with the latest edition of following Indian standards rules, regulations and acts. However, if Specification specifies conformance to any other international standard, equivalent BS / IEC / ISO / any other standard shall be applicable.

- a) IS:1255 Code of practice for installation and maintenance of power cables up to and including 33 kV rating.
- b) IS:732 Electrical wiring installation (system voltage not exceeding 650 V).
- c) IS:5216 Guide for safety procedures and practices in electrical works.
- d) IS:226 Structural steel (Standard Quality).
- e) IS:800 Code of practice for use of structural steel.
- f) IS:316 Code of practice for use of metal arc welding for general construction in mild steel.
- g) IS:1363 Hexagonal bolts, nuts and screws.
- h) IS:1572 Electroplated coatings of cadmium on iron and steel.
- i) IS:2629 Code of practice for hot dip galvanizing for iron and steel.
- j) IS:2633 Method of testing uniformity of coating on zinc coated articles.
- k) Indian Electricity Act.
- l) Indian Electricity Rules.
- m) Fire insurance regulations.
- n) Regulations laid down by the Chief Electrical Inspector of the State.
- o) Regulations laid down by the Factory Inspector of the State.
- p) Any other regulations laid down by the authorities.

2.2 In case any clause of contradictory nature arises between standards and this specification, the latter shall prevail.

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Vikram Jais



TITLE :
GENERAL TECHNICAL REQUIREMENTS

FOR

CABLING INSTALLATION

SPECIFICATION NO.
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3.0 CABLING MATERIALS TO BE PROVIDED

- 3.1 Trefoil Cable Clamps shall be provided for clamping single core cables carrying alternating current and shall be of aluminium alloy or nylon material as per Specification.
- 3.2 Omega Cable Clamps shall be provided to fasten the individual multi-core cable above 35mm outer diameter and shall be of aluminium alloy or mild steel.
- 3.3 Strip Cable Clamps shall be provided to fasten the group of multi-core cables up to 35mm diameter and shall be of mild steel or aluminium
- 3.4 Self Locking Clamps shall be shall be provided of nylon material with self locking feature when the cord is looped and shall provided with manual lock release.
- 3.4 Steel clamps shall be hot dip galvanized as per the requirements given in Specification.
- 3.5 Ferrules shall be provided for individual core of control cables and shall be of plastic material.
- 3.6 Cables shall be provided with cable number tags for identification Cable tags shall be of durable fibre, aluminium or stainless steel sheets as per Specification.
- 3.7 Miscellaneous items required for the buried cables such as cable markers, bricks, sand, protective slabs etc. shall be to provided by the vendor.

4.0 CABLING CONCEPT

- 4.1 In the plant building, substations, switchgear rooms, control rooms etc., power and control cables shall generally be laid on cable trays installed in concrete trenches, tunnels, cable basements, cable vaults, cable shafts or along building and technological structures as the case may be.
- 4.2 In case of multicore cables of diameter up to 30 mm where not more than 3 cables are taken in one run, these can be taken directly along structures, walkways, platforms, galleries, walls, ceiling etc. by proper clamping at regular intervals of 750 mm or less.
- 4.3 Power & control cables installed along buildings, structures, ceilings, walls, etc., which are required to be protected against mechanical damage, shall be taken in GI conduits.
- 4.4 GI Conduits shall also be used for flameproof installations, wherever required, with sealing at both ends.
- 4.5 Entry of cables from trenches/tunnels into buildings shall be by means method duly approved by purchaser approved, which shall be informed to successful bidder during detailed engg stage.
- 4.6 Cables laid exposed in racks/trays and routed from trenches/tunnels/basements etc to individual drive/ control devices etc shall be taken in embedded/exposed/surface-grouted rigid GI conduits and / or flexible conduits unless directly terminated to the equipment in the panels located above trenches, tunnels or basement.
- 4.7 All cables routed along walls or in equipment rooms shall be protected by means of laying them through G.I. pipes or by providing sheet metal covers up to a height of 2000 mm from

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S.A. Mohan

Vikram Jais



TITLE :
GENERAL TECHNICAL REQUIREMENTS

FOR

CABLING INSTALLATION

SPECIFICATION NO.
PE-SS-999-507-E111
VOLUME NO. : **II-B**
SECTION : **D**
REV NO. : **00** DATE : 26.08.09
SHEET : 3 OF 5

the working floor levels and platforms, for protection against mechanical damage. All vertical risers shall be enclosed type.

