

**KARNATAKA POWER  
CORPORATION LIMITED**

**1x370 MW YELAHANKA  
COMBINED CYCLE POWER  
PLANT**

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**VOLUME – II – B**

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**TECHNICAL SPECIFICATION  
FOR**

**AIR CONDITIONING SYSTEM**

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**SPECIFICATION NO. : PE-TS-409-553-A001 Rev 0**



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



**1x370MW YELAHANKA CCPP  
AIR CONDITIONING SYSTEM  
INDEX**

**SPECIFICATION No: PE-TS-409-553-A001**

**VOLUME: II B & III**

**REV. 00**

**DATE: MARCH 2016**

**SHEET : 1 OF 2**

**VOLUME – IIB**

<b>SECTIONS</b>	<b>TITLE</b>	<b>Page No</b>		
<b>SECTION-A</b>	INTENT OF SPECIFICATION	5		
<b>SECTION-B</b>	PROJECT INFORMATION WITH WIND AND SEISMIC DESIGN CRITERIA	8		
<b>SECTION-C</b>	TECHNICAL SPECIFICATIONS	10		
	<b>SECTION-C1</b>	SPECIFIC TECHNICAL REQUIREMENT	11	
	<b>SECTION-C2</b>	CUSTOMER SPECIFICATION	29	
		<b>C2 - A</b>	TECHNICAL REQUIREMENT	30
		<b>C2 - B</b>	PROJECT SPECIFIC GENERAL REQUIREMENTS	31
		<b>C2 - C</b>	PAINTING SPECIFICATIONS	32
	<b>SECTION-C3</b>	TECHNICAL SPECIFICATION (ELECTRICAL PORTION)	36	
	<b>SECTION-C4</b>	TECHNICAL SPECIFICATION (C&I PORTION)	65	
<b>SECTION-D</b>	STANDARD TECHNICAL SPECIFICATIONS	144		

<b>SECTION-E</b>	<b>ANNEXURE-I</b>	LIST OF MAKES OF SUB-VENDOR ITEMS	212
	<b>ANNEXURE-II</b>	MANDATORY SPARE LIST	216
	<b>ANNEXURE-III</b>	PAINTING & COLOUR SCHEME	219
	<b>ANNEXURE-IV</b>	LIST OF TOOLS & TACKLES	220
	<b>ANNEXURE-V</b>	SERVICE WATER ANALYSIS	222
	<b>ANNEXURE-VI</b>	DRAWINGS / DOCUMENTS SUBMISSION PROCEDURE	224
	<b>ANNEXURE-VII</b>	INSPECTION AND TESTING	227
	<b>ANNEXURE-VIII</b>	MASTER DRAWING LIST WITH SCHEDULE OF SUBMISSION	231
	<b>ANNEXURE-IX</b>	FORMAT FOR OPERATION AND MAINTENANCE MANUAL	234
	<b>ANNEXURE-X</b>	SITE STORAGE AND PRESERVATION	238



**1x370MW YELAHANKA CCPP  
AIR CONDITIONING SYSTEM  
INDEX**

**SPECIFICATION No: PE-TS-409-553-A001**

**VOLUME: II B & III**

**REV. 00**

**DATE: MARCH 2016**

**SHEET : 2 OF 2**

**VOLUME-III**

<b>SECTIONS</b>	<b>TITLE</b>	<b>Page No</b>
1	LIST OF DOCUMENTS TO BE SUBMITTED WITH BID	255
2	COMPLIANCE CUM CONFIRMATION CERTIFICATE	256
3	PRE BID CLARIFICATION SCHEDULE	258
4	NO DEVIATION CERTIFICATE	259
5	GUARANTEED POWER CONSUMPTION	261
6	SUGGESTIVE PRICE FORMAT INCLUDING MANDATORY SPARES ALONGWITH PERCENTAGE BREAKUP	262
8	<b>DRAWINGS</b>	
	<b>DRG TITLE</b>	
a	PID	267
b	TERMINAL DETAIL AND MAKE UP WATER	268
c	MECHANICAL LAYOUT DRAWINGS SHOWING LOCATION OF EQUIPMENT	269
d	TYPICAL EQUIPMENT ARRANGEMENT DRAWING	271
e	PLOT PLAN	274



**1x370MW YELAHANKA CCPP  
AIR CONDITIONING SYSTEM**

**SPECIFICATION No: PE-TS-409-553-A001**

**VOLUME: II B**

**REV. 00**

**DATE: MARCH 2016**

**VOLUME II B**



**1x370MW YELAHANKA CCPP  
AIR CONDITIONING SYSTEM**

**SPECIFICATION No: PE-TS-409-553-A001**

**VOLUME: II B**

**SECTION : A**

**REV. 00**

**DATE: MARCH 2016**

**SHEET 1 OF 3**

**SECTION-A**

**INTENT OF SPECIFICATION**



**1x370MW YELAHANKA CCPP  
AIR CONDITIONING SYSTEM**

**SPECIFICATION No: PE-TS-409-553-A001**

**VOLUME: II B**

**SECTION : A**

**REV. 00**

**DATE: MARCH 2016**

**SHEET 1 OF 3**

**1.0 INTENT OF SPECIFICATION**

- 1.1 The specification covers design, engineering, manufacture, supply / procurement, inspection and testing at vendor's / sub vendor's / manufacturer's works, painting, forwarding, proper packing and shipment and delivery at site, unloading, handling & transportation, storage, preservation , security / safety at site , Erection & Commissioning, minor civil & structural (as applicable) works as required on FOR site basis, Performance and guarantee testing / demonstration testing and handing over to BHEL's customer of **AIR CONDITIONING SYSTEM** as per details in different sections / volumes of this specification and various pre award agreements for **1X370 MW YELAHANKA CCPP**.
- 1.2 The contractor shall be responsible for providing all material, equipment & services, which are required to fulfil the intent of ensuring operability, maintainability, reliability and complete safety of the complete work covered under this specification, irrespective of whether it has been specifically listed herein or not. Omission of specific reference to any component / accessory necessary for proper performance of the equipment shall not relieve the contractor of the responsibility of providing such facilities to complete the supply, erection and commissioning, performance and guarantee/demonstration testing of **AIR CONDITIONING SYSTEM**.
- 1.3 It is not the intent to specify herein all the details of design and manufacture. However, the equipment shall conform in all respects to highest standards of design, engineering and workmanship and shall be capable of performing the required duties in a manner acceptable to purchaser who will interpret the meaning of drawings and specifications and shall be entitled to reject any work or material which in his judgement is not in full accordance herewith.
- 1.4 The extent of supply under the contract includes all items shown in the drawings, notwithstanding the fact that such items may have been omitted from the specification or schedules. Similarly, the extent of supply also includes all items mentioned in the specification and /or schedules, notwithstanding the fact that such items may have been omitted in the drawing. Similarly, the extent of supply also includes all Items required for completion of the system and not withstanding that they may have been omitted in drawings / specifications or schedules.
- 1.5 The general term and conditions, instructions to tenderers and other attachment referred to elsewhere are made part of the tender specification. The equipment materials and works covered by this specification is subject to compliance to all attachments referred to in the specification. The bidder shall be responsible for and governed by all requirements stipulated herein.
- 1.6 While all efforts have been made to make the specification requirement complete & unambiguous, it shall be bidders' responsibility to ask for missing information, ensure completeness of specification, to bring out any contradictory / conflicting requirement in different sections of the specification and within a section itself to the notice of BHEL and to seek any clarification on specification requirement in the format enclosed under Vol-III of the specification **within 10 days of receipt of tender documents**. In absence of



**1x370MW YELAHANKA CCPP  
AIR CONDITIONING SYSTEM**

**SPECIFICATION No: PE-TS-409-553-A001**

**VOLUME: II B**

**SECTION : A**

**REV. 00**

**DATE: MARCH 2016**

**SHEET 1 OF 3**

any such clarifications, in case of any contradictory requirement, the more stringent requirement as per interpretation of Purchaser / Customer shall prevail and shall be complied by the bidder without any commercial implication on account of the same. Further in case of any missing information in the specification not brought out by the prospective bidders as part of pre-bid clarification, the same shall be furnished by Purchaser/ Customer as and when brought to their notice either by the bidder or by purchaser/ customer themselves. However, such requirements shall be binding on the successful bidder without any commercial & delivery implication.

- 1.7 The bidder's offer shall not carry any sections like clarification, interpretations and /or assumptions.
- 1.8 Deviations, if any, should be very clearly brought out clause by clause along with cost of withdrawal in the enclosed schedule (in Vol – III); otherwise, it will be presumed that the vendor's offer is strictly in line with NIT specification. If no cost of withdrawal is given against the deviation, it will be presumed that deviation can be withdrawn without any cost to BHEL/its customer.
- 1.9 In the event of any conflict between the requirements of two clauses of this specification documents or requirements of different codes and standards specified, Section - C shall prevail over section – D, however more stringent requirement as per the interpretation of the owner shall apply.
- 1.10 In case all above requirements are not complied with, the offer may be considered as incomplete and would become liable for rejection.
- 1.11 For definition of word like Contractor, bidder, supplier, vendor, Customer/ Purchaser Employer, consultant, please referred relevant clause



**1x370MW YELAHANKA CCPP  
AIR CONDITIONING SYSTEM**

**SPECIFICATION No: PE-TS-409-553-A001**

**VOLUME: II B**

**SECTION : B**

**REV. 00**

**DATE: MARCH 2016**

**SHEET : 1 OF 2**

**SECTION: B**

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

## Yelahanka 1x350 MW CCPP Plant details

1	Topographical Details of site	
	a Latitude	:13 Deg 7 Min
	b longitude	:77 Deg 35Min
	c Elevation	: 900 Mtr (Please Refer the Contour Map)
2	Highest Flood level	: Not applicable and can be finalized by studying the Plant Topography
3	Elevation	: 900 Mtr (Please Refer the Contour Map)
4	Annual Mean of Daily Max Temp	37.Deg.cent
5	Annual Mean of Daily Min Temp	11.5 Deg cent
6	Highest Temp Recorded	39.Deg Cent
7	LowestTemp Recorded	9.9 Deg Cent
8	Desigen Temperature	28.0 Deg Cent.
9	Relative Humidity	at 830hrs 79%
		at 1730 hrs 52%
10	Annula total Rain Fall ( Max rain fall during July to Oct )	970 mm
11	Design Wind Speed	33M/sec (As per IS: 875)
12	Earthquake Zone	Seismic Zone II As per IS 1893



**1x370MW YELAHANKA CCPP  
AIR CONDITIONING SYSTEM  
TECHNICAL SPECIFICATION**

**SPECIFICATION No: PE-TS-409-553-A001**

**VOLUME: II B**

**SECTION : C**

**REV. 00**

**DATE: MARCH 2016**

**SECTION: C**

**TECHNICAL SPECIFICATIONS**



**1x370MW YELAHANKA CCPP  
AIR CONDITIONING SYSTEM  
SPECIFIC TECHNICAL REQUIREMENT**

**SPECIFICATION No: PE-TS-409-553-A001**

**VOLUME: II B**

**SECTION : C 1**

**REV. 00**

**DATE: MARCH 2016**

**SHEET : 1 OF 18**

**SECTION: C 1**

**SPECIFIC TECHNICAL REQUIREMENT**



**1x370MW YELAHANKA CCPP  
AIR CONDITIONING SYSTEM  
SPECIFIC TECHNICAL REQUIREMENT**

**SPECIFICATION No: PE-TS-409-553-A001**

**VOLUME: II B**

**SECTION : C 1**

**REV. 00**

**DATE: MARCH 2016**

**SHEET : 2 OF 18**

**1.0 FUNCTION**

**1.1 The purpose of this document is to bring out clarity with regard to the following:**

- a) System description and Basic operation & Control Philosophy
- b) Major technical requirements of various items covered under this package
- c) Scope, terminal points, exclusion
- d) Layout requirement

**2.0 SYSTEM DESCRIPTION**

**2.1 MAIN POWER HOUSE BUILDING & SERVICE CUM CONTROL BUILDING (AC PLANT – 1)**

**a) A Central Chilled water type air conditioning plant is provided to cater to the air conditioning requirements of the following areas :**

- Common Control Room.
- Control Equipment Rooms.
- UPS (Uninterrupted Power Supply) and Battery charger Room.
- Computer Room
- Shift incharge room
- Maintenance engineer room
- Office area of service cum control building.
- Electrical testing lab
- C&I testing lab
- conference room
- SWAS Room
- Record room of power house.

In case any of the above area is not in the vicinity of the control room areas the same shall be air conditioned through split AC's.

**b)** The air conditioning plant shall comprise of (2 x 100%) Screw Chilling machines. The condenser cooling & chilled water shall be circulated through these units by means of 2 x 100% horizontal centrifugal pump sets and 2 x 100% FRP cooling towers. The chilled water produced by the chilling units shall be circulated to the air handling units by means horizontal centrifugal pump sets. AHU room shall be located adjacent to or just above air-conditioned areas in Power House Building (each AHU room in power house shall contain 2 x 100% capacity AHU whereas 1 x 100% capacity in service building). The conditioned air from AHUs is distributed to the air-conditioned areas by galvanised sheet steel ducting (Zn coating conform to IS: 277 Gr. 275) and extruded Aluminium grilles / diffusers with volume control dampers and supporting frames. The return air is led back to the AHU Room Except charger and UPS room where in ducts for air conditioned areas at 11.5M level in power house, For balance areas, i.e. air conditioned areas at different floors of service cum control building, the return air is collected above the false



**1x370MW YELAHANKA CCPP  
AIR CONDITIONING SYSTEM  
SPECIFIC TECHNICAL REQUIREMENT**

**SPECIFICATION No: PE-TS-409-553-A001**

**VOLUME: II B**

**SECTION : C 1**

**REV. 00**

**DATE: MARCH 2016**

**SHEET : 3 OF 18**

ceiling/return air duct depending upon the feasibility and led back to the AHU rooms which acts as mixing plenum for return and fresh air.

- c) Controls for the AC & Ventilation (common) shall be PLC based.
- d) 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 outside BC Bay near col no 1 of Power House Building.
- e) The AHUs for this AC Plant would be located as under:
  - AHU Room at 17 M level of Power House Building in B-C Bay for AC areas at 11.5 m level.
  - AHU Room at 0 M level of Service cum control building in A-C Bay col 1-2 for AC areas at 0 m level.
  - AHU Room at 4.5 M level of Service cum control building in A-C Bay col 1-2 for AC areas at 4.5 m level.
  - AHU Room at 11.5 M level of Service cum control building in A-C Bay col 1-2 for AC areas at 11.5 m level.
- f) The Cooling Towers shall be located at 17.0 M lvl, Make-up water Storage Tank and Expansion Tank shall be located at 22.5 M level in BC Bay.
- g) 3T electric hoist with monorail for AC plant shall be provided for the AC Plant room only for maintenance purpose.

**2.2 CHEMICAL LAB (AC plant - 2)**

Multiple Non ductable split AC's shall be provided to cater to the air conditioning requirements of Chemical lab areas i.e. water analysis lab, oil & gas analysis lab, general equipment lab and office areas.

**2.3 SPLIT TYPE AIR CONDITIONERS**

Split type air conditioners (air cooled) shall be provided to cater to the air conditioning requirements of PLC areas having workstation for auxiliary plant. For areas requiring multiple working split ACs, One (1) No. standby (of same capacity) shall be provided.

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

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

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

**3.0 DESIGN CRITERIA**

**3.1 SYSTEM DESIGN CRITERIA - AIR CONDITIONING SYSTEM**

The outside design conditions considered are as follows:-



**1x370MW YELAHANKA CCPP  
AIR CONDITIONING SYSTEM  
SPECIFIC TECHNICAL REQUIREMENT**

**SPECIFICATION No: PE-TS-409-553-A001**

**VOLUME: II B**

**SECTION : C 1**

**REV. 00**

**DATE: MARCH 2016**

**SHEET : 4 OF 18**

	<b>Summer</b>	<b>Monsoon</b>	<b>Winter</b>
DBT (°C)	35.6	27.8	14.4
WBT (°C)	25.6	25.6	12.2

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

The inside design conditions to be maintained in all Air conditioned areas are:  $24 \pm 1^\circ\text{C}$  & RH  $50\% \pm 5\%$

- 3.3** A design margin of 12.5%, 10% & 10% margins on sensible heat, latent heat & overall heat respectively shall be considered in heat load calculation.
- 3.4** For winter heating load calculation, 50% of combined light load and eqpt. / Panel load as available in the room shall be considered.
- 3.5** Minimum 1.5 air change per hour or 35 CMH per person, whichever is higher shall be considered.
- 3.6** Lighting load shall be minimum 2 W / Sq. ft. or actual whichever is higher shall be considered.
- 3.7** The Occupancy for various areas shall be as under:
- For General area such (Service building floors) shall be minimum one person per 3 Sq. M.
  - For conference room the same shall be one person per 1.5 Sq. M.
  - For CCR, CER and UPS area (which are usually unmanned/ having very low occupancy) shall be one person per 15 Sq. M or occupancy shall be as per actual seating arrangement whichever is higher.
- 3.8** Coil face area of Air handling units shall be designed considering a face velocity of not more than 2.5 m/sec.
- 3.9** The air distribution system shall be sized to have a constant frictional drop along its length and velocity through ducts shall not exceed 7.6 m/.
- 3.10** Fire dampers shall be of continuous rated type. Motorized fire damper of 120 min fire rating shall be installed at supply and return air duct at suitable locations where duct pass through wall & floors for ease of isolation, maintenance and as well as for emergency operation. Fire damper in the supply air duct shall be closed on receiving fire signal from fire protection system through PLC Control Panel of AC Plant and shall also be possible to close manually.
- 3.11** The motors shall be designed for operation at 50 C temperature.
- 3.12** All the equipment's of air conditioning system shall be designed for continuous duty.
- 3.13** Design chilled water flow shall not be less than 0.7 m<sup>3</sup>/h per TR air-conditioning load and design condenser cooling water flow shall not be less than 0.9 m<sup>3</sup>/h per TR air conditioning load.
- 3.14** Water piping shall be sized for a maximum velocity of 2.5 m/s. However gravity flow/ pump suction line shall be sized for a maximum water velocity of 1.5 m/s.
- 3.15** A design margin of 10% on grand total heat is considered while designing the AC Plant capacity for each area.
- 3.16** For pumps, continuous motor rating (at 50 deg C ambient) shall be at least 15% above the maximum load demand of the pump in the entire operating range.
- 3.17** All motors shall have output at least 15% higher than the equipment power required (including drive loss) on entire operation range and shall be suitable for operation at 50 deg. C ambient.