- 4.8 For 415 V power wiring in ancillary buildings, offices and laboratories, cables shall be taken through embedded/exposed GI conduits or rigid PVC pipes as applicable.
- 4.9 Wherever cables are to be laid below roads and railway tracks, the same shall be taken through ducts buried at a suitable depth.
- 4.10 At certain places where hazardous fumes/gases may cause fire to the cables, cable trenches after installation of cables shall be sand-filled.
- 4.11 In corrosive atmosphere, Epoxy painted G.I. conduits shall be used for cables.
- 4.12 Single core cables, when pulled individually, shall be taken through PVC pipes only.
- 4.13 Cables shall be avoided below oil pipes and in the vicinity of steam pipes.
- 4.14 Cable installation shall be properly coordinated at site with other services and wherever necessary suitable adjustment shall be made in the cable routings with a view to avoid interference with any part of the building, structures, equipment, utilities and services
- 4.15 All apparatus, connections and cable work shall be designed and arranged to minimise the risk of fire and ingress of water. All material required to achieve the same shall be included in the cost of installation of cables.

5.0 TRANSPORTATION & STORAGE OF CABLE DRUMS

- 5.1 Transportation and storage of cable drums shall generally conform to the requirements of IS:1255. The cable drums shall be transported on wheels to the place of work.
- 5.2 Transportation of all cables, which shall be provided by purchaser as free issue items, from purchaser's storage area to the work site shall be the responsibility of vendor. Empty cable drums shall be returned to purchaser.

6.0 LAYING OF CABLES

- 6.1 Laying and installation of power, control and special cables shall generally conform to IS:1255.
- 6.2 The cables shall be paid-out in proper direction from the cable drums (opposite to the normal direction of rotation for transportation).
- 6.3 In case of higher size cables, the paid out cables shall run over rollers placed at close intervals and finally transferred carefully on the racks/trays. Care shall be taken so that kinks and twists or any mechanical damage does not occur to cables. only approved cable pulling grips or other devices shall be used. Under no circumstances cables shall be dragged on ground or along structure while paying out from cable drums, carrying to site and straightening for laying purpose.
- 6.4 All possible care shall be given while handling un-armoured cables.
- 6.5 Additional length of power cables of one loop with permissible bending radius shall be provided. For control cables extra length of 1 - 1.5 metre shall be provided.

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Vishnu Jha



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SPECIFICATION NO.
PE-SS-999-507-E111
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- 6.6 The bending radius of various types of cables shall not be less than those specified by cable manufacturers and that specified in IS:1255.
- 6.7 All cables shall be provided with identification tags indicating the cable numbers. Tags shall be fixed at both ends of cables, at each bend, and both sides of floor/wall crossings.
- 6.8 Single core cables for a. c. circuits shall form a complete circuit in trefoil formation supported by means of trefoil clamps of nonmagnetic material.
- 6.9 Multi-core cables above 1100 V grade shall be generally laid in ladder type trays in one layer with spacings not less than one cable diameter of bigger diameter cable.
- 6.10 All 1100 V grade multicore power cables and single core DC cables shall be placed in single layer, touching each other and clamped by means of single or multiple galvanized MS saddles/ aluminium strips/ nylon cable ties as specified in specification. Cables above 35mm outer diameter shall be clamped individually.
- 6.11 Control cables shall be laid touching each other and may not preferably be taken in more than two layers.
- 6.12 Segregation of the cables on the basis of their types and their functions shall be as under for horizontal formations:
- a) HT cables shall be laid in the top tier(s).
 - b) LT power cables to be laid in the tray(s) below the HT cable trays.
 - c) LT control cables to be laid in the tray(s) next below to the LT power Cable tray(s).
 - d) Special control cables including screened control cables to be laid in the bottom most tray(s).
- 6.13 For vertical formations, the tray closest to the wall shall be considered as bottom most tray and the order indicated in clause just above shall be followed.
- 6.14 When it may not be possible to accommodate cables as per the criteria indicated in the clauses 6.12 & 6.13 above, the following rules In hierarchical order shall override the criteria:
- a) Control cables are mixed up with the special control cables with clear minimum gap of 100mm between them.
 - b) LT power cables are mixed up with control cables with clear minimum gap of 150mm between them.
 - c) LT power cables are mixed up with HT power cables with clear minimum gap of 200mm between them.
- However, under no circumstances HT power cables can be mixed up with control cables of any type.
- 6.15 For laying cables along building steel structures and technological structures, the cables shall be taken by clamping with MS saddles screwed to the MS flats welded to the structure. MS saddles and flats shall be galvanized.
- 6.16 For laying cables along concrete walls, ceilings etc., the cables shall be taken by clamping with MS saddles screwed to the MS flats welded on the inserts. Where inserts are not available the saddles shall be directly fixed to the walls using rawl plugs and MS flat spacers of minimum 6mm thickness.

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SPECIFICATION NO.
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- 6.17 To facilitate pulling of cables in GI conduits, powdered soft stone, plastic soap or other dry inert lubricant may be used but grease or other material harmful to the cable sheaths shall not be used.
- 6.18 No single core cable shall pass through a GI conduit or duct singly except DC single core cables. AC single core cables shall pass through GI conduits/pipes in trefoil formation only.
- 6.19 Entry of cables from underground trenches to the buildings or tunnels shall be by some approved method. Necessary precautions shall be taken to make the entry point fully water tight by properly sealing the pipe sleeves wherever they enter directly into the building at trench level. The sealing shall be by cold setting compound. Any alternative sealing arrangement may be suggested with the offer for purchaser's consideration.

7.0 CABLE TERMINATION AND JOINTING

- 7.1 All cable entries in the equipment shall be sealed by cable glands.
- 7.2 Power cable terminations shall be carried out in a manner such as to avoid strain on the terminals by providing suitable clamps near the terminals.
- 7.3 Control cable cores entering switchboard or control panels shall be neatly bunched and strapped with PVC perforated tapes/nylon ties and suitably supported to keep them in position at the terminal block. Spare cores shall be neatly dressed and suitably taped at both ends.
- 7.4 Cable joint, not more than one in a circuit, shall normally be made at an intermediate point in the straight run of the cable only when the length of the run is more than the standard drum length supplied by the cable manufacturer.
- 7.5 Junction boxes shall be used, wherever required, for jointing of control cables.
- 7.6 Termination and jointing shall generally conform to the requirements of IS:1255 and shall strictly conform to the recommendations of termination and jointing kit supplier.
- 7.3 Cable installation shall be properly coordinated at site with other services and wherever necessary suitable adjustment shall be made in the cable routings with a view to avoid interference with any part of the building, structures, equipment, utilities and services
- 7.8 All apparatus, connections and cable work shall be designed and arranged to minimise the risk of fire and ingress of water. All material required to achieve the same shall be included in the cost of installation of cables.

10.0 DRAWINGS / DOCUMENTS TO BE SUBMITTED AFTER AWARD OF CONTRACT

- 10.2 The following documents shall be furnished after award of contract for purchaser's approval.
- a) Final Field Quality Plan.
 - b) Final Quality Plan.


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TITLE

LV MOTORS**DATA SHEET-A**2x500 MW NEYVELI NEW THERMAL POWER
STATION (NNTPS)

SPECIFICATION NO. PE-TS-400--552-A000

VOLUME II B

SECTION D

REV NO. DATE 02.08.2014

SHEET 1 OF 2

- 1.0 Design ambient temperature : 50 °C
- 2.0 Maximum acceptable kW rating of LV motor : 160KW *
- 3.0 Installation (Indoors/ Outdoors) : As required
- 4.0 Details of supply system
- a) Rated voltage (with variation) : 415V ± 10%
 - b) Rated frequency (with variation) : 50 Hz + 3 % to - 5%
 - c) Combined voltage & freq. variation : 10% (sum of absolute values)
 - d) System fault level at rated voltage : 50 kA for 1 sec
 - e) Short time rating for terminal boxes
 - o 90 kW and above (Breaker controlled) : 50 KA for 0.25 sec.
 - o Below 90 kW (Contactor controlled) : 50 KA protected by HRC fuse
 - f) LV System grounding : Solidly
- 5.0 Class of insulation : Class 'F', with temp rise limited to class B.
- 6.0 Minimum voltage for starting (As percentage of rated voltage) : 85% of rated voltage
- 7.0 Power cables data : Shall be given during Detailed engg
- 8.0 Earth Conductor Size & Material : Shall be given during Detailed engg
- 9.0 Space heater supply : 240 V, 1ϕ , 50 Hz (for motors above 30 Kw)
- 10.0 Rating up to which Single phase motor : Acceptable below 0.20 kW
- 11.0 Locked rotor current
- a) Limit as percentage of FLC : As per IS 12615*
- 12.0 Flame-proof motor
- a) Enclosure suitable (As per IS:2148) : As per requirement
 - b) Classification of Hazardous area (As per IS: 5572 part-I) : As per requirement
- 13.0 Makes : BHEL/ Customer approval
- 14.0 Paint shade : Shall be given during Detailed engg
- 15.0 Degree Of protection for motor/ terminal box : As per IS 4691