**1x370MW YELAHANKA CCPP  
AIR CONDITIONING SYSTEM  
SPECIFIC TECHNICAL REQUIREMENT**

**SPECIFICATION No: PE-TS-409-553-A001**

**VOLUME: II B**

**SECTION : C 1**

**REV. 00**

**DATE: MARCH 2016**

**SHEET : 5 OF 18**

**3.18** False ceiling shall be provided 3m above the finished floor level and shall be of non-luminous (opaque) type fire resistant material.

**3.19** Smoke detector shall be integral part of fire damper as per OEM manufacturer.

**4.0 SYSTEM CAPACITY AND CONFIRUATION:**

**a) For AC Plant-1 (Main power house building & Service cum control building):**

To meet the AC requirement, 2 X 200 TR (actual capacity) water cooled screw chillers (1 working + 1 Standby) shall be provided.

**b) For AC Pant-2 (Chemical lab):**

To meet the AC requirement, multiple split AC's shall be provided with 1 no of split ac as stand by.

**5.0 LAYOUT CONSIDERATIONS:**

**a) AC PLANT-1**

- i. TWO (2) nos. Screw chilling machines (1 working + 1 standby) complete with all accessories as described here in after.
- ii. TWO (2) Nos. Horizontal Split Casing/back pullout type Centrifugal Condenser Water Pump Sets (1 W + 1 SB) each complete with all accessories.
- iii. TWO (2) Nos. Horizontal Split Casing/ back pullout type Centrifugal Chilled Water Pump Sets (1W + 1 SB) each complete with all accessories.
- iv. TWO (2) Nos. Fiber glass reinforced plastic (FRP) construction Cooling Towers (1W + 1 SB) each CT complete with all accessories i.e. fan, motor, FRP basin, nozzles, level switch, make up connection, drains, piping, valves & fittings, strainer, ladder and supporting structure etc.
- v. Air Handling Units (AHUs).
  - 2 x 100% sheet metal cabinet type (double skin) air handling units of sectionalized construction each complete with all accessories as described hereinafter, to match the AC load of Central Equipment Room (CER), Common Control room (CCR), shift incharge room, computer room, battery charger room, UPS panel room etc. at 11.5 M level of Control Tower.
  - 1 x 100 % sheet metal cabinet type (double skin) air handling units of sectionalized construction each complete with all accessories as described hereinafter, to match the AC load of Common Control room (CCR), shift incharge room, maintenance engineer room etc. at 11.5 M level of Service cum control building
  - 1 x 100 % sheet metal cabinet type (double skin) air handling units of sectionalized construction each complete with all accessories as described hereinafter, to match the AC load of Library, office area, conference room etc. at 4.5M level of service cum control building.
  - 1 x 100 % sheet metal cabinet type (double skin) air handling units of sectionalized construction each complete with all accessories as described hereinafter, to match the AC load of conference room, C&I testing lab, electrical testing lab, telephone exchange etc. at 0 M level of service cum control building.



**1x370MW YELAHANKA CAPP  
AIR CONDITIONING SYSTEM  
SPECIFIC TECHNICAL REQUIREMENT**

**SPECIFICATION No: PE-TS-409-553-A001**

**VOLUME: II B**

**SECTION : C 1**

**REV. 00**

**DATE: MARCH 2016**

**SHEET : 6 OF 18**

- vi. Pan type humidifier in each AHU room.
- vii. Lot – Pre-filters (inside the pre-filter section of the AHUs at suction side)
- viii. Lot - Fine filters (shall be provided at common discharge of AHUs).
- ix. Condenser water piping.
- Lot- condenser water piping interconnecting condensers, cooling tower, pumps etc. complete with strainers, valves, fittings etc. Black steel pipe conforming to IS-1239, upto 150 NB, Part I, heavy grade or IS-3589 (6 mm thk), 200 NB and above depending upon pipe size shall be used.
- x. Chilled water piping
- Lot- chilled water piping with insulation interconnecting chiller, air-handling units and pumps sets complete with valves and fittings such as elbows, tees, reducers, flanges etc. Black steel pipe conforming to IS-1239, upto 150 NB part I, heavy grade or IS-3589 (min. 6mm thk), 200 NB and above depending upon pipe size shall be used.
  - One No. FRP chilled water expansion tank (1m<sup>3</sup> capacity) complete with valve, Level Gauge, Level Switch, Make-up connection, overflow and drain etc.
- xi. Lot-Drain water piping out of MS pipes conforming to IS-1239, Part I, heavy grade and galvanised as per IS:4736, from various equipment's like chillers, pumps, AHUs, cooling tower area etc. up to the nearest drain point. (Within the room & for Cooling tower up to nearest drain point or rain water pipe on the roof).
- xii. Make up water tank made of MS / FRP complete with valves, level gauge, level switch, make up connection, over flow and drain etc.
- xiii. Lot- 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).
- xiv. Fittings:
- The steel fittings shall conform to ASTM A234 Gr WPB for sizes 65 NB and above. For sizes 50 NB and below, the material shall conform to ASTM A-105.
  - For pipe sizes above 350 NB, fabricated fittings from sheets of adequate thickness may be used. The bend radius in case of mitre bends shall be minimum 1.5 times the nominal pipe diameter and angle between two adjacent sections shall not be more than 22.5 deg and shall be as per BS:2633/BS:534.
  - Fittings, flanges and pipe joints of refrigerant piping shall conform to ANSI B31.5.
- xv. Fire dampers
- The supply and return air ducts shall be provided with motor operated fire damper at locations where duct pass through walls & floors for ease of isolation, maintenance and as well as can be operated manually for emergency operation. The operation of these automatic dampers shall be interlocked the fire alarm system.



**1x370MW YELAHANKA CAPP  
AIR CONDITIONING SYSTEM  
SPECIFIC TECHNICAL REQUIREMENT**

**SPECIFICATION No: PE-TS-409-553-A001**

**VOLUME: II B**

**SECTION : C 1**

**REV. 00**

**DATE: MARCH 2016**

**SHEET : 7 OF 18**

- xvi. Lot – GSS Ducting of zinc coating (conforming to IS 277 Gr.200) sheet metal work including thermal insulation on complete supply air duct & return air duct and acoustic insulation for initial length of 5m from the AHU outlet.
- xvii. Online non chemical type scale preventer shall be provided.
- xviii. 1x100% Duty fresh air fan with pre-filter & fine filter in all AHU Rooms.

**b) AC PLANT-2**

Multiple split AC's as per actual load.

**6.0**

**AC EQUIPMENT DETAILS**

**6.1**

**Water Cooled screw Chiller Package**

**Each chilling package shall comprise of the following:**

- a) Screw compressors (suitable for Refrigerant R-134a/R407C) with motors complete with suction and discharge shut off valves, oil pumps, high pressure cut-out, low pressure cut-out, oil pressure cut-out, built-in automatic capacity control etc.
- b) One (1) No. shell and tube type water cooled condenser made of tested quality steel plate shell and integrally finned copper tubes complete with hot gas inlet, liquid outlet, relief and purge connection for refrigerant and water inlet, water outlet, drain connection etc.
- c) One (1) No. shell and tube type water chiller made of tested quality steel plate shell and seamless copper tubes, plain from outside, integrally surface enhanced complete with liquid inlet and vapour outlet connection for refrigerant and water inlet, water outlet, drain connection etc.
- d) Lot-MS heavy class (IS 1239) seamless refrigerant piping, valves and fittings, inter-connecting compressor, condenser and chiller.
- e) Lot-MS structural frame work with anti-vibration pads.
- f) Initial fill of refrigerant and compressor lube oil
- g) Lot- insulation of suction line and chiller
- h) 150 mm dial type pressure gauges at the inlet and outlet of the condenser and chiller respectively
- i) 150 mm dial type temperature gauges at the inlet and outlet of condenser and chiller respectively
- j) Lot-Controls comprising the following: -
- All controls for Screw chiller are microprocessor based as part of Screw chiller package.
  - Water flow switch at the outlet of the each condenser and chiller.
- k) Accessories (valves, pressure gauges, water flow switches, controls and instruments etc shall be provided with each screw chiller as per customer approved PID.

**6.2**

**CONDENSER WATER PUMP SETS**

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

- a) One No. horizontal split casing/ back pullout type centrifugal pump of adequate capacity to match the package chiller / system requirement.



**1x370MW YELAHANKA CCPP  
AIR CONDITIONING SYSTEM  
SPECIFIC TECHNICAL REQUIREMENT**

**SPECIFICATION No: PE-TS-409-553-A001**

**VOLUME: II B**

**SECTION : C 1**

**REV. 00**

**DATE: MARCH 2016**

**SHEET : 8 OF 18**

- b) One No. adequately sized TEFC sq. cage induction motor suitable for 415 V, 3 phase, 50 Hz AC supply.
- c) One set of base plate, coupling guard, anti-vibration pads, and foundation bolts etc.
- d) Valves, Instruments, other fittings etc. along with condenser water pumps.
  - One No. Y-type strainer at inlet complete with brass screen, drain arrangement, etc.
  - 150 mm dia dial type pressure gauges one each at suction & discharge side of the pump set.
  - Gate valves, one each at suction and discharge side of the pump set.
  - One No. non-return (check) valve at discharge side of pump set.

**6.3 CHILLED WATER PUMP SETS**

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

- a) One No horizontal split casing/ back pullout type centrifugal pump of adequate capacity to match the package chiller/system requirement.
- b) One No adequately sized TEFC sq. cage induction motor suitable for 415 V, 3 phase, 50 Hz AC supply.
- c) One set of base plate, coupling guard, anti-vibration pads, and foundation bolts etc.
- d) Valves, Instruments other fittings etc along with chilled water pumps.
  - One No. Y-type strainer at inlet complete with brass screen, drain arrangement, etc.
  - 150 mm dia dial type pressure gauges one each at suction & discharge side of the pump set.
  - Gate valves, one each at suction and discharge side of the pump set.
  - One No. non-return (check) valve at discharge side of pump set.
  - One No. Pressure Switch at discharge side of pump set.

**6.4 COOLING TOWER**

- a) Induced draft (single cell) FRP type shall consist of all accessories i.e. fan, motor, FRP basin, FRP louver, PVC eliminators nozzles, make up connection, drains overflow & piping, valves & fittings, strainer of brass wire mesh, ladder and supporting structure etc.

**6.5 AIR HANDLING UNIT (DOUBLE SKIN TYPE)**

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

- a) The casing of AHU shall be of double skin construction. Double skin sandwich panels (inside and outside) shall be fabricated using minimum 18G galvanized steel, with 25 mm thick polyurethane insulation of minimum 40 kg/m<sup>3</sup> density in between 16G galvanized steel sheet channel shall be used as reinforcing to give structural strength. Supports made in a 16 G MS structure of sectionalized construction with one coat of rust proof anti corrosive paints followed by two coat of final paint and complete with insulated drain pan, insulated drain piping etc. AHUs shall be cabinet type with Fan section, coil section and filters section.
- b) Fan section complete with forward / backward curved multi-bladed centrifugal fan mounted on a shaft with adjustable motor base.



**1x370MW YELAHANKA CCPP  
AIR CONDITIONING SYSTEM  
SPECIFIC TECHNICAL REQUIREMENT**

**SPECIFICATION No: PE-TS-409-553-A001**

**VOLUME: II B**

**SECTION : C 1**

**REV. 00**

**DATE: MARCH 2016**

**SHEET : 9 OF 18**

- c) One No adequately sized TEFC sq. cage induction motor suitable for 415 V, 3 phase, 50 Hz AC supply with drive package comprising fan pulley, motor pulley, V-belt and belt guard.
- d) Cooling coil section (integral with filter section) with suitably sized chilled water cooling coil made of copper tubes and aluminum fins along with valves for isolation.
- e) Pre filter (50 mm thick having efficiency of 65-80% in accordance with BS: 6540/ASHRAE – 52-76), fine filter (150mm thick having efficiency of 80-90% in accordance with BS: 6540/ASHRAE – 52-76).
- f) Drain piping from the AHUs up to nearest drain point.
- g) Lot – Controls comprising
  - One No. 3 way mixing valve with actuator
  - One No. Proportionating type temperature & RH sensor.
- h) Motors shall be installed inside the AHU.
- i) Accessories (valves, pressure gauges, water flow switches, controls and instruments etc shall be provided with pump as per customer approved PID
- j) Drain piping from the AHUs up to nearest drain point.
- k) Serrated rubber pads for vibration isolation

**6.6 STRIP HEATER PACKAGE AND HUMIDIFICATION PACKAGE**

- a) One set of electrical strip heater package of suitable capacity shall be provided in supply air duct. Heater package shall be connected with thermostat / Humidistat which will be provided in return air path inside AHU Room / Package AC Room.  
  
Temp gauge, temp element shall also be provided and the same shall be hooked with PLC system. RH and temp sensor shall be provided and the same shall be hooked with PLC system.
- 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.

**6.7 SHEET METAL WORK**

- a) Lot – GSS supply and return air Ducting of zinc coating (as per IS-277 Gr.275) complete with vanes, damper, hangers / supports etc.

	Larger dimensions of Duct	Thickness of GS sheet (mm)	Type of Transverse Joint Connection	Bracing
a.	Upto 600	0.63 (24 g)	S-drive, 25 mm pocket or bar slips on 2.5 m centers	30 x 30 x3 angles 1.2 m from joint
b.	601 thru 750	0.63 (24 g)	S-drive, 25 mm pocket or 25 mm bar slips on 2.5 m centers	25 x 25 x 3 angles braced at 1.2 m from joints.
c.	751 thru 1000	0.80 (22 g)	S-drive, 25 mm pocket or 25 mm bar slips on 2.5 m centers	25 x 25 x3 angles Braced at 1.2 m from joints.



**1x370MW YELAHANKA CCPP  
AIR CONDITIONING SYSTEM  
SPECIFIC TECHNICAL REQUIREMENT**

**SPECIFICATION No: PE-TS-409-553-A001**

**VOLUME: II B**

**SECTION : C 1**

**REV. 00**

**DATE: MARCH 2016**

**SHEET : 10 OF 18**

d.	1001 thru 1500	0.80 (22 g)	40 x 40 angle connections or 40 mm pocket or 40 mm bar slips with 35 x 3 bar reinforcing on 2.5 m centers	40 x 40 x 4 angle Braced at 1.2 m from joints.
e.	1501 thru 2200	1.00 (20 g)	40 x 40 angle Connections or 40 mm pocket or 40 mm bar slips with 35 x 3 bar reinforcing on 2.5 m centers.	40 x 40x 4 angle Braced at 600 mm from joints.
f.	2201 and larger	1.25 (18 g)	50 x 50 angle connections or 40 mm pocket or 40 mm bar slips 1 m centers with 35 x 3 bar reinforcing	50 x 50 x 5 angle Braced at 600 mm from joints.

- b) Insulation of supply air AC duct and return air duct (as applicable).
- c) Lot- Supply air diffusers / grilles (Frame and Louvers of Diffuser/Grilles shall be of extruded aluminum of 1.2 mm thick section, duly powder coated) with volume control dampers. Return air Diffusers will have no Volume control Damper.
- d) Lot- Acoustic insulation of first 5M of ducting after AHUs but limited to plenum. Acoustic insulation of 25 mm thick resin bonded glass wool of 48 kg/m<sup>3</sup> density and 30 gauge perforated Aluminium sheet having 5 mm dia perforation at 8 to 10 mm center-to-center distance shall be provided.
- e) Motorized fire damper shall be installed at supply and return air duct at suitable locations where duct pass through wall & floors for ease of isolation, maintenance and as well as for emergency operation. Fire damper in the supply and return air duct shall close on receiving fire signal from fire protection system and shall also be possible manually from remote control panel. Necessary arrangement shall be incorporated in the duct for providing duct mounted multi- sensor detectors in the return air duct for all air conditioned areas. Also respective Air Handling Units, Air washers/UAFs shall trip on receiving fire signal from fire protection system

**6.8 INSULATION**

**Lot-Insulation shall be provided as under:**

S.No	Surface	Insulation Material	Insulation Form	Thickness (mm)	Finish
i)	AC Duct	Resin bonded Fiberglass (IS :8183) Or Aluminium faced Nitrile rubber	Roll / Slab	50  13	F3  No separate finish required
ii)	Acoustic insulation of first 5M of ducting after AHUs but limited to	-do-	Roll / Slab	25	Refer clause no 4.61



**1x370MW YELAHANKA CCPP  
AIR CONDITIONING SYSTEM  
SPECIFIC TECHNICAL REQUIREMENT**

**SPECIFICATION No: PE-TS-409-553-A001**

**VOLUME: II B**

**SECTION : C 1**

**REV. 00**

**DATE: MARCH 2016**

**SHEET : 11 OF 18**

S.No	Surface	Insulation Material	Insulation Form	Thickness (mm)	Finish
	plenum				
iii)	Refrigerant Piping	Expanded polystyrene or resin bonded mineral wool	Pipe Section	75	F-1
iv)	AHU drain pipe	Expanded polystyrene or resin bonded mineral wool	Pipe Section	25	F-1
v)	Chilled water piping, valves & specialties	-do-	Pipe Section	75	F-1
vi)	Chilled Water Pumps	-do-	Slabs	50	F-1
vii)	Expansion tank with pipe	-do-	Slabs	50	F-1
vii)	Chiller	Nitrile Rubber	Slab/Roll		Manufacturer standard

**Insulation material shall be as per specification as under:**

Insulation	Code	Density Kg/m <sup>3</sup>	Thermal conductivity MW/cm OC
Resin bonded fiberglass	IS:8183	At least 24 For Thermal Insulation & 48 for Acoustic Insulation	0.49 at 50°C
Expanded polystyrene	IS:4671	At least 15	0.37 at 50°C
Mineral Wool	IS:9842	At least 81	0.43 at 50°C

**The specification for various finishes shall be as follows**

a) Finish F-1:

- Step-1: Wrapping of Poly-Bonded Hessian (PBH- to act as vapour seal) on outer surface of insulation with 50mm overlap stitching and sealing of overlap with synthetic adhesive like CPRX or equivalent compound.
- Step-2: The surface then shall be wrapped with 19 mm mesh 24 SWG GI wire netting, butting all the joints and laced down with 22 SWG lacing wire.
- Step-3: Sand cement (4:1) plaster shall be applied in two layers totalling to 12.5 mm thick, the second layer being brought to a smooth finish. A water proofing compound shall be added to the cement before its application

b) Finish F-2:

- Step-1: Insulation shall be covered with 500g polythene with 50 mm overlap and sealing of overlap with synthetic adhesive like CPRX or Equivalent compound.



**1x370MW YELAHANKA CCPP  
AIR CONDITIONING SYSTEM  
SPECIFIC TECHNICAL REQUIREMENT**

**SPECIFICATION No: PE-TS-409-553-A001**

**VOLUME: II B**

**SECTION : C 1**

**REV. 00**

**DATE: MARCH 2016**

**SHEET : 12 OF 18**

- Step-2: The polythene shall be covered with 30 gauge Aluminium sheet and locking of joints with self-locking screws at a pitch of minimum 100mm.