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Vishnu Jha



TITLE

LV MOTORS

DATA SHEET-A

2x500 MW NEYVELI NEW THERMAL POWER
STATION (NNTPS)

SPECIFICATION NO. PE-TS-400--552-A000

VOLUME II B

SECTION D

REV NO. DATE 02.08.2014

SHEET 1 OF 2

*** LT motors of continuous duty shall be energy efficient IE2 class conforming to IS12615
16.0 TESTING**

16.1 Type Tests

For HT & LT Motors above 50kW, type test reports for type tests as per IS: 325/ IS: 12615 conducted on equipment similar to those proposed to be supplied and carried out within last five years from the date of bid opening viz. February 2012 shall be submitted. However, if such reports are not available, one motor of each type shall be subjected to type tests for free of cost.


16.2 Routine Tests

All motors shall be subjected to routine tests as per IS: 325/ IS: 12615 in the presence of customer or customer representative.


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Vignesh Jais

	TITLE	SPECIFICATION NO.
	MOTOR DATA SHEET - C	VOLUME II B
		SECTION D
		REV NO. 00 DATE 29/08/2005
		SHEET 1 OF 2

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

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			

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 Vikram Jais

	TITLE	SPECIFICATION NO.
	MOTOR DATA SHEET - C	VOLUME II B
		SECTION D
		REV NO. 00 DATE 29/08/2005
		SHEET 2 OF 2

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


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 Vikram Jais

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			



QUALITY PLAN

SHEET 1 OF 9

CUSTOMER :

PROJECT

SPECIFICATION :

BIDDER/ VENDOR

QUALITY PLAN
NUMBER PED-506-00-Q-007, REV-03

SPECIFICATION :

SYSTEM

ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)

SECTION

VOLUME III

1 SL. NO.	2 COMPONENT/OPERATION	3 CHARACTERISTIC CHECK	4 CAT.	5 TYPE/METHOD OF CHECK	6 EXTENT OF CHECK	7 REFERENCE DOCUMENT	8 ACCEPTANCE NORM	9 FORMAT OF RECORD	10 AGENCY			11 REMARKS
									P	W	V	
1.0	RAW MATERIAL & BOUGHT OUT CONTROL											
1.1	SHEET STEEL, PLATES, SECTION, EYEBOLTS	1.SURFACE CONDITION	MA	VISUAL	100%	-	FREE FROM BLINKS, CRACKS, WAVINESS ETC	LOG BOOK	3	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANFR'S DRG./SPEC	MANFR'S DRG./SPEC	-DO-	3	-	-	
		3.PROOF LOAD TEST (EYE BOLT)	MA	MECH. TEST	-DO-	-DO-	-DO-	INSPEC. REPORT	3	-	2	
1.2	HARDWARES	1.SURFACE CONDITION	MA	VISUAL	100%		FREE FROM CRACKS, UN-EVENNESS ETC.	-DO-	3	-	-	
		2.PROPERTY CLASS	MA	VISUAL	SAMPLES	MANFR'S DRG./SPEC BOOK	RELEVANT IS/SPEC.	SUPPLIERS TC & LOG	3	-	2	PROPERTY CLASS MARKING SHALL BE CHECKED BY THE VENDOR
1.3	CASTING	1.SURFACE CONDITION	MA	VISUAL	100%		FREE FROM CRACKS, BLOW HOLES ETC.	LOG BOOK	3	-	2	
		2.CHEM. & PHY. PROP.	MA	CHEM & MECH TEST	1/HEAT NO.	MANFR'S DRG./SPEC	RELEVANT IS/	SUPPLIER'S TC	3	-	2	HEAT NO. SHALL BE VERIFIED
		3.DIMENSIONS	MA	MEASUREMENT	100%	MANUFR'S DRG.	MANUFR'S DRG.	LOG BOOK	3	-	2	
1.4	PAINT & VARNISH	1.MAKE, SHADE, SHELF LIFE & TYPE	MA	VISUAL	100% CONTINUOUS	MANFR'S DRG./SPEC	MANFR'S DRG./SPEC	LOG BOOK	3	-	2	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

S. A. K.



QUALITY PLAN

SHEET 2 OF 9

			CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
			BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION			VOLUME III			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
1.5	SHAFT (FORGED OR ROLLED)	1. SURFACE COND.	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	-	VENDOR'S APPROVAL IDENTIFICATION SHALL BE MAINTAINED
		2. CHEM. & PHYSICAL PROPERTIES	MA	CHEM. & PHYSICAL TESTS	1/HEAT NO. OR HEAT TREATMENT BATCH NO	MFG. DRG. SPEC.	RELEVANT IS	SUPPLIER'S TC	3	-	2	
		3. DIMENSIONS	MA	MEASUREMENT	100%	-DO-	MANUFR'S DRG.	LOG BOOK	3	-	2	
		4. INTERNAL FLAWS	CR	UT	-DO-	ASTM-A388	MANUFR'S SPEC. BHEL SPEC.	-DO-	3	2	1	
1.6	SPACE HEATERS, CONNECTORS, TERMINAL BLOCKS, CABLES, CABLE LUGS, CARBON BRUSH TEMP. DETECTORS, RTD, BTD'S	1. MAKE & RATING	MA	VISUAL	-DO-	MANUFR'S DRG. SPEC.	MANUFR'S DRG. SPEC.	-DO-	3	-	2	
		2. PHYSICAL COND.	MA	-DO-	-DO-	-	NO PHYS. DAMAGE, NO ELECTRICAL DISCONTINUITY	-DO-	3	-	2	
		3. DIMENSIONS (WHEREVER APPLICABLE)	MA	MEASUREMENT	SAMPLE	MANUFR'S DRG./ SPEC.	MANUFR'S DRG. / SPEC.	-DO-	3	-	2	
		4. PERFORMANCE/ CALIBRATION	MA	TEST	100%	-DO-	-DO-	INSP. REPORT	3	-	2	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

S. A. K. K. K.
 Project Officer



QUALITY PLAN

SHEET 3 OF 9

CUSTOMER :

PROJECT

SPECIFICATION :

BIDDER/ VENDOR

QUALITY PLAN

NUMBER :

SYSTEM

NUMBER PED-506-00-Q-007, REV-03

SPECIFICATION :

TITLE

SECTION

VOLUME III

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
1.7	OTHER INSULATING MATERIALS LIKE SLEEVES, BINDINGS CORDS, PAPERS, PRESS BOARDS ETC.	1. SURFACE COND. ETC. 2. OTHER CHARACTERISTICS	MA MA	VISUAL TEST	100% SAMPLE	- MANUF'S SPEC.	NO VISUAL DEFECTS MANUF'S SPEC.	INSPT. REPORT LOG BOOK AND OR SUPPLIER'S TC	3 3	- -	2 2	
1.8	SHEET STAMPING (PUNCHED)	1. SURFACE COND. 2.DIMENSIONS INCLUDING BURS HEIGHT 3. ACCEPTANCE TESTS	MA MA MA	VISUAL MEASUREMENT ELECT. & MECH TESTS	100% SAMPLE -DO-	- MANUFR'S DRG. . MANUF'S SPEC./ RELEVANT IS	NO VISUAL DEFECTS (FREE FROM BURS) MANUFR'S DRG. RELEVANT IS	LOG BOOK -DO- SUPPLIER'S TC	3 3 3	- -	- 2 2	FOR MV MOTOR INSULATION/VARNISH THICKNESS SHALL BE MORE THAN THE BURS HEIGHT
1.9	CONDUCTORS	1. SURFACE FINISH 2.ELECT. PROP. & MECH. PROP	MA MA	VISUAL ELECT. & MECH.TEST	100% SAMPLES	- RELEVANT IS/ BS OR OTHER STANDARDS	FREE FROM VISUAL DEFECTS RELEVANT IS/ BS OR OTHER STANDARDS	LOG BOOK SUPPLIERS TC & VENDOR'S INSPN. REPORTS	3* 3	- -	2* 2	* MOTOR MANUFACTURER TO CONDUCT VISUAL CHECK FOR SURFACE FINISH ON RANDOM BASIS (10% SAMPLE) AT HIS WORKS AND MAINTAIN RECORD FOR VERIFICATION BY BHEL/CUSTOMER.
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			