**6.9 PIPING VALVES ETC**

- Valves shall have full size port and suitable for horizontal and as well as vertical installation. All valves shall be provided with locking arrangement.
- Valves for regulating duty shall be of globe type suitable for controlling throughout its lift.
- Manual gear operators shall be provided for valves of size 350 NB and above.
- All valves with rising stem shall have position indicators.
- The refrigerant line valves shall have steel or brass body with TEFLON gland packing. The construction of disc shall be either globe or angle type. The valve seat shall have white metal lining or equivalent.
- All water line valves shall be of cast Iron body for sizes 65 NB and above conforming to IS: 780 and gun metal construction for sizes less than 65NB conforming to IS:778.

**7.0 CONTROL PHILOSOPHY**

**7.1** The operation of the AC plant shall be done by PLC based control panel with Remote I/O panel in different / same locations.. Further, overall control of both AC & ventilation system shall be done from common PLC based control panel located in the AC PLANT-1 Room. Control panel shall also be provided with solid –state annunciation, start-stop push buttons, indication lamps & interlocks. The AC Plant compressor can be started only when its associated condenser fan, chilled water pumps are in operation.

**7.2** Stop / trip Annunciation for all the equipment's (Fan, Pumps, Chillers and safety interlocks) shall be provided in local control panel. Following controls is also required to be built up in the common control panel.

**7.3 SAFETY CONTROLS**

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

- High discharge pressure cut-out (HP)
- Low suction pressure cut out (LP)
- Oil pressure cut-out (OP)
- Chilled water flow switch
- Anti-freeze thermostat (AFT)
- Airstat / safety thermostat with heaters of the AHU's

**7.4 OPERATING CONTROL**

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

- Automatic capacity control system.
- Automatic unloaded starting device
- Operating Thermostat
- Unloading solenoid valves (if applicable)



**1x370MW YELAHANKA CCPP  
AIR CONDITIONING SYSTEM  
SPECIFIC TECHNICAL REQUIREMENT**

**SPECIFICATION No: PE-TS-409-553-A001**

**VOLUME: II B**

**SECTION : C 1**

**REV. 00**

**DATE: MARCH 2016**

**SHEET : 13 OF 18**

- e) 3 way flow control valve at the AHU's
- f) Operation / Sequence Interlock of the Air conditioning system shall be as under:
- g) Cooling tower fan is started.
- h) Condenser water pump is started.
- i) The Air Handling Unit is started.
- j) Chiller Pump is started
- k) Chilling unit is started
- l) AC plant auxiliaries drives shall be provided with Local start & stop

**7.5 POWER SUPPLY ARRANGEMENT**

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

**7.6 INTERFACE WITH DCS**

Following hardwired signals shall be provided in the DCS for monitoring purpose

- a) Temperature & Humidity.
- b) AC Plant On / Off Status.
- c) Pump Run / Trip.
- d) AHU Run / Trip.
- e) General AC Plant Warning.
- f) The operation of the air conditioners shall be done from local start-stop push button. Peripherals serial link shall be provided for the transfer of important signals to DCS in the central control room.

**8.0 SPECIFIC REQUIREMENT**

- a) Efficiency of centrifugal fan and pump shall not be less than 70%.
- b) Electrical feeder suitable for following motor rating shall be provided for following equipment. Vendor to ensure that motor rating is not more than the rating mentioned below.

Sr. no.	Items	Motor rating (Kw)
1.	Screw Chiller	140
2.	Chilled Water Pump	25
3.	Condenser Water Pump	30
4.	AHU for Power House at 17.0Mtr.	45
5.	AHU for Service Building	11
6.	Cooling Tower	18.5 for single, 9.3 for twin
7.	Fresh Air Fan	1.5



**1x370MW YELAHANKA CCPP  
AIR CONDITIONING SYSTEM  
SPECIFIC TECHNICAL REQUIREMENT**

**SPECIFICATION No: PE-TS-409-553-A001**

**VOLUME: II B**

**SECTION : C 1**

**REV. 00**

**DATE: MARCH 2016**

**SHEET : 14 OF 18**

8.	Air Cooled PAC 15TR	21
9.	Air Cooled PAC 10TR	16

**9.0 GENERAL**

- 1) Basis of design all calculations including heat load calculations for summer seasons, equipment selection criterion, layout drawings/ schemes/G.A. dwg and documents like data sheet/ technical particulars etc are subject to Customer approval during detail engineering stage.
- 2) Vendor to furnish characteristic curves for all major equipment offered indicating duty point during detailed engineering.
- 3) All drawings and documents shall be computer based.
- 4) All commissioning spares & consumables for trouble free operation shall be provided Vendor to include level gauge & level switch for each tank for alarm & trip of the pumps. Also include one no. Pressure switch for each pump
- 5) Quality Requirements in the Technical Specification are indicating minimum requirements for inspection and testing. Vendor shall note that quality plan is subject to Customer & BHEL-approval during detail engineering stage. Standard QP format is enclosed in the technical specification.
- 6) Indicative list of makes is enclosed as per Annexure-I however these equipments / items shall be subject to Customer & BHEL approval during detail engineering Stage.
- 7) Inserts or any support arrangement for fixing ducting, fans, piping etc. shall not be provided by BHEL. Necessary supports may be taken from nearest structure / walls / roofs / floors etc. by Vendor.
- 8) Fixing frame works for diffusers and grilles in the scope of Vendor.
- 9) Anchor fastener shall be used by vendor for fixing duct pipes etc. wherever applicable.
- 10) Necessary supports and structures / frames etc. as required for supporting the duct / piping / equipments etc. as lump-sum basis is in the scope of Vendor and no unit rates shall be applicable for these items.
- 11) Drain piping within room up to the drain point to be provided by the Vendor.
- 12) Vendor to furnish schedule of power and control cables. Vendor to furnish cable termination details interconnection drawings etc. during detail engineering stage.
- 13) The tools and machine required for erection of equipment shall be arranged by Vendor.
- 14) Tools & tackles as required for regular maintenance shall be supplied by Vendor.
- 15) Instruments required for performance testing of various equipment / system of the package shall be arranged by Vendor at site.
- 16) Instrument for testing shall be calibrated by Air-conditioning plant supplier before taking up testing.
- 17) Temperature gauges shall be provided with thermo wells and fixing arrangement.



**1x370MW YELAHANKA CCPP  
AIR CONDITIONING SYSTEM  
SPECIFIC TECHNICAL REQUIREMENT**

**SPECIFICATION No: PE-TS-409-553-A001**

**VOLUME: II B**

**SECTION : C 1**

**REV. 00**

**DATE: MARCH 2016**

**SHEET : 15 OF 18**

- 18) Pressure gauges shall have provision for air venting. Three way valves shall be used which shall have air venting provision.
- 19) Matching sockets / stubs (weld type) for flow switches and other instruments shall be supplied.
- 20) 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%.
- 21) Besides the system performance as above, bidder shall guarantee major technical parameters of various equipments as per design basis / details furnished.
- 22) The guarantee tests shall cover but not limited to the following rated parameters for smooth operation of ventilation system.
  - Design dry bulb temperature and relative humidity of conditioned air, Auxiliary power consumption, Vibration and noise level etc.
  - Performance test of the Ventilation system shall be carried out at site after proper installation. The site test shall include performance testing of equipment for 72 continuous hours in summer or monsoon and 24 continuous hours in winter. 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.
- 23) For motorized fire damper / 3 Way valve actuators / motorised valves, power supply shall be derived by vendor from respective control panels. BHEL shall not provide any feeder for them. Suitable transformer shall be provided by bidder (if required) to derive the power input. Further distribution through junction box / distribution board shall be in vendor scope and shall have provision for isolation of individual fire damper/ valves.
- 24) Tender drawings enclosed form the part of specification and the bidder shall check the space requirements for installing the equipment as per the specification and layout requirements given in the specifications.
- 25) Bidder should suitably group the signals coming from various instruments etc. & the same shall terminate in local JB, from Local JB common cable to PLC / panel / MCC shall be selected. Any Electrical / C&I items and accessories like junction box, glands etc. shall be included by vendor in his scope. Only those items shall be provided free of cost which are categorically listed in the Electrical scope sheet of technical specification.
- 26) 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.
- 27) 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.



**1x370MW YELAHANKA CCPP  
AIR CONDITIONING SYSTEM  
SPECIFIC TECHNICAL REQUIREMENT**

**SPECIFICATION No: PE-TS-409-553-A001**

**VOLUME: II B**

**SECTION : C 1**

**REV. 00**

**DATE: MARCH 2016**

**SHEET : 16 OF 18**

- 28) Quality requirements in the Technical specification are minimum requirements for inspection and testing. Vendor to note that quality plans are subject to Customer approval during detail engineering stage. Standard QP format is enclosed in the technical specification.
- 29) The drawings/ documents submitted by vendor shall be complete in all respects with revised drawing submitted incorporating all comments. Any incomplete drawing submitted shall be treated as non-submission with delays attributable to vendor's account. For any clarification/discussion required to complete the drawings, the bidder shall himself depute his personal to BHEL / Customer's place any number of time as per the requirement for across the table discussions/ finalizations/ submissions of drawings.
- 30) Sealing of duct opening, grouting of foundation / foundation bolts etc. including special type of grouting like GPX2 etc. are in the scope of Air-conditioning system vendor.
- 31) Flat, platform type RCC / PCC foundation shall be provided for installing Chiller/ PUMP, AHU and FAN etc. Vendor shall fix the equipment using anchor fasteners to secure the equipment obtain parameters related to vibration and noise.
- 32) Bidder to note that the P&ID shows only the bare minimum requirement of valves and instruments. Any instrumentation & valves as required for the completion of the system in line with technical specification shall be provided by bidder during detailed engineering without any commercial implication.
- 33) 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.
- 34) Air-conditioning plant supplier to furnish drawings/ documents as per the dwg. / documents distribution as per project requirement.
- 35) 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.
- 36) All electrical equipment shall be suitable for the power supply fault levels and other climatic conditions indicated in project information / synopsis / specifications enclosed.
- 37) The bidder's proposal shall be for equipment in accordance with the tech. Specification.
- 38) The bidder shall furnish complete tech. Particulars in data sheet and schedules as specified elsewhere in the specification.
- 39) Necessary duct mounted Booster fan (if required) to maintain the static pressure for Precision AC shall be provided without any implication.

**10.0 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 equipment's.
- 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.



**1x370MW YELAHANKA CCPP  
AIR CONDITIONING SYSTEM  
SPECIFIC TECHNICAL REQUIREMENT**

**SPECIFICATION No: PE-TS-409-553-A001**

**VOLUME: II B**

**SECTION : C 1**

**REV. 00**

**DATE: MARCH 2016**

**SHEET : 17 OF 18**

- d) Provision of drain traps / points,
- e) For Electrical scope, refer Electrical scope matrix sheet.

**11.0**

**CODES AND STANDARDS**

Design, manufacture, inspection and testing of the equipment covered by the specification shall unless otherwise specified conform to the latest edition of the standards and codes including all addenda mentioned below:

IS-659 : Safety code for air-conditioning

IS-660 : Safety code for mechanical refrigeration

ASHRAE-23 : Standard method of testing and rating [67 Standards] air conditioner.

ARI-450-6 : Standards for water cooled refrigerant Condenser.

ASME Sec. VII : Unfired pressure vessels

IS-4503 : Shell and tube type heat exchanger.

ASHRAE 22-72 : Method of testing for rating water cooled refrigerant condenser.

ASHRAE-15-2007 : Safe Standard for Refrigeration System

ASHRAE-30-1995 : Method of testing liquid chilling packages

ANSI-8-31.5 : Refrigeration piping.

ANSI-8-9.1 : Safety code for mechanical refrigeration.

ARI-410 : Standard for air cooling and air heating coils.

ARI-210 : Standard for unitary air conditioning equipment.

IS-3588 : Specification for electrical axial flow fans.

AMCA-210 : Methods of performance test for fans.

BS-2831 : Methods of test for air filters used in AC and general ventilation.

IS-4671 : Expanded polystyrene for thermal insulation purpose.

IS-702 : Industrial bitumen

IS-1239 : Heavy class Pipes for sizes up to 150 mm dia.

IS-8188 : For Water conditioning

IS-325 : 3 phase induction motors

IS-4029 : Guide line for testing 3 phase induction motor

IS-210 : Specification grey iron casting

IS-2062 : Structural steel

AMCA - Bulletin : Standard code of testing centrifugal and axial No. 210 flow fans

IS-2825 : Code of practice for welding mild steel

IS-2676 : Dimensions for wrought aluminum and aluminum alloy sheets and strips.

ASHRAE Code : For various filter

ASHRAE-62-2004 : Ventilation rates

IS-655 : Specification for metal air ducts



**1x370MW YELAHANKA CCPP  
AIR CONDITIONING SYSTEM  
SPECIFIC TECHNICAL REQUIREMENT**

**SPECIFICATION No: PE-TS-409-553-A001**

**VOLUME: II B**

**SECTION : C 1**

**REV. 00**

**DATE: MARCH 2016**

**SHEET : 18 OF 18**

PUMP DESIGN AND TESTING SHOULD CORRESPOND TO THE PROCEDURE MENTIONED IN IS-1520



**1x370MW YELAHANKA CCPP  
AIR CONDITIONING SYSTEM**

**CUSTOMER SPECIFICATIONS**

**SPECIFICATION No: PE-TS-409-553-A001**

**VOLUME: II B**

**SECTION : C 2**

**REV. 00**

**DATE: MARCH 2016**

## **SECTION: C 2**

### **CUSTOMER SPECIFICATIONS**



**1x370MW YELAHANKA CCPP  
AIR CONDITIONING SYSTEM**

**CUSTOMER SPECIFICATIONS  
TECHNICAL REQUIREMENT**

**SPECIFICATION No: PE-TS-409-553-A001**

**VOLUME: II B**

**SECTION : C 2A**

**REV. 00**

**DATE: MARCH 2016**

## **SECTION: C 2A**

# **CUSTOMER SPECIFICATIONS TECHNICAL REQUIREMENT**

**(REFER SECTION C1)**



**1x370MW YELAHANKA CCPP  
AIR CONDITIONING SYSTEM**

**PROJECT SPECIFIC GENERAL  
REQUIREMENTS**

**SPECIFICATION No: PE-TS-409-553-A001**

**VOLUME: II B**

**SECTION : C 2B**

**REV. 00**

**DATE: MARCH 2016**

## **SECTION: C 2B**

# **CUSTOMER SPECIFICATIONS PROJECT SPECIFIC GENERAL REQUIREMENTS**



**1x370MW YELAHANKA CCPP  
AIR CONDITIONING SYSTEM**

**PAINTING SPECIFICATIONS**

**SPECIFICATION No: PE-TS-409-553-A001**

**VOLUME: II B**

**SECTION : C 2C**

**REV. 00**

**DATE: MARCH 2016**

**SECTION: C 2C**

**CUSTOMER SPECIFICATIONS**

**PAINTING SPECIFICATIONS**



## 1.0 SCOPE

- 1.1 This section covers the painting requirements for the power plant equipment, structures, piping etc. and any other surface required to be painted.

## 2.0 CODES AND STANDARDS

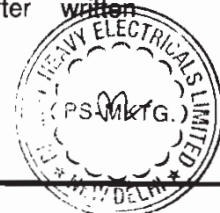
Painting of equipment shall be carried out as per the specifications indicated below and shall conform to the relevant IS specification for the material and workmanship.

The following Indian Standards may be referred to for carrying out the painting job :

IS:5	:	Colours for ready mixed paints and enamels
IS:1303	:	Glossary of terms relating to paints
IS:2379	:	Colour code for identification of pipelines
IS:1477	:	Code of practice for painting of ferrous metals in buildings (Parts I & II)
IS:2524	:	Code of practice for painting of non-ferrous metals in buildings (Parts I & II)
IS:2395	:	Code of practice for painting of concrete, masonry and plaster surfaces (Parts I & II)
IS:2338	:	Code of practice for finishing of wood and wood based materials (Parts I & II)
IS:6278	:	Code of practice for white washing and colour Washing
IS:3140	:	Code of practice for painting asbestos cement building products
IS:158	:	Ready mixed paint, brushing, bituminous, black, lead-free, acid, alkali, water and heat resisting
IS:2074	:	Ready mixed paint, air drying, red Oxide Zinc Chrome, priming
IS:104	:	Ready mixed paint, brushing, Zinc Chrome, priming
IS: 2932	:	Enamel , synthetic, exterior (a) undercoating (b) finishing

## 3.0 PREPARATION OF SURFACES

All surfaces to be painted shall be thoroughly cleaned of all grease, oil, loose mill scale, dust, rust and any other foreign matter. Mechanical cleaning by power tool and scrapping with steel wire brushes shall be adopted to clear the surfaces. However, in certain locations where power tool cleaning cannot be carried out, sand scrapping may be permitted with steel wire brushes and/or abrasive paper. Cleaning with solvents shall be resorted to only in such areas where other methods specified above have not achieved the desired results. Cleaning with solvents shall be adopted only after written approval of the OWNER / ENGINEER.



069



#### 4.0 PRIMER PAINT

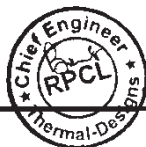
After the surface is prepared, one coat of Zinc Phosphate primer conforming to IS:2074 shall be applied. After this first coat is dried up completely, second coat of red oxide primer shall be applied. Primer shall be applied by brushing to ensure a continuous film without 'holidays'. The dry film thickness of each coat shall be minimum 30 microns.

#### 5.0 FINISH PAINT

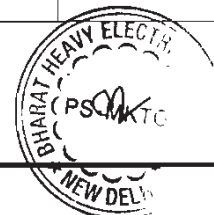
Synthetic enamel paint conforming to IS:2932 shall be used for finish coats. The colour/shade shall be as approved by the OWNER. After cleaning the dust on the dried up primer, first coat of synthetic enamel shall be applied. After this first coat dries up hard, the surface is wet scrubbed cutting down to a smooth finish and ensuring that at no place the first coat is completely removed. After allowing the water to get evaporated completely, the second finish coat of synthetic enamel paint shall be applied.

#### 6.0 SUGGESTED COLOUR CODES FOR PAINTING

SL. NO.	ITEM/SERVICE	COLOUR	IS-5 Grade	COLOUR (BAND)	IS-5
1.0	Structures, platforms, galleries, ladders and handrails	Dark Admiralty Grey	632	-	-
2.0	Boiler casing, ESP and ducting	Nut Brown	413	-	-
3.0	Crane				
3.1	Crane structure	Golden Yellow	356	-	-
3.2	Trolley and hook	Crimson	540	-	-
4.0	Fans, pumps, motors, compressors	Light Grey	631	-	-
5.0	Tanks (without insulation and cladding)				
5.1	Outdoor	Aluminium	-	-	-
5.2	Indoor	Light grey	631	-	-
6.0	Vessels & all other proprietary equipment (without insulation & cladding)	Light grey	631	-	-
7.0	Switchgear	Light grey	631	-	-
8.0	Control & relay panels	Light grey	631/70 78 of IS 1650	-	-
9.0	Turbine	Golden Yellow	356	-	-



070



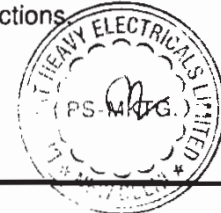


## PAINTING

SL. NO.	ITEM/SERVICE	COLOUR	IS-5 Grade	COLOUR (BAND)	IS-5
10.0	Generator & exciter	Light grey	631	--	-
11.0	Transformers	Grey	-	-	-
12.0	Machinery guards	Signal red	537	-	-
13.0	Piping (without insulation and cladding )				
13.1	Water System				
	Boiler feed	Sea green	217	-	-
	Condensate	Sea green	217	Light brown	410
	D M Water	Sea green	217	Light orange	557
	Soft water	Sea green	217	French blue	166
	Bearing cooling water	Sea green	217	French blue	166
	Potable & filtered water	Sea green	217	French blue	166
	Service & clarified water	Sea green	217	French blue	166
	Raw water	Sea green	217	White	-
	Cooling water	Sea green	217	French blue	166
13.2	Air System				
	Station air	Sky blue	101	-	-
	Control air	Sky blue	101	White	-
13.3	Oil system				
	Fuel oil	Light brown	410	French	166
	Light oil	Light Brown	410	Brilliant green	221
	Lubricating oil	Light brown	410	Light grey	631
	Transformer oil	Light brown	410	Light orange	557
13.4	Gas system				
	Carbon dioxide	Canary yellow	309	Light grey	631
	Hydrogen	Canary yellow	309	Signal red	537
13.5	Fire services	Fire red	536	-	-
13.6	Ash slurry pipes	Black	-	-	-
13.7	Vacuum pipes	Sky blue	101	Black	-
13.8	Fuel pipes (pulverised coal)	Light brown	410	-	-
13.9	Drainage	Black	-	-	-

## Notes :

1. This colour code basically refers to IS:2379 for piping with necessary modifications
2. Where band colour is specified, same shall be provided at 30 metre intervals on long uninterrupted lines and also adjacent to valves and junctions.



071



**1x370MW YELAHANKA CCPP  
AIR CONDITIONING SYSTEM**

**TECHNICAL SPECIFICATION  
(ELECTRICAL PORTION)**

**SPECIFICATION No: PE-TS-409-553-A001**

**VOLUME: II B**

**SECTION : C-3**

**REV. 00**

**DATE: MARCH 2016**

**SECTION: C-3  
TECHNICAL SPECIFICATION (ELECTRICAL PORTION)**



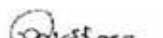
**TITLE :**  
**ELECTRICAL EQUIPMENT SPECIFICATION**  
**FOR**  
**AC & VENTILATION SYSTEM**  
**1 x 370 MW YELAHANKA TPS**

SPECIFICATION NO.
VOLUME NO. : <b>II-B</b>
SECTION : <b>C</b>
REV NO. <b>00</b> : DATE : 19.01.16
SHEET : 1 OF 3

**TECHNICAL SPECIFICATION**  
**FOR**  
**AC & VENTILATION SYSTEM**  
**(ELECTRICAL PORTION)**

  
Anshul

  
P. S. Rao

  
Prasen Kumar



**TITLE :**  
**ELECTRICAL EQUIPMENT SPECIFICATION**  
**FOR**  
**AC & VENTILATION SYSTEM**  
**1 x 370 MW YELAHANKA TPS**

SPECIFICATION NO.
VOLUME NO. : <b>II-B</b>
SECTION : <b>C</b>
REV NO. <b>00</b> : DATE : 19.01.16
SHEET : 2 OF 3

**1.0 EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER:**

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

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

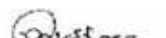
Refer “Electrical Scope between BHEL and Vendor”.

**3.0 DOCUMENTS TO BE SUBMITTED ALONG WITH BID**

- 3.1 The electrical specification without any deviation from the technical/quality assurance requirements stipulated shall be deemed to be complied by the bidder in case bidder furnishes the overall compliance of package technical specification in the form of

  
Anshul

  
S. S. Srinivas

  
Prasen Kumar



**TITLE :**  
**ELECTRICAL EQUIPMENT SPECIFICATION**  
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**AC & VENTILATION SYSTEM**  
**1 x 370 MW YELAHANKA TPS**

SPECIFICATION NO.
VOLUME NO. : <b>II-B</b>
SECTION : <b>C</b>
REV NO. <b>00</b> : DATE : 19.01.16
SHEET : 3 OF 3

compliance certificate/No deviation certificate.

3.2 No technical submittal such as copies of data sheets, drawings, write-up, quality plans, type test certificates, technical literature, etc, is required during tender stage. Any such submission even if made, shall not be considered as part of offer.

**4.0 List of enclosures :**


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



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E. S. Das



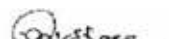
Prasenjit Ghose



Anshul



E. S. Das



Prasenjit Ghose

## ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)

PACKAGES : AC &amp; VENTILATION SYSTEM

Annexure 1

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

PROJECT: YELAHANKA CCPP

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1	415V MCC	BHEL	BHEL	240 V AC (supply feeder)/415 V AC (3 PHASE 4 WIRE) supply shall be provided by BHEL based on load data provided by vendor at contract stage for all equipment supplied by vendor as part of contract. Any other voltage level (AC/DC) required will be derived by the vendor.
2	Local Push Button Station (for motors)	BHEL	BHEL	Located near the 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. For 3.b) & c): Sizes of cables required shall be informed by vendor at contract stage (based on inputs provided by BHEL) in the form of cable listing. Finalisation of cable sizes shall be done by BHEL. Vendor shall provide lugs & glands accordingly. 2. Termination at BHEL equipment terminals by BHEL. 3. Termination at Vendor equipment terminals by Vendor.
4	Junction box for control & instrumentation cable	Vendor	Vendor	Number of Junction Boxes shall be sufficient and positioned in the field to minimize local cabling ( max 10-12 mtrs) and trunk cable.
5	Any special type of cable like compensating, co-axial, prefab, MICC, optical fibre etc.	Vendor	Vendor	Refer C&I portion of specification for scope of fibre Optical cables if used between PLC/ microprocessor & DCS.
6	Cable trays, accessories & cable trays supporting system 100/ 50 mm cable trays/ Conduits/ Galvanised steel cable troughs for local cabling	BHEL Vendor	BHEL Vendor	Local cabling from nearby main route cable tray (BHEL scope) to equipment terminal (vendor's scope) shall be through 100/ 50 mm. cable trays/ conduits/ Galvanised steel cable troughs, as per approved layout drawing during contract stage.
7	Cable glands ,lugs and bimetallic strip for equipment 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 and control cables.
8	Conduit and conduit accessories for cabling between equipment supplied by vendor	Vendor	Vendor	Conduits shall be medium duty, hot dip galvanised cold rolled mild steel rigid conduit as per IS: 9537.
9	Lighting	BHEL	BHEL	
10	Equipment grounding (including electronic earthing) &	BHEL	BHEL	Refer note no. 4 for electronic earthing

## ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)

## Annexure 1

PACKAGES : AC &amp; VENTILATION SYSTEM

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

PROJECT: YELAHANKA CCPP

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
	lightning protection			
11	Below grade grounding	BHEL	BHEL	
12	LT Motors with base plate and foundation hardware	Vendor	Vendor	Makes shall be subject to customer/ BHEL approval at contract stage.
13	Mandatory spares	Vendor	-	Vendor to quote as per specification.
14	Recommended O & M spares	Vendor	-	As specified elsewhere in specification
15	Any other equipment/ material/ service required for completeness of system based on system offered by the vendor (to ensure trouble free and efficient operation of the system).	Vendor	Vendor	
16	a) Input cable schedules (Control & Screened Control Cables) b) Cable interconnection details for above c) Cable block diagram	Vendor Vendor Vendor	- - -	Cable listing for Control and Instrumentation Cable and electronic earthing cable in enclosed excel format shall be submitted by vendor during detailed engineering stage.
17	Electrical Equipment & cable tray layout drawings	Vendor	-	For ensuring cabling requirements are met, vendor shall furnish Electrical equipment layout & cable tray layout drawings (both in print form as well as in AUTOCAD) of the complete plant (including electrical area) indicating location and identification of all equipment requiring cabling, and shall incorporate cable trays routing details marked on the drawing as per PEM interface comments. Cabling arrangement of the same (wherever overhead cable trays, trenches, cable ducts, conduits etc.) shall be decided during contract stage. Electrical equipment layout & cable tray layout drawing shall be subjected to BHEL/ customer approval without any commercial implications to BHEL.
18	Electrical Equipment GA drawing	Vendor	-	For necessary interface review.


NOTES:

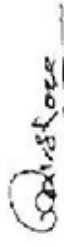
1. Make of all electrical equipment/ items supplied shall be reputed make & shall be subject to approval of BHEL/customer after award of contract.

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR( FOR EPC PROJECTS)  
PACKAGES : AC & VENTILATION SYSTEM  
SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT  
PROJECT: YELAHANKA CCPP

2. All QPs shall be subject to approval of BHEL/customer after award of contract without any commercial implication.
3. In case the requirement of Junction Box arises on account of Power Cable size mis-match due to vendor engineering at later stage, vendor shall supply the Junction Box for suitable termination.
4. Vendor shall indicate location of Electronic Earth pit in their Civil assignment drawing.

  
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S A Khan

  
Praveen Kohse

TITLE :  
**GENERAL TECHNICAL REQUIREMENTS**  
  
**FOR**  
  
**LV MOTORS**

SPECIFICATION NO.  
PE-SS-999-506-E101  
VOLUME NO. : **II-B**  
  
REV NO. : **00** DATE :  
SHEET : 1 OF 1

**GENERAL TECHNICAL REQUIREMENTS**

**FOR**

**LV MOTORS**

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



TITLE :  
**GENERAL TECHNICAL REQUIREMENTS**  
  
**FOR**  
  
**LV MOTORS**

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

**1.0 INTENT OF SPECIFICATION**

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

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

**2.0 CODES AND STANDARDS**

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

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

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

**3.0 DESIGN REQUIREMENTS**

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

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

**3.3 Starting Requirements**

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

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



TITLE :  
**GENERAL TECHNICAL REQUIREMENTS**  
  
**FOR**  
  
**LV MOTORS**

SPECIFICATION NO.  
PE-SS-999-506-E101  
VOLUME NO. : **II-B**  
SECTION : **D**  
REV NO. : **00** DATE :  
SHEET : 2 OF 4

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

3.3.3 The following frequency of starts shall apply

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

#### 3.4 **Running Requirements**

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

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

#### 3.5 **Stress During bus Transfer**

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

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

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

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

#### 4.0 **CONSTRUCTIONAL FEATURES**

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

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

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

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



TITLE :  
**GENERAL TECHNICAL REQUIREMENTS**  
  
**FOR**  
  
**LV MOTORS**

SPECIFICATION NO.  
PE-SS-999-506-E101  
VOLUME NO. : **II-B**  
SECTION : **D**  
REV NO. : **00** DATE :  
SHEET : 3 OF 4

- 4.4. Motors shall not be provided with any electric or pneumatic operated external fan for cooling the motors.
- 4.5. Frames shall be designed to avoid collection of moisture and all enclosures shall be provided with facility for drainage at the lowest point.
- 4.6. In case Class 'F' insulation is provided for LV motors, temperature rise shall be limited to the limits applicable to Class 'B' insulation.  
In case of continuous operation at extreme voltage limits the temperature limits specified in table-1 of IS:325 shall not exceed by more than 10°C.
- 4.7. **Terminals and Terminal Boxes**
- 4.7.1. Terminals, terminal leads, terminal boxes, windings tails and associated equipment shall be suitable for connection to a supply system having a short circuit level, specified in the Data Sheet-A.  
  
Unless otherwise stated in Data Sheet-A, motors of rating 110 kW and above will be controlled by circuit breaker and below 110 kW by switch fuse-contactor. The terminal box of motors shall be designed for the fault current mentioned in data sheet "A".
- 4.7.2. unless otherwise specified or approved, phase terminal boxes of horizontal motors shall be positioned on the left hand side of the motor when viewed from the non-driving end.
- 4.7.3. Connections shall be such that when the supply leads R, Y & B are connected to motor terminals A B & C or U, V & W respectively, motor shall rotate in an anticlockwise direction when viewed from the non-driving end. Where such motors require clockwise rotation, the supply leads R, Y, B will be connected to motor terminals A, C, B or U W & V respectively.
- 4.7.4. Permanently attached diagram and instruction plate made preferably of stainless steel shall be mounted inside terminal box cover giving the connection diagram for the desired direction of rotation and reverse rotation.
- 4.7.5. Motor terminals and terminal leads shall be fully insulated with no bar live parts. Adequate space shall be available inside the terminal box so that no difficulty is encountered for terminating the cable specified in Data Sheet-A.
- 4.7.6. Degree of protection for terminal boxes shall be IP 55 as per IS 4691.
- 4.7.7. Separate terminal boxes shall be provided for space heaters.. If this is not possible in case of LV motors, the space heater terminals shall be adequately segregated from the main terminals in the main terminal box. Detachable gland plates with double compression brass glands shall be provided in terminal boxes.
- 4.7.8. Phase terminal boxes shall be suitable for 360 degree of rotation in steps of 90 degree for LV motors.
- 4.7.9. Cable glands and cable lugs as per cable sizes specified in Data Sheet-A shall be included. Cable lugs shall be of tinned Copper, crimping type.
- 4.8. Two separate earthing terminals suitable for connecting G.I. or MS strip grounding conductor of size given in Data Sheet-A shall be provided on opposite sides of motor frame. Each terminal box shall have a grounding terminal.

4.9. **General**



TITLE :  
**GENERAL TECHNICAL REQUIREMENTS**  
**FOR**  
**LV MOTORS**

SPECIFICATION NO.  
PE-SS-999-506-E101  
VOLUME NO. : **II-B**  
SECTION : **D**  
REV NO. : **00** DATE : 20/3/15  
SHEET : 4 OF 4

- 4.9.1 Motors provided for similar drives shall be interchangeable.
- 4.9.2 Suitable foundation bolts are to be supplied alongwith the motors.
- 4.9.3 Motors shall be provided with eye bolts, or other means to facilitate safe lifting if the weight is 20Kgs. and above.
- 4.9.4 Necessary fitments and accessories shall be provided on motors in accordance with the latest Indian Electricity rules 1956.
- 4.9.5 All motors rated above 30 kW shall be provided with space heaters to maintain the motor internal air temperature above the dew point. Unless otherwise specified, space heaters shall be suitable for a supply of 240V AC, single phase, 50 Hz.
- 4.9.6 Name plate with all particulars as per IS: 325 shall be provided
- 4.9.7 Unless otherwise specified, the colour of finish shall be grey to Shade No. 631 and 632 as per IS:5 for motors installed indoor and outdoor respectively. The paint shall be epoxy based and shall be suitable for withstanding specified site conditions.

**5.0 INSPECTION AND TESTING**

- 5.1 All materials, components and equipments covered under this specification shall be procured, manufactured, as per the BHEL standard quality plan No. PED-506-00-Q-006/0 and PED-506-00-Q-007/2 enclosed with this specification and which shall be complied.
- 5.2 LV motors of type-tested design shall be provided. Valid type test reports not more than 5 year shall be furnished. In the absence of these, type tests shall have to be conducted by manufacturer without any commercial implication to purchaser.
- 5.3 All motors shall be subjected to routine tests as per IS: 325 and as per BHEL standard quality plan.
- 5.4 Motors shall also be subjected to additional tests, if any, as mentioned in Data Sheet A.

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

- a) OGA drawing showing the position of terminal boxes, earthing connections etc.
- b) Arrangement drawing of terminal boxes.
- c) Characteristic curves:  
*(To be given for motor above 55 kW unless otherwise specified in Data Sheet).*
  - i) Current vs. time at rated voltage and minimum starting voltage.
  - ii) Speed vs. time at rated voltage and minimum starting voltage.
  - iii) Torque vs. speed at rated voltage and minimum voltage.  
For the motors with solid coupling the above curves i), ii), iii) to be furnished for the motors coupled with driven equipment. In case motor is coupled with mechanical equipment by fluid coupling, the above curves shall be furnished with and without coupling.
  - iv) Thermal withstand curve under hot and cold conditions at rated voltage and max. permissible voltage.