QUALITY PLAN

SHEET 4 OF 9

CUSTOMER :

PROJECT

SPECIFICATION :

BIDDER/
VENDOR

TITLE
QUALITY PLAN
NUMBER PED-506-00-Q-007, REV-03

NUMBER :
SPECIFICATION :
TITLE

SYSTEM

ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)

SECTION VOLUME III

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
1.10	BEARINGS	3.DIMENSIONS	MA	MEASUREMENT	-DO-	-DO-	-DO-	Log Book	3	-	2	
		1.MAKE & TYPE	MA	VISUAL	100%	MANFR'S DRG./ APPROVED DATASHEET	MANFR'S DRG./ APPROVED DATASHEET	-DO-	3	-	2	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	BHEL DATA SHEET	BHEL DATA SHEET BEARING MANUF'S CATALOGUES	-DO-	3	-	2	
1.11	SLIP RING (WHEREVER APPLICABLE)	3.SURFACE FINISH	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	2	
		1.SURFACE COND.	MA	VISUAL	100%	-	-DO-	-DO-	3	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANUF'S DRG	MANUF'S DRG	-DO-	3	-	-	
		3.TEMP.WITH-STAND CAPACITY	MA	ELECT.TEST	-DO-	MANUF'S SPEC./ BHEL SPEC.	MANUF'S SPEC./ BHEL SPEC.	-DO-	3	-	2	
1.12	OIL SEALS & GASKETS	4.HV/IR	MA	-DO-	100%	-DO-	-DO-	-DO-	3	-	2	
		1.MATERIAL OF GASKET	MA	VISUAL	100%	MANUF'S DRG/SPECS	MANUF'S DRG./ SPECS.	-DO-	3	-	-	
		2.SURFACE COND.	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	-	
		3.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANUF'S DRG	MANUF'S DRG	-DO-	3	-	-	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

S. A. K.



QUALITY PLAN

SHEET 5 OF 9

CUSTOMER :	PROJECT TITLE	SPECIFICATION : NUMBER :
BIDDER/ VENDOR SYSTEM	QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03 ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)	SPECIFICATION : TITLE SECTION VOLUME III

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
2.0	IN PROCESS											
2.1	STATOR FRAME WELDING (IN CASE OF FABRICATED STATOR)	1.WORKMANSHIP & CLEANNESS	MA	VISUAL	100%	-DO-	GOOD FINISH	LOG BOOK	3/2	2	-	
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	MANUF'S DRG	MANUF'S DRG	-DO-	2	-	-	
2.2	MACHINING	1.FINISH	MA	VISUAL	100%	-DO-	GOOD FINISH	LOG BOOK	2	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	MANUF'S DRG	MANUF'S DRG	-DO-	2	-	-	
		3.SHAFT SURFACE FLOWS	MA	PT	-DO-	RELEVENT SPEC./ ASTM-E165	MANUF'R'S SPEC./ BHEL SPEC./	-DO-	2	-	1	
2.3	PAINTING	1.SURFACE PREPARATION	MA	VISUAL	100%	MANFR'S SPEC/BHEL SPEC./ RELEVANT STAND	BHEL SPEC. SAME AS COL.7	LOG BOOK	2	-	-	
		2.PAINT THICKNESS (BOTH PRIMER & FINISH COAT)	MA	MEASUREMENT BY ELCOMETER	SAMPLE	-DO-	-DO-	-DO-	2	-	-	
		3.SHADE	MA	VISUAL	-DO-	-DO-	-DO-	Log Book	2	-	-	
		4.ADHESION	MA	CROSS CUTTING & TAPE TEST	-DO-	-DO-	-DO-	Log Book	2	-	-	
BHEL			PARTICULARS		BIDDER/VENDOR							
			NAME									
			SIGNATURE									
			DATE					BIDDER'S/VENDORS COMPANY SEAL				

S. A. K.



QUALITY PLAN

CUSTOMER :

PROJECT
TITLE

SPECIFICATION :
NUMBER :

BIDDER/
VENDOR

QUALITY PLAN
NUMBER PED-506-00-Q-007, REV-03

SPECIFICATION :
TITLE

SHEET 6 OF 9


SYSTEM

ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)