CUSTOMER :		PROJECT		SPECIFICATION :						
BIDDER/ VENDOR SYSTEM		TITLE		NUMBER :						
CAT.		QUALITY PLAN		TITLE						
SHEET 1 OF 9		NUMBER PED-506-00-Q-007, REV-03		SECTION						
COMPONENT/OPERATION		REFERENCE DOCUMENT		AGENCY						
CHARACTERISTIC CHECK		ACCEPTANCE NORM		VOLUME III						
TYPE/ METHOD OF CHECK		EXTENT OF CHECK		REMARKS						
CAT.		5		P W V						
3		6		10						
4		7		11						
1	2	3	4	5	6	7	8	9	10	11
1.0	RAW MATERIAL & BOUGHT OUT CONTROL		MA	VISUAL	100%	-	FREE FROM BLINKS, CRACKS, WAVINESS ETC	LOG BOOK	3	-
1.1	SHEET STEEL, PLATES, SECTION, EYEBOLTS	1.SURFACE CONDITION	MA	MEASUREMENT	SAMPLE	MANFR'S DRG./SPEC	MANFR'S DRG./SPEC	-DO-	3	-
		2.DIMENSIONS	MA	MECH. TEST	-DO-	-DO-	INSPEC. REPORT		3	-
		3.PROOF LOAD TEST (EYE BOLT)	MA	VISUAL	100%	MANFR'S DRG./SPEC	FREE FROM CRACKS, UN-EVENNESS ETC.	-DO-	3	-
1.2	HARDWARES	1.SURFACE CONDITION	MA	VISUAL	SAMPLES	MANFR'S DRG./SPEC BOOK	RELEVENT IS/SPEC.	SUPPLIERS TC & LOG	3	-
		2.PROPERTY CLASS	MA	VISUAL	100%	MANFR'S DRG./SPEC	FREE FROM CRACKS, BLOW HOLES ETC.	LOG BOOK	3	-
1.3	CASTING	1.SURFACE CONDITION	MA	CHEM & MECH TEST	1/HEAT NO.	MANFR'S DRG./SPEC	RELEVENT IS/	SUPPLIERS TC	3	-
		2.CHEM. & PHY. PROP.	MA	MEASUREMENT	100%	MANUF'R'S DRG.	MANUF'R'S DRG.	LOG BOOK	3	-
		3.DIMENSIONS	MA	VISUAL	100% CONTINUOUS	MANFR'S DRG./SPEC	MANFR'S DRG./SPEC	LOG BOOK	3	-
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	-
		PARTICULARS		BIDDER/VENDOR						
		NAME								
		SIGNATURE								
		DATE								
										BIDDERS/VENDORS COMPANY SEAL


Amshul  
S A Khan  
Praveen Kishore



SL. NO.	COMPONENT/OPERATION	CUSTOMER :				PROJECT				SPECIFICATION :			
		QUALITY PLAN		TITLE		TITLE		TITLE		NUMBER :		TITLE	
		SHEET 3 OF 9		NUMBER PED-506-Q-007, REV-03		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		SECTION		AGENCY		VOLUME III	
		CHARACTERISTIC CHECK	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	P	W	V	REMARKS		
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	VISUAL	100%	-	NO VISUAL DEFECTS	INSPT REPORT	3	-	2		
1.8	SHEET STAMPING (PUNCHED)	1. SURFACE COND. 2.DIMENSIONS INCLUDING BURS HEIGHT 3. ACCEPTANCE TESTS	MA	VISUAL	100%	MANUF'S SPEC.	NO VISUAL DEFECTS (FREE FROM BURS)	LOG BOOK AND OR SUPPLIER'S TC	3	-	2		
1.9	CONDUCTORS	1. SURFACE FINISH 2.ELECT. PROP. & MECH. PROP	MA	VISUAL	100%	MANUF'S DRG. .	MANUF'S DRG.	-DO-	3	-	2		FOR MV MOTOR INSULATION/VARNISH THICKNESS SHALL BE MORE THAN THE BURS HEIGHT
			MA	ELECT. & MECH TESTS	-DO-	MANUF'S SPEC./ RELEVANT IS	RELEVANT IS	SUPPLIER'S TC	3	-	2		
			MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	LOG BOOK	3*	-	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.
			MA	ELECT. & MECH. TEST	SAMPLES	RELEVANT IS/ BS OR OTHER STANDARDS	RELEVANT IS/ BS OR OTHER STANDARDS	SUPPLIERS TC & VENDOR'S INSPN. REPORTS	3	-	2		
<b>BHEL</b>													
<b>PARTICULARS</b>													
<b>BIDDER/VENDOR</b>													
NAME													
SIGNATURE													
DATE													
BIDDER'S/VENDORS COMPANY SEAL													

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 Praveen Kishore

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

 Anshul  
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 Praveen Kishore

SHEET 5 OF 9		QUALITY PLAN		CUSTOMER :			PROJECT			SPECIFICATION :		
COMPONENT/OPERATION		CHARACTERISTIC CHECK		BIDDER/ VENDOR			TITLE			NUMBER :		
SL. NO.	2	3	4	5	6	7	8	9	SECTION		VOLUME III	
			CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	P	W	V	REMARKS
1												
2.0	IN PROCESS		MA	VISUAL	100%	-DO-	GOOD FINISH	LOG BOOK	3/2	2	-	
2.1	STATOR FRAME WELDING (IN CASE OF FABRICATED STATOR )	1.WORKMANSHIP & CLEANNESS	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	-	-	
2.3	PAINTING	3.SHAFT SURFACE FLOWS	MA	PT	-DO-	RELEVENT SPEC./ ASTM-E165	MANUF'S SPEC./ BHEL SPEC./	-DO-	2	-	1	
		1.SURFACE PREPARATION	MA	VISUAL	100%	MANFRS SPEC./BHEL SPEC./ SAME AS 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	-	-	
<b>BHEL</b>												
PARTICULARS									BIDDER/VENDOR			
NAME												
SIGNATURE												
DATE												
												BIDDER'S/VENDORS COMPANY SEAL

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SHEET 6 OF 9		CUSTOMER :		PROJECT TITLE		SPECIFICATION :					
QUALITY PLAN		BIDDER/ VENDOR SYSTEM		QUALITY PLAN NUMBER PED-506-Q-007, REV-03		SPECIFICATION :					
CHARACTERISTIC CHECK		CAT.		REFERENCE DOCUMENT		TITLE					
COMPONENT/OPERATION		TYPE/ METHOD OF CHECK		EXTENT OF CHECK		AGENCY					
SL. NO.		3		6		VOLUME III					
		4		7		REMARKS					
		5		8		P W V					
		6		9		10					
		7		11							
1	2	3	4	5	6	7	8	9	10	11	
2.4	SHEET STACKING	1.COMPLETENESS 2.COMPRESSION & TIGHTENING 3.CORE LOSS & HOTSPOT	MA	MEASUREMENT	SAMPLE	MANUFR'S SPEC.	MANUFR'S SPEC.	Log Book	2	-	-
					100%	-DO-	-DO-	Log Book	2	-	-
					-DO-	-DO-	-DO-	Log Book	2	1*	1
2.5	WINDING	1.COMPLETENESS 2.CLEANLINESS 3.IR-HV-IR 4.RESISTANCE 5.INTERTURN INSULATION 6.SURGE WITH STAND AND TAN DELTA TEST	CR	VISUAL	100%	MANUFR'S SPEC./BHEL SPEC.	MANUFR'S SPEC./BHEL SPEC.	Log Book	2	-	-
					-DO-	-DO-	-DO-	Log Book	2	-	-
					-DO-	-DO-	-DO-	Log Book	2	-	1
					-DO-	-DO-	-DO-	Log Book	2	-	-
					-DO-	-DO-	-DO-	Log Book	2	-	-
					-DO-	-DO-	-DO-	Log Book	2	-	1
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SL. NO.	COMPONENT/OPERATION	QUALITY PLAN				CUSTOMER :				PROJECT				SPECIFICATION :			
		SHEET 7 OF 9				TITLE				NUMBER :				TITLE			
		CHARACTERISTIC CHECK	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY	SECTION	VOLUME III	REMARKS	P	W	V			
1	2	3	4	5	6	7	8	9	10	11							
2.7	COMPLETE STATOR ASSEMBLY	4.DURATION 1.COMPACTNESS & CLEANLINESS	MA	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1						
2.8	BRAZING/COMPRESSION JOINT	1.COMPLETENESS 2.SOUNDNESS 3.HV	MA CR CR	VISUAL -DO- MALLETT TEST & UT	100% -DO- -DO-	-DO- -DO- -DO-	-DO- -DO- -DO-	Log Book Log Book Log Book Log Book	2 2 2 2	- - - 1	- - - 1						
2.9	COMPLETE ROTOR ASSEMBLY	1.RESIDUAL UNBALANCE 2.SOUNDNESS OF DIE CASTING	CR CR	DYN. BALANCE ELECT. (GROWLER TEST)	-DO- -DO-	MFG SPEC./ ISO 1940 MFG. SPEC.	MFG. DWG. MFG. SPEC.	Log Book Log Book	2 2	- 1	- 1		VERIFICATION FOR MV MOTOR ONLY				
2.10	ASSEMBLY	1.ALIGNMENT 2.WORKMANSHIP 3.AXIAL PLAY 4.DIMENSIONS 5.CORRECTNESS, COMPLETENESS TERMINATIONS/ MARKING/ COLOUR CODE 6. RTD. ,BTD & SPACE HEATER MOUNTING.	MA MA MA MA MA MA	MEAS. VISUAL MEAS. -DO- VISUAL	-DO- -DO- -DO- -DO- 100%	-DO- -DO- -DO- MFG.DRG./ MFG SPEC. MFG SPEC. RELEVANT IS	-DO- -DO- -DO- MFG.DRG./ RELEVANT IS MFG SPEC. RELEVANT IS	Log Book Log Book Log Book Log Book Log Book Log Book	2 2 2 2 2 2	- - - - - -	- - - - - -						
<b>BHEL</b>																	
<b>BIDDER/VENDOR</b>																	
PARTICULARS																	
NAME																	
SIGNATURE																	
DATE																	
BIDDERS/VENDORS COMPANY SEAL																	


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SHEET 8 OF 9		QUALITY PLAN		CUSTOMER :			PROJECT			SPECIFICATION :		
COMPONENT/OPERATION		CHARACTERISTIC CHECK		BIDDER/ VENDOR :			TITLE			NUMBER :		
SL. NO.	2	3	4	5	6	7	8	9	10	11	VOLUME III REMARKS	
			CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	P	W	V	
3.0	TESTS	1. TYPE TESTS INCLUDING SPECIAL TESTS AS PER BHEL SPEC. 2. ROUTINE TESTS INCLUDING SPECIAL TEST AS PER BHEL SPEC. 3. VIBRATION & NOISE LEVEL 4. OVERALL DIMENSIONS AND ORIENTATION 5. DEGREE OF PROTECTION 6. MEASUREMENT OF RESISTANCE OF RTD & BTD 7. MEASUREMENT OF RESISTANCE, IR OF SPACE HEATER 8. NAMEPLATE DETAILS 9. EXPLOSION FLAME PROOF NESS (IF SPECIFIED) 10. PAINT SHADE, THICKNESS & FINISH	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
			MA	-DO-	100%	-DO-	-DO-	-DO-	2	1 <sup>\$</sup>	1	<sup>\$</sup> NOTE - 2
			MA	-DO-	100%	IS-12075 & IS-12065	IS-12075 & IS-12065	-DO-	2	1 <sup>\$</sup>	1	<sup>\$</sup> NOTE - 2
			MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPC. REPORT	2	1	-	
			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
			MA	-DO-	100%	-DO-	-DO-	-DO-	2	1 <sup>\$</sup>	1	<sup>\$</sup> NOTE - 2
			MA	-DO-	100%	-DO-	-DO-	-DO-	2	1 <sup>\$</sup>	1	<sup>\$</sup> NOTE - 2
			MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPC. REPORT	2	1 <sup>\$</sup>	1	<sup>\$</sup> NOTE - 2
			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
			MA	VISUAL & MEASUREMENT BY ELKOMETER	SAMPLE	BHEL SPEC. & DATA SHEET	BHEL SPEC. & DATA SHEET	TC	2	1 <sup>\$</sup>	1	SAMPLING PLAN TO BE DECIDED BY INSPECTION AGENCY <sup>\$</sup> NOTE - 2
<b>BHEL</b>												
				<b>PARTICULARS</b>				<b>BIDDER/VENDOR</b>				
				<b>NAME</b>								
				<b>SIGNATURE</b>								
				<b>DATE</b>								
BIDDER/SVENDORS COMPANY SEAL												


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		<b>QUALITY PLAN</b>		<b>CUSTOMER :</b>		<b>PROJECT TITLE</b>		<b>SPECIFICATION : NUMBER :</b>	
				<b>BIDDER/ VENDOR :</b>		<b>QUALITY PLAN NUMBER PED-506-Q-007, REV-03</b>		<b>SPECIFICATION : TITLE</b>	
<b>SHEET 9 OF 9</b>		<b>SYSTEM CAT.</b>		<b>TYPE/ METHOD OF CHECK</b>		<b>EXTENT OF CHECK</b>		<b>SECTION AGENCY</b>	
<b>COMPONENT/OPERATION</b>		<b>CHARACTERISTIC CHECK</b>		<b>3</b>		<b>6</b>		<b>VOLUME III REMARKS</b>	
<b>2</b>		<b>4</b>		<b>5</b>		<b>7</b>		<b>10</b>	
<b>1</b>		<b>3</b>		<b>4</b>		<b>8</b>		<b>11</b>	
<p><b>NOTES:</b></p> <p>1 DEPENDING UPON THE SIZE AND CRITICALLY, WITNESSING BY BHEL SHALL BE DECIDED.</p> <p>2 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON.</p> <p>3 IN CASE TEST CERTIFICATES FOR THESE TESTS ON SIMILAR TYPE, SIZE AND DESIGN OF MOTOR FROM INDEPENDENT LABORATORY ARE AVAILABLE, THESE TEST MAY NOT BE REPEATED.</p> <p>4 WHEREVER CUSTOMER IS INVOLVED IN INSPECTION, AGENCY (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER.</p> <p><u>Legends for Inspection agency</u></p> <p>1. BHEL/CUSTOMER  2. VENDOR (MOTOR MANUFACTURER)  3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER)</p> <p>P. PERFORM  W. WITNESS  V. VERIFY</p>									
<b>BHEL</b>		<b>PARTICULARS</b>		<b>BIDDER/VENDOR</b>					
		<b>NAME</b>							
		<b>SIGNATURE</b>							
		<b>DATE</b>							
<b>BIDDER'S/VENDORS COMPANY SEAL</b>									

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CUSTOMER :		PROJECT		SPECIFICATION :							
BIDDER/ VENDOR SYSTEM		TITLE		NUMBER :							
CAT. SYSTEM		QUALITY PLAN		SPECIFICATION							
SHEET 1 OF 2		NUMBER PED-506-00-Q-006, REV-01		TITLE							
CHARACTERISTICS CHECK		ITEM AC ELECT. MOTORS BELOW 55KW (LV)		SECTION VOLUME III							
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT. SYSTEM	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY	REMARKS	
1	2	3	4	5	6	7	8	9	P W V	10 11	
1.0	ASSEMBLY	1.WORKMANSHIP 2.DIMENSIONS 3.CORRECTNESS COMPLETENESS TERMINATIONS/ MARKING/COLOUR CODE	MA	VISUAL -DO- VISUAL	100% -DO- 100%	MANUF'S SPEC MFG. DRG./ MFG. SPEC. MFG.SPEC./ RELEVANT IS	MANUF'S SPEC MFG. DRG./ MFG. SPEC. MFG.SPEC. RELEVANT IS	-DO- -DO- -DO-	2 - 2 - 2 -	- - -	
2.0	PAINTING	1.SHADE	MA	VISUAL	SAMPLE	MANUF'R'S SPEC/BHEL SPEC./RELEVANT STANDARD	BHEL SPEC. SAME AS COL.7	LOG BOOK	2 -	-	
3.0	TESTS	1.ROUTINE TEST INCLUDING SPECIAL TEST AS PER BHEL SPEC. 2.OVERALL DIMENSIONS & ORIENTATION	MA	-DO-	100%	IS-325/ BHEL SPEC./ DATA SHEET	SAME AS COL.7	TEST REPORT	2 1	1	NOTE -1 & NOTE-3
			MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPN. REPORT	2 1	1	NOTE -1 & NOTE-3
BHEL		PARTICULARS		BIDDER/VENDOR							
		NAME									
		SIGNATURE									

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		QUALITY PLAN		CUSTOMER :		PROJECT TITLE		SPECIFICATION :			
SL. NO.	COMPONENT/OPERATION CHARACTERISTICS CHECK	BIDDER/ VENDOR SYSTEM	EXTENT OF CHECK	TYPE/ METHOD OF CHECK	ACCEPTANCE NORM	FORMAT OF RECORD	SECTION AGENCY	NUMBER :	VOLUME III REMARKS		
1	2	3	4	5	6	7	8	9	10	11	
	3.NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPN. REPORT	2	1 -	
	<p>NOTES:</p> <ol style="list-style-type: none"> <li>ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON</li> <li>WHERE EVER CUSTOMER IS INVOLVED IN INSPECTION, (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER.</li> <li>FOR EXHAUST/VENTILATION FAN MOTORS OF RATING UPTO 1.5KW , ONLY ROUTINE TEST CERTIFICATES SHALL BE FURNISHED FOR SCRUTINY.</li> </ol> <p><u>Legends for Inspection agency</u></p> <ol style="list-style-type: none"> <li>BHEL/CUSTOMER</li> <li>VENDOR (MOTOR MANUFACTURER)</li> <li>SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER)</li> </ol> <p>P. PERFORM W. WITNESS V. VERIFY</p>										
<b>BHEL</b>		<b>PARTICULARS</b>		<b>BIDDER/VENDOR</b>							
		<b>NAME</b>									
		<b>SIGNATURE</b>									
		<b>DATE</b>									
										<b>BIDDER'S/VENDORS COMPANY SEAL</b>	

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S A Khan  
Praveen Kishore



TITLE

**LV MOTORS****DATA SHEET-A****1 X 370 MW YELAHANKA TPP**

SPECIFICATION NO.

VOLUME II B

SECTION D

REV NO. 00 DATE 19.01.16

SHEET 1 OF 1

- 1.0 Design ambient temperature : 50 °C
- 2.0 Maximum acceptable kW rating of LV motor : 200 KW
- 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 110 kW and above (Breaker : 50 KA for 0.2 sec..  
Controlled)
    - o Below 110 kW (Contactor : 50 KA protected by fuse  
Controlled)
  - 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 : (a) 85% of rated voltage  
(As percentage of rated voltage)
- 7.0 Power cables data : Shall be given during detailed engg.
- 8.0 Earth Conductor Size & Material : As per attached Datasheet of Earthing.
- 9.0 Space heater supply : 240 V, 1ϕ, 50 Hz
- 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 requirement  
(As per IS: 5572 part-I)
- 13.0 Paint shade : Shall be given during detailed engg
- 14.0 Degree Of protection for motor/ terminal box : IP 54/ IP 55

**15.0** \* Continuous duty LT motors up to 200 KW Output rating (at 50 deg.C ambient temperature), shall be Premium efficiency (IE3) as per IEC: 60034-30/ IS:12615



TITLE

**LV MOTORS****DATA SHEET-A****1 X 370 MW YELAHANKA TPP**

SPECIFICATION NO.

VOLUME II B

SECTION D

REV NO. 00 DATE 19.01.16

SHEET 1 OF 1

**16.0 TESTING****16.1 Type Tests**

For LT Motors above 55kW, 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 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.

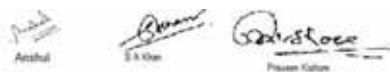
**16.2 Routine Tests**

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

	TITLE	<p style="text-align: center;">MOTOR DATA SHEET – C 1 x 370 MW YELAHANKA CCPP</p>	SPECIFICATION NO.
			VOLUME II B
			SECTION D
			REV NO. 00 DATE
			SHEET 1 OF 2

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

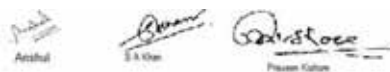
NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			



	TITLE	MOTOR DATA SHEET – C 1 x 370 MW YELAHANKA CCPP	SPECIFICATION NO.
			VOLUME II B
			SECTION D
			REV NO. 00 DATE
			SHEET 2 OF 2

S. No.	Description	Data to be filled by successful bidder
	c) At starting	
<b>C.</b>	<b>Constructional Features</b>	
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)	
<b>D.</b>	<b>Characteristic curves/ drawings</b> (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	

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			









**1x370MW YELAHANKA CCPP  
AIR CONDITIONING SYSTEM**

**TECHNICAL SPECIFICATION  
(C&I PORTION)**

**SPECIFICATION No: PE-TS-409-553A001**

**VOLUME: II B**

**SECTION : C-4**

**REV. 00**

**DATE: MARCH 2016**

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



**C&I TECHNICAL SPECIFICATION  
AIR CONDITIONING & VENTILATION SYSTEM  
(PLC BASED)**



## Table of Contents

Section-C	Sht. No.
1.1 Specific Technical requirement	3
<b>Section-D</b>	
1.1 PLC Panel Technical Specification, Datasheet & Quality Plan	8
1.2 PLC Configuration	29
1.3 Drive Control philosophy	31
1.4 Instrumentation datasheet	34
1.5 Junction Box specification	49
1.6 Motor operated valve Actuator Datasheet	52
1.7 Instrumentation Check list	57
1.8 Furniture specification	63
1.9 Signal exchange format to Plant DCS	65
1.10 Applicable cable types	67
1.11 KKS Philosophy	69
1.12 List of Deliverables	74
1.13 C&I Mandatory Spares	76



Technical specification for  
**AIR CONDITIONING SYSTEM**

**1X370 MW YELAHANKA CCPP**

SPEC NO.: **PE-TS-409-145-I**

VOLUME

SECTION

REV. NO. 00

DATE : 05.01.2016

SHEET OF

# SPECIFIC TECHNICAL REQUIREMENT



**SPECIFIC TECHNICAL REQUIREMENT FOR  
AIR CONDITIONING & VENTILATION SYSTEM  
1X370 MW YELAHANKA CCPP**

SPECIFICATION NO.

VOLUME **II-B**

SECTION : **C**

REV. NO. 00

DATE: 05.01.2016

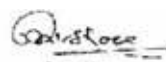
SHEET 1

OF 4

1. **Complete** Control & Instrumentation for Air Conditioning & Ventilation System is in Vendor scope of supply. Items not specifically mentioned however required for the completeness of the system shall be supplied by Vendor.
2. A common PLC based control system cum Annunciation panel with solid state annunciation windows along with product integrated microprocessor panel for the chilling unit for AC and ventilation system shall be in Vendor scope of supply.
3. Vendor to ensure necessary provision and hardware requirement in the PLC panel for both AC & Ventilation system.
4. Field instrumentation along with necessary fittings, accessories and valve manifold etc. and Field Junction Box (JB's), are in Vendor's scope. Each instrument/ equipment shall have a unique KKS Tag no. Field instrument specification and Data Sheet are given elsewhere in this specification. Vendor to provide local control panel wherever required.
5. All fields cabling for instruments/motor/pump/blower to JB is in Vendor's scope. The field I/O s to be grouped together in JB's suitably and a common trunk cable shall be taken to the panel.
6. Cable schedule, cable interconnection details and wiring diagram where one end equipment and/or both end equipments are in Vendor scope shall be provided by the Vendor.
7. Instrument installation drawings are to be provided by Vendor. All instrument fitting and erection hardware/racks as per instrument installation diagram shall be in Vendor's scope.
8. All manual valves at pump discharge shall be provided with Open and Close Limit Switches.
9. All wetted part of Level Switch, Level Gauge, Pressure gauge, Pressure switch, differential pressure switch etc. shall be of SS316.
10. PLC control system as defined in the enclosed specification and Data Sheets shall be in Vendor scope. The PLC system shall comprise of (i) PLC based local panel with Redundant hot standby processor (ii) Operator interface in the form of CRT, keyboard and OWS along with required furniture (iii) laser printer with OWS.
11. BHEL shall provide 2 feeders of UPS category. Further distribution shall be in vendor's scope. Terminal point will be power TBs of PLC panel.

  
Anshul

  
E.A. Gopal

  
Prasen Kumar



**SPECIFIC TECHNICAL REQUIREMENT FOR  
AIR CONDITIONING & VENTILATION SYSTEM  
1X370 MW YELAHANKA CCPP**

SPECIFICATION NO.

VOLUME **II-B**

SECTION : **C**

REV. NO. 00

DATE: 05.01.2016

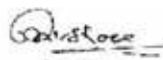
SHEET 2

OF 4

12. PLC shall have the facility to synchronize its time with BHEL plant master clock system using IRIG-B signals. Necessary Hardware (IRIG-B port) for same at PLC end to be provided by Vendor. The cable connecting PLC and plant master clock system shall be in BHEL scope.
13. PLC shall be connected to DCS through MODBUS on RS 485 protocol for monitoring purpose.
14. All furniture (tables, chairs etc.) required for PLC operator HMI shall be in Vendor's scope. Chairs shall be capable of being adjusted for height and position of backrest. The chairs shall be mounted on five castors, shall swivel and shall have arm rests'. One table and chair shall be provided for each operator station and separate table for each printer.
15. The requirements given below are to be read in conjunction with detailed Technical specification enclosed. In case of any contradictions, the more stringent requirement shall prevail subject to BHEL approval.
16. For instrument and control cable scope of supply, refer 'Electrical scope split sheet' in Electrical portion of the specification.
17. Vendor shall provide at least 20% or minimum two numbers, whichever are higher, spare channels as hot on rail spares in each configured I / O modules. In addition to this 10% or minimum one number, whichever is higher, extra assigned complete spare I / O modules mounted on rails in sub racks as hot on rail spare for each category of installed I / O modules shall also be provided. Spare modules shall be distributed over each controller group. Spare channel and modules shall be fully wired up to termination cabinets.
18. Every panel-mounted instrument, requiring power supply, shall be provided with a pair of easily replaceable glass cartridge fuses of suitable rating. Every instrument shall be provided with a grounding terminal and shall be suitably connected to the panel grounding bus.
19. Supplied system shall have provision for hardwired connectivity with plant DCS of critical signals. Same shall be decided during detailed engineering.
20. Provision for input fire signal from fire alarm system to be ensured in the PLC panel for opening/ closing of the motor operated fire dampers.
21. Provision for separate Terminal block/wiring diagram for power and control blocks of control panel to be ensured.
22. Provision for earthing of the panel to be provided by vendor.

  
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**SPECIFIC TECHNICAL REQUIREMENT FOR  
AIR CONDITIONING & VENTILATION SYSTEM  
1X370 MW YELAHANKA CCPP**

SPECIFICATION NO.

VOLUME **II-B**

SECTION : **C**

REV. NO. 00

DATE: 05.01.2016

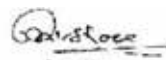
SHEET 3

OF 4

23. Vendor to submit GA drawing of control panel indicating layout of instruments, construction details, wiring diagram, class of protection for enclosure, paint type, paint color, thickness and material of enclosure sheet, control scheme during detailed engineering.
24. Layout & space requirement of panel to be specified during detailed engineering.
25. All bidirectional drives (Motor Operated Valves, MOVs) are integral starter type. Typical Hook Up diagram of all types of drives is attached for use(subject to Customer approval).
26. Vendor shall provide Cable Schedule in BHEL excel format provided in Electrical portion of the specification. Also, Cable Interconnections details for Complete System shall be in Vendors' scope.
27. 240V AC (supply feeder)/415 V AC (3phase 4 wire) supply shall be provided by BHEL at a single point as per 'Electrical scope split sheet' in Electrical portion of the specification. Further distribution to various instruments/Equipment shall be in Vendor's scope. Vendor to include the necessary power distribution board in his scope. Any power supply other than the above, if required for any instrument/equipment has to be derived from the above supply & all the necessary hardware for the same shall be in Vendor's scope.
28. Vendor to provide all control panels, system cabinets, termination & relay cabinets complete with all accessories, wiring and all mounting and erection hardware including junction boxes, canopies, structural steel as required. All instruments/drives shall be terminated on Junction Boxes/Panel in Vendor scope of supply. 20% Spare terminals shall be provided on Junction Boxes.
29. Vendor to delegate/depute their person/experts as per owner/consultant requirements.
30. The make of all the items shall be from approved sub-vendor list/ Reputed Make only.
31. The design, manufacture, inspection, testing, site calibration and installation of all C&I equipment and systems covered under this specification shall conform to the latest editions of applicable codes and standards eg. ANSI, ASME, IEEE, ISO, IEC, IGCI, AWS, NFPA, AISC, IGS, SAMA, UBC, UL, NESC, NEMA, ISA, DIN, VDE, IS etc.
32. Vendor shall provide the signal exchange, to Plant DCS in BHEL prescribed format to be furnished during detailed engineering.

  
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Prasen Kumar



**SPECIFIC TECHNICAL REQUIREMENT FOR  
AIR CONDITIONING & VENTILATION SYSTEM  
1X370 MW YELAHANKA CCPP**

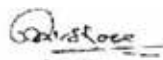
SPECIFICATION NO.	
VOLUME <b>II-B</b>	
SECTION : <b>C</b>	
REV. NO. 00	DATE: 05.01.2016
SHEET 4	OF 4

**NOTES:**

1. All equipment items shall be of latest design with proven on track record from reputed experienced manufacturers of specified type and range of equipment. The make/model of various instruments/items/systems and instrument sub-vendor shall be subject to approval of BHEL/Customer during detailed engineering stage.
2. The above given scope is indicative & minimum. Any item/ equipment not indicated above however required for the completeness of the system is to be supplied by Vendor without any technical, commercial and delivery implication to BHEL.
3. Documents of C&I System shall be submitted to end user/owner for approval during detail engineering. Changes, if any, shall be accommodated by the Vendor without any price/time implication.

  
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Technical specification for  
**CONTROL & INSTRUMENTATION**

**1X370 MW YELAHANKA CCPP**

SPEC NO.: **PE-TS-409-145-I**

VOLUME


SECTION

REV. NO. 00

DATE : 05.01.2016

SHEET OF

# PLC SPECIFICATION


	<b>TITLE:</b> <b>SPECIFICATION FOR  PROGRAMMABLE LOGIC  CONTROLLER SYSTEM</b> 1X370MW YELAHANKA CAPP	SPECIFICATION NO. PES-145-36	
		VOLUME <b>II-B</b>	
		SECTION <b>D</b>	
		REV. NO. 00	DATE: 05.01.2016
		SHEET 1	OF 8

## 1. SCOPE

This specification covers the Design, Manufacture, Assembly, Inspection and Testing at manufacturer's works, proper packing and delivery to site, erection & commissioning, site acceptance test of the PLC Control & Monitoring System comprising PLC Control panel/Remote I/O panel (housing Processors, I/O cards, power supply packs etc.), Operator workstations(OWS), Printers, Annunciation system, cables and all other equipment and accessories required for completeness of the system as mentioned in different sections of this specification.

## 2. GENERAL

- 2.1. The offered PLC shall be of Industrial Grade and from Original Equipment manufacturer (OEM).
- 2.2. The PLC shall perform protection logic, interlock and sequential control functions such as binary logic operation, set/reset operation, timers, counters, logic blocks, math functions, input quality checking engineering unit conversion, Boolean functions & PID control (Analog logic function) etc.
- 2.3. The system shall be redundant in processor, power supply and communication interfaces unless otherwise specified. The control of all drives and equipment shall be effected through the keyboard/mouse / panel mounted push button / control switches as per Data sheets-A&B. The system shall include self-diagnostic features not limited to the following:-
  - Memory Faults, both PROM and EPROM
  - Processor Faults
  - Communication Faults
  - I/O interface or address faults
  - Voltage signal discrepancy on input and output
  - Power supply faults
  - Output loop check
  - Channel level diagnostics such as fault monitoring, contact bounce filtering etc.
  - Failure of main or I/O processor
- 2.4. The system shall have facility for connecting to Main Plant's Distributed control system (DCS) using hardware/software interface for two-way transfer of signals.
- 2.5. The mimic shall be displayed on the OWS screen and may also be provided on the control desk/panel (as per Datasheet).
- 2.6. In case OWS is provided, HMI functions like trends, curves, bar charts, historical storage of data, logs and reports etc. shall be provided in addition to Plant schematics. The necessary catalogue / literature elaborating the features of HMI shall be supplied along with the bid.
- 2.7. It shall be possible to use the same OWS as programming station.
- 2.8. The PLC system shall be sized to meet process/system requirements as per the approved P&IDs and Control write-up.
- 2.9. The PLC system shall be designed to ensure that no single device failure should result in failure of any other device.

	<b>TITLE:</b> <b>SPECIFICATION FOR  PROGRAMMABLE LOGIC  CONTROLLER SYSTEM</b> 1X370MW YELAHANKA CAPP	SPECIFICATION NO. PES-145-36	
		VOLUME <b>II-B</b>	
		SECTION <b>D</b>	
		REV. NO. 00	DATE: 05.01.2016
		SHEET 2	OF 8

- 2.10. Signal multiplication where required shall be done in PLC. Use of relays for multiplication of contacts (for control, monitoring and alarm) is not acceptable. The control/ monitoring components on the control panel/ desk shall be driven through I/O modules.
- 2.11. Bidder shall provide all software on CDs along with required software licenses .The original CDs of installed operating & application software shall be maintained by bidder. Software modification and up gradation (as & when required) shall also be covered under the vendor scope without any cost implication.
- 2.12. PLC programming console shall be provided with industry proven antivirus software with perpetual license (free version not acceptable).

### 3. TECHNICAL REQUIREMENTS

Details of various PLC system components shall be inclusive of but not limited to the following:

#### 3.1. CODES AND STANDARDS

- 3.1.1. The equipment covered under this specification shall meet the requirements of latest edition of all applicable codes and standards like ANSI, NEMA, IEEE, IEC, NEC & IS.
- 3.1.2. PLC shall conform to IEC: 61131
- 3.1.3. The offered PLC shall comply with safety standards as per Data sheet-A&B.


#### 3.2. CONTROL PANEL

3.2.1. PLC control panel shall be freestanding type with provision for mimic display, push-button stations, control switches, indicating lamps, metering instruments like Indicators, ammeters etc. and facia windows for critical alarms.

3.2.2. The salient features of construction shall be:

Sheet material: Cold rolled sheet steel  
Frame thickness: Not less than 3.0mm  
Enclosure thickness: Not less than 2.5 mm for load bearing sections (mounted with instruments) and not less than 1.6 mm for others  
Gland plate thickness: 3.0mm  
Base channel: ISMC 100 with anti-vibration mounting & foundation bolts.


3.2.3. Each panel shall be identified by a name plate, which shall be of non-rusting metal or three ply lamcold, with engraved lettering.

	<b>TITLE:</b> <b>SPECIFICATION FOR</b> <b>PROGRAMMABLE LOGIC</b> <b>CONTROLLER SYSTEM</b> <b>1X370MW YELAHANKA CCPP</b>	SPECIFICATION NO. PES-145-36	
		VOLUME <b>II-B</b>	
		SECTION <b>D</b>	
		REV. NO. 00	DATE: 05.01.2016
		SHEET 3	OF 8

- 3.2.4. Vendor shall indicate earthing details along with bid.
- 3.2.5. 25 x 6 mm Copper ground bus to be provided for each panel.
- 3.2.6. 240V AC single phase, thermostatically controlled space heaters shall be provided. Each free standing panel shall have a door switch operated fluorescent lamp and a 240V AC plug point.
- 3.2.7. Painting treatment shall be as per IS: 6005. Two coats of lead oxide primer shall be followed by powder coating. Paint shade shall be as specified in the "Data sheet for PLC system"-Data Sheet-A&B. Project specific paint shade, if applicable, shall be followed.
- 3.2.8. Panel internal wiring shall be as per NEC and NEMA standard.
- 3.2.9. TB points in terminal block shall be cage clamp type/screw type.
- 3.2.10. The annunciation system shall be facia window type, driven by the PLC. Audible alarm, Acknowledge, Reset and lamp test facility shall be provided as per ISA sequence – S18.1, M.

### 3.3. PROCESSORS

- 3.3.1. The microprocessors shall be 32 bit, and Hot redundant.
- 3.3.2. Hot redundancy: PLC shall be provided with two processors (Main processing unit and memories) one for normal operation and one as hot standby. In case of failure of working processor, there shall be an appropriate alarm and simultaneously the hot standby processor shall take over the complete operation automatically. This transfer from main processor to standby processor shall be bump less and shall not cause any disturbance whatsoever. In the event of both processors failing, the system shall revert to fail safe mode. It shall be possible to keep any of the processor as master and other as standby.
- 3.3.3. An authorized forcing facility shall be provided for changing the status of inputs and outputs, timers and flags to facilitate fault finding and other testing requirements.
- 3.3.4. The standby processor shall be updated automatically in line with the changes made in the working processor.
- 3.3.5. In the event of any replacement of the processor, synchronization of the replaced processor shall be automatic upon live insertion.
- 3.3.6. The cycle time for input scanning, execution of logics, overheads and output scan shall not exceed 120 m sec.
- 3.3.7. The processor & memory shall be loaded up to 50% at normal conditions and maximum up to 60% under worst loading conditions.
- 3.3.8. The memories shall be field expandable. Memory capacity shall be sufficient for complete system operation and have a capability for at least 20% expansion in future.
- 3.3.9. Memory shall be non-volatile, preferably EEPROM type. However, in case volatile memory is provided, battery backup shall be provided for a minimum of three months to keep the stored program intact. Battery drain indication shall be provided at least 1 week before the battery gets drained and same shall be annunciated in OWS.

	<b>TITLE:</b> <b>SPECIFICATION FOR</b> <b>PROGRAMMABLE LOGIC</b> <b>CONTROLLER SYSTEM</b> 1X370MW YELAHANKA CAPP	SPECIFICATION NO. PES-145-36	
		VOLUME <b>II-B</b>	
		SECTION <b>D</b>	
		REV. NO. 00	DATE: 05.01.2016
		SHEET 4	OF 8

### 3.4. INPUT / OUTPUT Modules

3.4.1. Input/output card assignments shall be modular i.e. no single card shall be assigned with more than one drive of a particular sub-system. The maximum number of channels per I/O module shall be as follows.

- Analog Input Module: 16
- Analog Output Module: 16
- Binary Input Module: 32
- Binary Output Module: 32
- Analog Input/output combined: 16
- Binary Input/output combined: 32

3.4.2. On line module replacement (hot swappable): All modules cards shall have quick disconnect terminations allowing for card replacement without disconnection of external wiring and without switching off the power supply.

3.4.3. Each I/O shall be protected against the reversal of polarity of the power voltage to I/O.

3.4.4. 10% spare capacity shall be ensured in each card channel assignment. Overall minimum 20% spare channels shall be provided.


3.4.5. Output command to MCC/Switchgear shall be through coupling relays, whose mounting location shall be as per "Data sheet A & B for PLC System". In case coupling relays are located in PLC Panel, the same shall be in PLC vendor's scope of supply.