SECTION VOLUME III

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
2.4	SHEET STACKING	1.COMPLETENESS	MA	MEASUREMENT	SAMPLE	MANUFR'S SPEC.	MANUFR'S SPEC.	Log Book	2	-	-	(FOR MOTORS OF 2MW AND ABOVE) * ON 10% RANDOM SAMPLE
		2.COMPRESSION & TIGHTENING	MA	MEASUREMENT	100%	-DO-	-DO-	Log Book	2	-	-	
		3.CORE LOSS & HOTSPOT	MA	ELECT.TEST	-DO-	-DO-	-DO-	Log Book	2	1*	1	
2.5	WINDING	1.COMPLETENESS	CR	VISUAL	100%	MANUFR'S SPEC./BHEL SPEC.	MANUFR'S SPEC./BHEL SPEC.	Log Book	2	-	-	
		2.CLEANLINESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-	
		3.IR-HV-IR	CR	ELECT. TEST	-DO-	-DO-	-DO-	Log Book	2	-	1	
		4.RESISTANCE	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	
		5.INTERTURN INSULATION	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-	
		6.SURGE WITH STAND AND TAN. DELTA TEST	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	
2.6	IMPREGNATION	1.VISCOSITY	MA	PHY. TEST	AT STARTING	-DO-	-DO-	Log Book	2	-	-	
		2.TEMP. PRESSURE VACCUM	MA	PROCESS CHECK	CONTINUOUS	-DO-	-DO-	Log Book	2	-	-	
		3.NO. OF DIPS	MA	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	THREE DIPS TO BE GIVEN
BHEL			PARTICULARS		BIDDER/VENDOR							
			NAME									
			SIGNATURE									
			DATE					BIDDER'S/VENDORS COMPANY SEAL				

S. A. K. K. K.
 Project Officer

		QUALITY PLAN			CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :		
SHEET 8 OF 9		BIDDER/ VENDOR			SYSTEM			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	SECTION VOLUME III			REMARKS	
									P	W	V		
1	2	3	4	5	6	7	8	9	10			11	
3.0	TESTS	1. TYPE TESTS INCLUDING SPECIAL TESTS AS PER BHEL SPEC.	MA	ELECT. TEST	1/TYPE/SIZE	IS-325/ BHEL SPEC./ DATA SHEET	IS-325/ BHEL SPEC./ DATA SHEET	TEST REPORT	2	1*	1	* NOTE - 1	
		2. ROUTINE TESTS INCLUDING SPECIAL TEST AS PER BHEL SPEC.	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1 ^s	1	^s NOTE - 2	
		3. VIBRATION & NOISE LEVEL	MA	-DO-	100%	IS-12075 & IS-12065	IS-12075 & IS-12065	-DO-	2	1 ^s	1	^s NOTE - 2	
		4. OVERALL DIMENSIONS AND ORIENTATION	MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPC. REPORT	2	1	-		
		5. DEGREE OF PROTECTION	MA	ELECT. & MECH. TEST	1/TYPE/ SIZE	RELEVANT IS	BHEL SPEC. AND DATA SHEET	TC	2	-	1	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3	
		6. MEASUREMENT OF RESISTANCE OF RTD & BTD	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1 ^s	1	^s NOTE - 2	
		7. MEASUREMENT OF RESISTANCE, IR OF SPACE HEATER	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1 ^s	1	^s NOTE - 2	
		8. NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPC. REPORT	2	1 ^s	1	^s NOTE - 2	
		9. EXPLOSION FLAME PROOF NESS (IF SPECIFIED)	MA	EXPLOSION FLAME PROOF TEST	1/TYPE	IS-3682 IS-8239 IS-8240	IS-3682 IS-8239 IS-8240	TC	2	-	1	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3	
		10. PAINT SHADE, THICKNESS & FINISH	MA	VISUAL & MEASUREMENT BY ELKOMETER	SAMPLE	BHEL SPEC. & DATA SHEET	BHEL SPEC. & DATA SHEET	TC	2	1 ^s	1	SAMPLING PLAN TO BE DECIDED BY INSPECTION AGENCY ^s NOTE - 2	
BHEL			PARTICULARS			BIDDER/VENDOR							
			NAME										
			SIGNATURE										
			DATE						BIDDER'S/VENDORS COMPANY SEAL				


 S. A. K. Saha
 Project Officer