3.4.6. Status feedback from MCC shall be in the form of potential free contact.

### 3.5. DATA BUS/ I/O BUS

3.5.1. The Data bus connecting PLC and HMI work stations shall be TCP/IP on Ethernet.

3.5.2. The Data bus and I/O bus communication medium shall be twisted pair shield copper conductor for indoor locations and those areas not subjected to induced signals. Repeaters/signal amplifiers shall not be used. Copper conductor cable used shall be Category-5 or better. The communication medium shall be Fibre optic cable in the event any portion of communication cable run is in outdoor or where distances are beyond 500 meters.

	<b>TITLE:</b> <b>SPECIFICATION FOR</b> <b>PROGRAMMABLE LOGIC</b> <b>CONTROLLER SYSTEM</b> 1X370MW YELAHANKA CAPP	SPECIFICATION NO. PES-145-36	
		VOLUME <b>II-B</b>	
		SECTION <b>D</b>	
		REV. NO. 00	DATE: 05.01.2016
		SHEET 5	OF 8

### 3.6. OPERATOR WORK STATION (OWS)

3.6.1. The OWS and Keyboard shall be desktop mounted and shall be used for controlling, monitoring and programming function.

3.6.2. Colour CRT(s) with keyboard and mouse shall be as per Data Sheet-A&B. CRT shall have graphic display facility.

3.6.3. The OWS shall be with Windows based operating system having necessary Engineering/Configuring software.

3.6.4 Specification of OWS

#### (a) CPU

- |                           |  |
|---------------------------|--|
| 1. Processor              | 32 Bit or better                                       |
| 2. Main Memory            | Min. 1 GB and expandable to at least 4 GB              |
| 3. Hard drive             | Min 40 GB  |
| 4. Floppy drive           | 3.5", 1.44 MB  |
| 5. Removable bulk storage | DVD (R/RW)   |
| 6. Graphic memory         | Min. 16 MB   |
| 7. Auto controller        | 16 bit or better                                       |
| 8. Operating system       | Window XP or better                                    |
| 9. Communication ports    | 2 serial, 1 parallel, 8 Nos. USB, Dual 100 MB Ethernet |
| 10. Expansion slot        | 3 Nos. or more   |

#### (b) Monitor


- |                         |   |
|-------------------------|---|
| 1. Type                 | LCD colour monitor (TFT based)                                  |
| 2. Screen diagonal      | 24" (approx.) flat  |
| 3. Display              | XGA or better   |
| 4. Degree of Protection | IP-30   |
| 5. External controls    | Brightness, Contrast, Horizontal/vertical amplification & shift |
| 6. Power supply         | 240 VAC, 50 Hz, 1 phase   |
| 7. Version              | Industrial grade  |

#### (c) Keyboard & Mouse

- |                    |   |
|--------------------|---|
| 1. Type            | Flat spill membrane or positive depression type ASCII |
| 2. Life expectancy | 50 Million cycles per key                             |
| 3. Version         | Industrial  |
| 4. Mouse           | Optical   |

### 3.7. PRINTER

Printers shall be provided as per Data Sheet-A&B.

	<b>TITLE:</b> <b>SPECIFICATION FOR  PROGRAMMABLE LOGIC  CONTROLLER SYSTEM</b> 1X370MW YELAHANKA CCPP	SPECIFICATION NO. PES-145-36	
		VOLUME <b>II-B</b>	
		SECTION <b>D</b>	
		REV. NO. 00	DATE: 05.01.2016
		SHEET 6	OF 8

### 3.8. COMMUNICATION WITH PLANT DCS/ THIRD PARTY SYSTEM

- 3.8.1. The PLC system shall be provided with hardwired/serial interface for communication with plant DCS. Hardwired outputs from PLC shall be isolated. Necessary isolators shall be part of PLC.
- 3.8.2. Serial communication to / from DCS where provided shall be engineered to ensure that signal communication time from / to DCS shall not exceed 1 seconds for control / feedback.
- 3.8.3. Serial communication to DCS shall be MODBUS protocol on RS 485 network.
- 3.8.4. Data transmitted from PLC to DCS shall include all information necessary for the DCS graphic displays to monitor and control the process equipment and PLC. Such data may include pertinent analog and digital status information, interlock, alarms and maintenance conditions. Data transmitted from DCS to the PLC shall include necessary signals to provide operator control interface from DCS for the process/ equipment being controlled by PLC.


### 3.9. POWER SUPPLY Scheme

- 3.9.1. BHEL shall provide 2 feeders of UPS category. Further distribution shall be in vendor's scope. Terminal point will be power TBs of PLC panel. Input feeder failure shall be monitored in the PLC system. Necessary redundant power pack and transformers shall be provided (in the PLC panel) to derive the power supply for control desk, PLC panel and input / output cabinets, Remote I/O Panels, OWS and associated HMI peripherals, etc.

## 4. DRAWING/DOCUMENT AND DATA TO BE FURNISHED AFTER AWARD OF THE CONTRACT:

### 4.1. For Approval:

- PLC system configuration drawing along with functional write-up.
- Input/output signal list.
- BOM of PLC
- List of PLC controlled devices
- Control panel/control desk GA drawings.
- Control desk/panel component layout drawing.
- Control panel/control desk Foundation detail and cutout drawings.
  
- Power distribution scheme.
- Block logic diagrams/ Ladder diagram mimic.
- Annunciation list.
- PLC control room layout drawing.
- List of soft signal exchange with Plant DCS.
- List of mandatory spares.
- Load list
- Quality plan
- FAT
- CRT display
- Power supply scheme for PLC system, HMI & peripherals, Remote I/O etc.

	<b>TITLE:</b> <b>SPECIFICATION FOR</b> <b>PROGRAMMABLE LOGIC</b> <b>CONTROLLER SYSTEM</b> 1X370MW YELAHANKA CAPP	SPECIFICATION NO. PES-145-36	
		VOLUME <b>II-B</b>	
		SECTION <b>D</b>	
		REV. NO. 00	DATE: 05.01.2016
		SHEET 7	OF 8

#### 4.2. For Information:

- Cable schedule and cable interconnection drawing( in BHEL approved format)
  - Between Field and PLC
  - Between Field and MCC
  - Between MCC and PLC
- Electronic earthing requirements.
- Panel Heat dissipation data
- Product/component catalogues.
- Operation & Maintenance Manual on CDs.
- Softcopy of Final/As-built drawings on CDs.
- Calculation for Processor, Memory & Data bus loading

The above list is the minimum requirements. Additional documents/calculations required shall be finalized during contract stage.

#### 5. DRAWINGS AND DOCUMENTS TO BE SUBMITTED ALONG WITH THE BID

- Proposed PLC system configuration drawing with write-up
- Product catalogues and specifications for PLC as well as HMI application.
- Proposed power supply schemes for PLC system, peripherals, and Remote I/O panels.


#### 6. TESTING AND INSPECTION

- 6.1. The bidder shall adopt suitable quality assurance program to ensure that the equipments offered will meet the specification requirements in full.
- 6.2. BHEL's standard Quality Plan for PLC is enclosed with the specification. The bidder shall furnish his acceptance to BHEL's QP and submit the signed and stamped copy of QP along with the offer.
- 6.3. The complete PLC system, including all instrument and devices shall be subjected to standard factory tests (i.e. Type Tests and Routine Tests) as per relevant IS, NEMA, IEEE, IEC.
- 6.4. Factory Acceptance Test-FAT (Functional Tests) shall be performed prior to shipment and Owner/Purchaser shall be notified 15 days before the schedules dates of the test.
- 6.5. The certificates for following type tests, as per IEC Standard, shall be submitted: -
  - Surge protection test as per IEC-225-4
  - Dry heat test as per IEC-68-2-2
  - Damp Heat test as per IEC-68-2-3
  - Vibration Heat test as per IEC-68-2-6
  - Electrostatic discharge test as per IEC-801-2 or equivalent
  - Radio frequency Immunity test as per IEC-801-6 or equivalent
  - Electromagnetic Immunity test as per IEC-801-3 or equivalent

#### 7. SPARES AND CONSUMABLES

- 7.1. Commissioning Spares and consumables

The bidder shall supply all commissioning spares and consumables 'as required' during Start-up, as part of the main equipment supply.

	<b>TITLE:</b> <b>SPECIFICATION FOR</b> <b>PROGRAMMABLE LOGIC</b> <b>CONTROLLER SYSTEM</b> <b>1X370MW YELAHANKA CAPP</b>	SPECIFICATION NO. PES-145-36	
		VOLUME <b>II-B</b>	
		SECTION <b>D</b>	
		REV. NO. 00	DATE: 05.01.2016
		SHEET 8	OF 8

### 7.2. Mandatory Spares

The bidder shall offer along with main offer, the Mandatory Spares as specified elsewhere in the specification. The Mandatory Spares offered shall be of the same make and type as the main equipment.

### 7.3. Recommended Spares

The bidder shall furnish a list of Recommended Spares indicating the normal service expectancy period and frequency of replacement; quantities recommended for 3 years operation along with unit rate against each item to enable BHEL/BHEL's Customer to place a separate order later, if required.

### 7.4. Special Tools & Tackles

The bidder shall supply all Special Tools & Tackles 'as required' during Start-up and further maintenance of the system, as part of the main equipment supply.

### 7.5. Spares, Service support

Bidder shall provide availability of spares and service support for minimum 15 years after guarantee period.

## 8. MARKING AND PACKING

### 8.1. Marking:

A stainless steel name-plate shall be permanently fixed on each equipment giving its Tag/serial Number and salient technical specification.

### 8.2. Packing:

All equipment/materials shall be suitably packed and protected for the entire period of dispatch, storage and erection against impact, abrasion, corrosion, incidental damage due to vermin, sunlight, high temperature, rain, moisture, humidity, dust, sea-water spray (where applicable) as well as rough handling and delays in transit and storage in open.

## 9. PERFORMANCE AND GUARANTEE

The PLC system shall be guaranteed to meet the performance requirement as specified and also for trouble-free continuous operation for 12 months from the date of commissioning or 18 months from the date of delivery at site whichever is later unless specified otherwise in Vol-IIB Section - B or Section - C.

## 10. APPLICABLE DATA SHEET FORMS

This document shall be read with the following data sheet forms :

- Data Sheet A & B for PLC system - PE-DC-999-145-1036-1



Technical specification for  
**CONTROL & INSTRUMENTATION**

**1X370 MW YELAHANKA CCPP**

SPEC NO.: **PE-TS-409-145-I**

VOLUME

SECTION

REV. NO. 00

DATE : 05.01.2016

SHEET OF

# PLC DATA SHEET




**DATA SHEET FOR PLC SYSTEM  
FOR AIR CONDITIONING & VENTILATION SYSTEM  
1X370MW YELAHANKA CCPP**

SPECIFICATION NO.: PE-TS-409-	
VOLUME	II B
SECTION	D
REV. NO.	00
DATE:	05.01.2016
SHEET	1 OF 1

Data Sheet No.: PES-145-36-DS1-0

**Data Sheet A&B**DATA SHEET – A FOR PLC SYSTEM  
(TO BE FILLED BY PURCHASER)DATA SHEET – B  
TO BE FILLED BY BIDDER)

<b>GENERAL</b>	PROJECT	1X370MW YELAHANKA CCPP
	SERVICE	AIR CONDITIONING & VENTILATION SYSTEM
	QUANTITY	<input type="checkbox"/> UNITISED <input checked="" type="checkbox"/> COMMON
	LOCATION	<input checked="" type="checkbox"/> INDOOR <input type="checkbox"/> OUTDOOR <input checked="" type="checkbox"/> AC <input type="checkbox"/> NON-AC
<b>PLC EQUIPMENT</b>	MAKE / MODEL NO.	BIDDER TO INDICATE
	<b>PROCESSOR</b>	REDUNDANT WITH HOT STANDBY
	DATA BUS (HMI)	<input type="checkbox"/> COPPER WIRE <input type="checkbox"/> FIBRE OPTIC
	DATA BUS (I/O - CPU)	<input type="checkbox"/> COPPER WIRE <input type="checkbox"/> FIBRE OPTIC
	DATA BUS (REMOTE I/O - CPU)	<input type="checkbox"/> COPPER WIRE <input type="checkbox"/> FIBRE OPTIC
	FIELD CONTACTS INTERROGATION VOLTAGE	<input checked="" type="checkbox"/> 24 V DC <input type="checkbox"/> 48 V DC <input type="checkbox"/> 110 V AC
	LOCATION OF COUPLING RELAYS	<input checked="" type="checkbox"/> MCC <input type="checkbox"/> PLC PANEL
	DESKTOP OWS QUANTITY (OWS and EWS shall be as per PLC Configuration diagram attached elsewhere in the specification)	<input type="checkbox"/> ONE <input checked="" type="checkbox"/> TWO <input type="checkbox"/> _____ <input checked="" type="checkbox"/> DESKTOP VERSION <input type="checkbox"/> SERVER VERSION <input type="checkbox"/> WORK STATION VERSION REQUIREMENT OF OWS IN CCR <input type="checkbox"/> YES <input type="checkbox"/> NO QUANTITY _____
	DESKTOP MONITOR TYPE	<input type="checkbox"/> 19" <input checked="" type="checkbox"/> 24"    TFT/CRT MONITOR <input type="checkbox"/> GIU <input type="checkbox"/> OTHERS
	PRINTER	INKJET <input type="checkbox"/> A3 ___NOS <input type="checkbox"/> A4 ___NOS LASER B/W <input type="checkbox"/> A3 ___NOS <input type="checkbox"/> A4 ___NOS COLOR INKJET <input type="checkbox"/> A3 ___NOS <input type="checkbox"/> A4 ___NOS COLOR LASER <input checked="" type="checkbox"/> A3 ___NOS <input type="checkbox"/> A4 ___NOS
PROGRAMMING / CONFIGURATION FACILITY (OWS and EWS shall be as per PLC Configuration diagram attached elsewhere in the specification)	A) <input type="checkbox"/> HAND HELD <input type="checkbox"/> LAPTOP B) ENGINEERING SOFTWARE <input type="checkbox"/> ONE OWS <input checked="" type="checkbox"/> ALL OWS <input type="checkbox"/> _____	
SAFETY STANDARD	<input type="checkbox"/> SIL-3 <input type="checkbox"/> SIL-2 <input checked="" type="checkbox"/> NIL	
<b>SPARE LIST</b>	COMPUTER FURNITURE	BOQ <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO INDUSTRIAL GRADE <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO
	SPARE LIST	<input type="checkbox"/> START UP & COMMISSIONING <input checked="" type="checkbox"/> MANDATORY SPARE <input type="checkbox"/> RECOMMENDED
	SPARE LIST ATTACHED	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO
<b>REDUNDANCY</b>	CPU	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO
	POWER SUPPLY	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO
	COMMUNICATION	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO
	I/O CARD	<input type="checkbox"/> YES <input type="checkbox"/> NO
	OTHER ELECTRONICS	<input type="checkbox"/> YES <input type="checkbox"/> NO

	<b>DATA SHEET FOR PLC SYSTEM FOR AIR CONDITIONING &amp; VENTILATION SYSTEM</b> 1X370MW YELAHANKA CCPP		SPECIFICATION NO.: PE-TS-409-	
			VOLUME II B	
			SECTION D	
			REV. NO. 00	DATE: 05.01.2016
			SHEET 1	OF 1
Data Sheet No.: PES-145-36-DS1-0				
<b>Data Sheet A&amp;B</b>				
DATA SHEET – A FOR PLC SYSTEM (TO BE FILLED BY PURCHASER)			DATA SHEET – B (TO BE FILLED BY BIDDER)	
<b>No. of CHANNELS PER CARD</b>	ANALOG INPUT	<input type="checkbox"/> 8 NOs	<input checked="" type="checkbox"/> 16 NOs	
	ANALOG OUTPUT	<input type="checkbox"/> 8 NOs	<input checked="" type="checkbox"/> 16 NOs	
	BINARY INPUT	<input type="checkbox"/> 16 NOs	<input checked="" type="checkbox"/> 32 NOs	
	BINARY OUTPUT	<input type="checkbox"/> 16 NOs	<input checked="" type="checkbox"/> 32 NOs	
	RTD**	4 NOs		
	THERMOCOUPLE**	8 NOs		
	ELECTRONIC CARD ISOLATION	<input checked="" type="checkbox"/> GALVANIC <input type="checkbox"/> OPTICAL <input type="checkbox"/> OTHER		
<b>PANEL</b>	QUANTITY	BIDDER TO INDICATE		
	CLASS OF PROTECTION(Refer Location of PLC)	<input checked="" type="checkbox"/> IP-42		
	REMOTE I/O PANEL	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO AC REQUIREMENT <input type="checkbox"/> YES <input type="checkbox"/> NO		
	COLOUR#	RAL 7032		
	BACK-UP DESK	<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO		
	MIMIC	<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO IF YES, THEN <input type="checkbox"/> PANEL MOUNTED GUI <input type="checkbox"/> ACRYLIC		
	CONTROL HARDWARE	<input type="checkbox"/> PB <input type="checkbox"/> INDICATORS <input checked="" type="checkbox"/> FACIAS 25 Nos. <input type="checkbox"/> OTHERS		
	CONFORMAL COATING	<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO		
<b>COMMUNICATION WITH OTHER SYSTEM</b>	HARDWIRED	<input checked="" type="checkbox"/> YES (Critical signals) <input type="checkbox"/> NO		
	PURPOSE	<input type="checkbox"/> CONTROL <input checked="" type="checkbox"/> MONITORING		
	MEDIUM	<input checked="" type="checkbox"/> UTP <input type="checkbox"/> FIBRE OPTIC <input type="checkbox"/> OTHERS		
	TIME SYNCHRONIZATION SIGNAL FORMAT	<input type="checkbox"/> PULSE <input type="checkbox"/> RS-485 <input checked="" type="checkbox"/> IRIG-B <input type="checkbox"/> NTP		
	SOFTLINK	<input checked="" type="checkbox"/> MODBUS <input type="checkbox"/> OPC IF MODBUS THEN <input checked="" type="checkbox"/> RS-485 <input type="checkbox"/> ETHERNET		
	SERIAL LINK	COMMUNICATION PORT TYPE _____		
<b>POWER SUPPLY INPUT FEEDER</b>	PLC PANEL	BIDDER TO INDICATE LOAD DATA		
	REMOTE I/O PANEL	BIDDER TO INDICATE LOAD DATA		
<b>POWER SUPPLY</b>	SOURCE	<input type="checkbox"/> UPS(INDUSTRIAL GRADE) <input type="checkbox"/> 24V DC CHARGER <input checked="" type="checkbox"/> BHEL SHALL PROVIDE TWO FEEDERS OF UPS CATEGORY		
	BATTERY TYPE	<input type="checkbox"/> Ni-Cd <input type="checkbox"/> LEAD ACID <input type="checkbox"/> OTHERS		
	BACK-UP TIME	<input type="checkbox"/> 30 MINS <input type="checkbox"/> 60 MINS <input type="checkbox"/> OTHERS		
	BATTERY CONFIGURATION	<input type="checkbox"/> 1X100% <input type="checkbox"/> 2X100% <input type="checkbox"/> 2X50%		
<b>CUSTOMER TRAINING</b>	TRAINING	<input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED		
	NO OF DAYS	3 DAYS		
	LOCATION	<input type="checkbox"/> VENDOR'S WORK <input type="checkbox"/> PROJECT SITE <input type="checkbox"/> OTHERS		



Technical specification for  
**CONTROL & INSTRUMENTATION**  
1X370 MW YELAHANKA CCPP

SPEC NO.: PE-TS-409-145-I

VOLUME

SECTION

REV. NO. 00

DATE : 05.01.2016

SHEET OF

# PLC Quality Plan

  
Anil

  
E. S. Srinivas

  
Prasen Kumar



PEM :: C&I

## STANDARD QUALITY PLAN FOR PROGRAMMABLE LOGIC CONTROLLER

QUALITY PLAN NO.: **PE-QP-999-145-1036**

VOLUME **IIB**

SECTION **D**

REV. NO. **01** DATE: **24.08.2007**

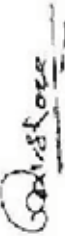
SHEET **1** OF **8**

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks
									P	W	V	
<b>1.0</b>	<b>Materials /Components</b>											
1.1	Panels & Control Desks	Physical Inspection for Dimensions, Painting, Cutouts, Lifting / Locking Arrangements, Components, Drawing Pocket, Mounting accessories, Plinth & AV Pads, Cable Gland Plates, Hardwares, Hinges, Louvers & Filters, Fans & Panel Lamps	MA	Visual	100%	Contract specifications, Approved GA Drawings, BOQ	As per ref documents. No physical damage.	BHEL Quality Inspection Report.	3/2	2	1	
1.2	Power Supply/Packs, Battery charger, Transformer, UPS.	Physical Inspection Physical Damages Dimensions Mounting Accessories	MA	Visual	100%	Contract specifications, BOQ.	As per reference documents, Test Report	BHEL Quality Inspection Report.	3/2	2	1	
1.3	Indicating Lamp, Annunciator, Meters, Transducers, Signal Converters, Instruments, Single Loop Controllers	Physical Verification Physical Damages Dimensions Accessories	MA	Visual	100%	Contract specifications, BOQ.	As per ref documents No physical damage. Test/ Calibration report.	BHEL Quality Inspection Report	3/2	2	1	
1.4	PLC processors, I/O modules, Power Supply modules, Communication modules, Mounting Racks, Ethernet	Physical Inspection <ul style="list-style-type: none"> <li>• Identification Labels</li> <li>• Physical Damages</li> <li>• Quantity</li> <li>• Spare Capacity</li> </ul>	MA	Visual	100%	Product Catalogue, Data sheets, Approved Configuration diagram, BOQ	As per ref documents. Test Certificates	BHEL Quality Inspection Report.	3/2	2	1	

LEGEND: \* CR - Critical characteristics  
 MA - Major characteristics  
 MI - Minor characteristics

\$ P - Agency Performing the Test.  
 W - Agency Witnessing the Test.  
 V - Agency Verifying the Test.

1 - BHEL  
 2 - Vendor  
 3 - Sub-vendor

  
 Anshul  
 S A Khan



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## STANDARD QUALITY PLAN FOR PROGRAMMABLE LOGIC CONTROLLER

QUALITY PLAN NO.: **PE-QP-999-145-1036** \_\_\_\_\_  
 VOLUME **IIB**  
 SECTION **D**  
 REV. NO. **01** DATE: **24.08.2007**  
 SHEET **2** OF **8**

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks
									P	W	V	
1.5	CPU, Monitor, Keyboard, Mouse, CD Drives, Printers, OS, System Software, Engineering software in the form of Licensed CD.	Physical Inspection Identification Labels, <b>Tech. Specification</b> Physical Damages Accessories Installation arrangements for Computers & Printers	MA	Visual	100%	Contract specifications, Product Catalogue, Approved GA / Configuration drawing, BOQ.	As per reference documents.	BHEL Quality Inspection Report.	3/2	2	1	

LEGEND: \* CR - Critical characteristics  
 MA - Major characteristics  
 MI - Minor characteristics

\$ P - Agency Performing the Test.  
 W - Agency Witnessing the Test.  
 V - Agency Verifying the Test.

1 - BHEL  
 2 - Vendor  
 3 - Sub-vendor

Anshul

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## STANDARD QUALITY PLAN FOR PROGRAMMABLE LOGIC CONTROLLER

QUALITY PLAN NO.: **PE-QP-999-145-1036**

VOLUME **IIB**

SECTION **D**

REV. NO. **01** DATE: **24.08.2007**

SHEET **3** OF **8**

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks
									P	W	V	
<b>2.0</b>	<b>Assembly</b>											
2.1	Functional Test for HMI/OWS devices such as Monitors, Keyboards, Mouse, Printers etc.	Operation	MA	Functional	100%	Approved Configuration Diagram & BOQ and FAT	Correct Operation of interconnected Devices of HMI system.	BHEL Quality Inspection Report.	2	1	1	
2.2	Hardware Functional Verification.	Physical arrangement, Wiring check & labeling, Continuity Checking, IR & HV test	MA	Visual/ Electrical	100%	Approved GA Drawing, Panel Wiring Diagram, IR & HV as per relevant International standard	Test Certification	BHEL Quality Inspection Report.	2	2	1	
2.3	Powering Up	Healthiness of all the modules/equipment, associated with Powering of PLC system	MA	Visual /Electrical	100%	Approved power supply scheme	All equipment to be healthy on power ON	BHEL Quality Inspection Report.	2	1	1	
2.4	Burn in test for PLC modules	Healthiness of PLC modules on Continuous Energisation, Temperature maintenance	MA	Visual/ Electrical	100%	FAT Procedure	Test certification as per FAT	BHEL Quality Inspection Report.	2	2	1	

LEGEND: \* CR - Critical characteristics  
 MA - Major characteristics  
 MI - Minor characteristics

\$ P - Agency Performing the Test.  
 W - Agency Witnessing the Test.  
 V - Agency Verifying the Test.

1 - BHEL  
 2 - Vendor  
 3 - Sub-vendor

  
 S. A. Koushik  
 Anshul



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## STANDARD QUALITY PLAN FOR PROGRAMMABLE LOGIC CONTROLLER

QUALITY PLAN NO.: PE-QP-999-145-1036

VOLUME IIB

SECTION D

REV. NO. 01 DATE: 24.08.2007

SHEET 4 OF 8

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks
									P	W	V	
<b>3.0</b>	<b>Factory Acceptance Test (FAT)</b>											
3.1	Input Output Functional Verification	I/O configuration, I/O operation	MA	Visual/ Electrical	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.2	Processor Verification	Processor configuration, Powering up, standby operation (as applicable) and Loading	MA	Visual	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.3	Power Supply Module Verification	Redundancy Operation	MA	Electrical	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.4	Communication System Verification	Redundancy operation of Communication System, Measurement of Response Time, Communication with third party system	MA	Electrical	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.5	Diagnostic Verification	Self Diagnostic features of PLC system	MA	Visual	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.6	Control Panel/Desk Verification	Operation of PLC driven annunciation system, Mosaic, Push buttons & selector switches, Indicating lamps	MA	Visual	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.7	Software Verification	(i) Control Logics (ii) Engineering Features (iii) HMI Features	MA	Visual	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	

LEGEND: \* CR - Critical characteristics  
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**STANDARD QUALITY PLAN  
FOR  
PROGRAMMABLE LOGIC CONTROLLER**

QUALITY PLAN NO.: PE-QP-999-145-I036__			
VOLUME IIB			
SECTION D			
REV. NO. 01	DATE: 24.08.2007		
SHEET 5	OF	8	

**FACTORY ACCEPTANCE TEST (FAT) PROCEDURE**

This document covers procedure to conduct/witness PLC system functional tests in order to demonstrate conformity to purchase specifications and related engineering documents. The test shall be conducted at the system suppliers works. The system supplier shall conduct all functional tests before commencing FAT and test results shall be made available during FAT. Vendor must furnish following relevant drawings, duly approved by BHEL Engineering, for reference during FAT.

- a) Technical Specification of PLC.
- b) PLC System Configuration
- c) General Assembly Drawings.
- d) Panel Wiring Diagrams.
- e) Bill of Quantity for PLC System.
- f) Logic Diagram.
- g) HMI Schematics.
- h) Input / Output List.

Further the vendor shall furnish applicable product specification, datasheets, catalogues, test-certificates, and internal inspection records to enable FAT. Vendor shall also submit, [to the inspecting agency](#), his standard test procedure, for clauses given below; where vendor's standard practice has been referred.

**APPLICABLE TEST PROCEDURE:**

**1. Input/Output Functional Verification.**

Check for correctness of addressing of racks, slots and I/O modules as per applicable PLC configuration diagram. Appropriate signal generators shall be used to simulate Inputs and outputs to check operation and SCAN time. [Check online replacement of cards, processors, power supply etc.](#)

**2. Processor Verification**

PLC Configuration drawing to be referred for ascertaining

- i) Redundancy



**STANDARD QUALITY PLAN  
FOR  
PROGRAMMABLE LOGIC CONTROLLER**

QUALITY PLAN NO.: PE-QP-999-145-I036__			
VOLUME IIB			
SECTION D			
REV. NO. 00	DATE: 23.03.2005		
SHEET 6	OF	8	

ii) Type (Hot or Cold)

Both the processors are to be checked for healthiness in case of redundant configuration as per vendor's standard practice. In case of hot redundancy, switchover of control from primary processor to standby processor shall be demonstrated for uninterrupted control and data processing as per vendor's standard practice. Switchover shall be witnessed, by manual power off or resetting the Primary CPU or simulating failure of primary processor. Checking should be by witnessing the lighting up of Processor's LEDs as per manufacturer's product standard.

Vendor shall demonstrate, as per Vendor's standard practice, adequate Loading (Spare Capacity) of Processors, as mentioned in contract specs. This shall be done, by simulating worst load operation of fully integrated PLC system.

**3. Power Supply Module Verification**

Check if PSM is in redundant mode as per specification. Check the healthiness of power supply from both the modules' lamp indication/measurement. Simulate failure of one PSM and verify that standby PSM has taken over without any interruption.

**4. Communication System Verification**

Communication system has to be in line with approved PLC Configuration Diagram. Verify that both the communication buses are intact and connected. Communication between PLC processors, I/O rack, OWS etc. is to be checked through simulation of input data. Simulate the bus failure by disconnection of working bus. Check that the communication continues without interruption or loss of data.

Following response times are to be demonstrated as per vendor's standard practice for conformance to contract specifications:

1. Screen update time
2. I/O scan time
3. SOE resolution time
4. Data transfer time with third party system using Communication Protocol as per Contract specification and as per quantum of data as per approved signal exchange list.

**5. Diagnostic Verification**

Product Catalogue/Literature shall be referred for checking of all diagnostic features. Hardware failure to be simulated by removing an I/O

**STANDARD QUALITY PLAN  
FOR  
PROGRAMMABLE LOGIC CONTROLLER**

QUALITY PLAN NO.: <b>PE-QP-999-145-I036</b> ___			
VOLUME IIB			
SECTION D			
REV. NO. 00	DATE: 23.03.2005		
SHEET 7	OF	8	

**6. Control Panel /Desk Verification**

- i) PLC driven annunciation system should be checked by alarm signal simulation.
- ii) Push Button and selector switch operation should be checked by verification of corresponding change of status of Data Base point.
- iii) Indicating lamp / MIMIC should be checked by corresponding Data Base point simulation.

**7. Software Verification**

- i). Control Logics:- Software switches, lamps and Analog sources shall be used for simulation of field conditions .Control logics shall be checked for its correct functionality as per approved logic schemes
- ii). Engineering features:-
  - a) Online changing of parameters, set points.
  - b) Online modification in Control Logic Diagrams.
  - c) Online configuration of Graphics, Trends, Logs, HSR.
- iii). HMI features:-  
Check for configuration & operation of Graphics, Trends, Logs, HSR and Alarms, in the form of Displays and Printouts, by simulation of Inputs as per approved documents.

**8. Burn in Elevated Temperature test**

Electronic equipments shall be subjected to Burn in elevated temperature test as per the procedure detailed below:

- a) (i) PLC modules are kept at 50 Deg c under continuous energized condition for 48 hours.

**STANDARD QUALITY PLAN  
FOR  
PROGRAMMABLE LOGIC CONTROLLER**

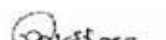
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VOLUME IIB			
SECTION D			
REV. NO. 00		DATE:	
23.03.2005			
SHEET	8	OF	8

ii) 48 hours test period shall be divided into 4 equal time segment of 12 hours duration each. For every 12 hours duration segment, after lapse of first 11 hours 110% of nominal voltage shall be applied to the panel under test for a period of 30 minutes followed by application of 90% of nominal voltage for the next 30 minutes.

b) Assembled Panels with complete wiring shall be kept under continuous energized condition for 120 hours at ambient temperature. Temperature rise in panels should be below 10 Deg C above ambient.

  
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P. S. Rao

  
Prasen Kumar



Technical specification for  
**CONTROL & INSTRUMENTATION**

**1X370 MW YELAHANKA CCPP**

SPEC NO.: **PE-TS-409-145-I**

VOLUME

SECTION

REV. NO. 00

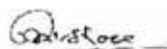
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SHEET OF

# PLC CONFIGURATION

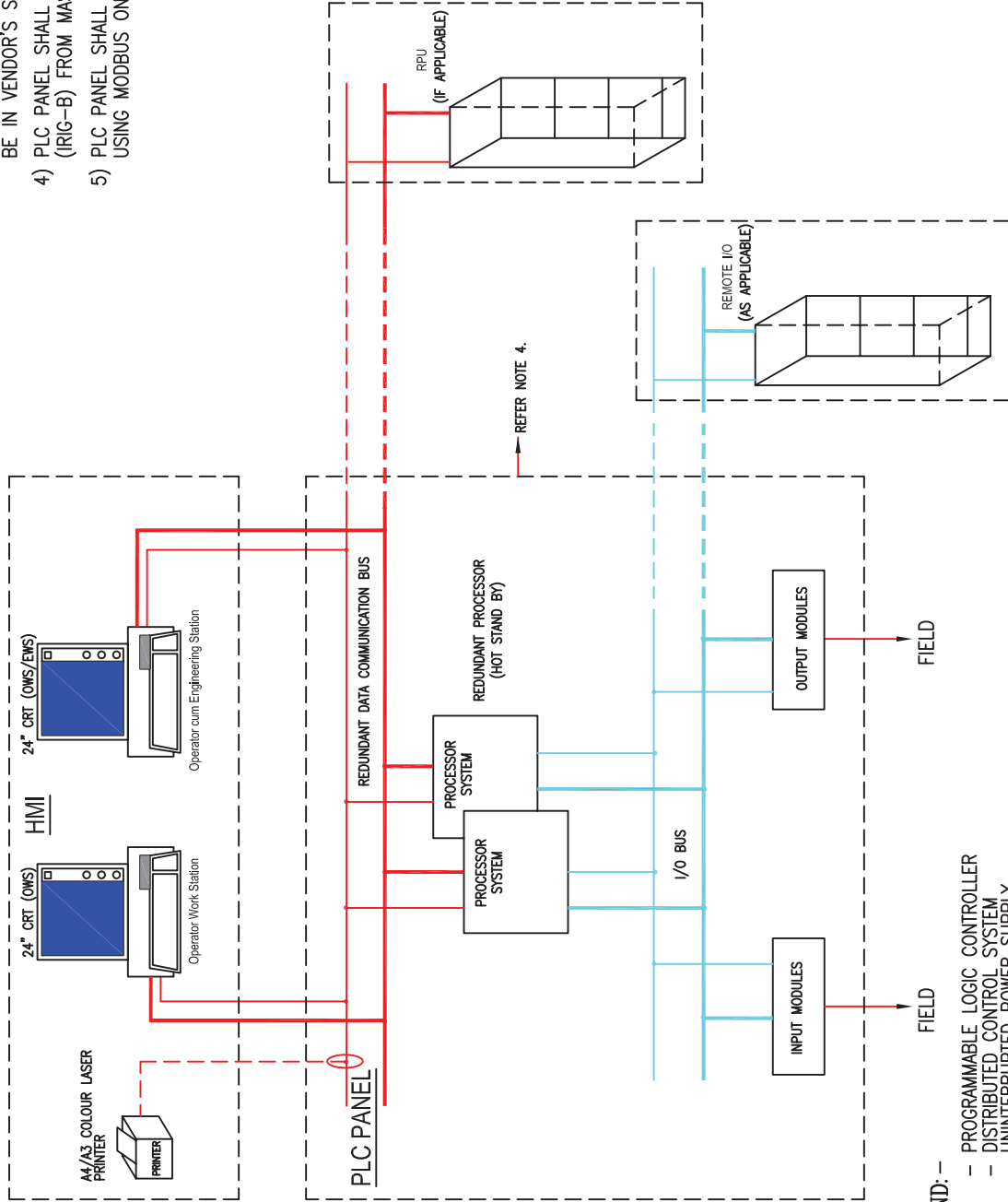
  
Anshul

  
P. S. Rao

  
Prasen Kumar

**NOTES:**

- 1) TABLE TOP OWS/EWS SHALL BE 24" OR AVAILABLE INDUSTRY STANDARD.
- 2) PLC SYSTEM SHALL HAVE REDUNDANCY IN PROCESSOR AND COMMUNICATION SYSTEM.
- 3) BHEL SHALL PROVIDE 2 FEEDERS OF UPS CATEGORY. FURTHER DISTRIBUTION SHALL BE IN VENDOR'S SCOPE. TERMINAL POINT WILL BE POWER TBs OF PLC PANEL.
- 4) PLC PANEL SHALL HAVE PROVISION TO ACCEPT TIME SYNC. SIGNAL (IRIG-B) FROM MASTER CLOCK SYSTEM (PLANT AREA).
- 5) PLC PANEL SHALL HAVE PROVISION FOR DATA EXCHANGE WITH PLANT DCS USING MODBUS ON RS-485.



**LEGEND: -**

- PLC - PROGRAMMABLE LOGIC CONTROLLER
- DCS - DISTRIBUTED CONTROL SYSTEM
- UPS - UNINTERRUPTED POWER SUPPLY
- OWS/EWS - OPERATOR WORK STATION/ ENGINEERING WORK STATION
- HMI - HUMAN MACHINE INTERFACE
- MCCB - MOULDED CASE CIRCUIT BREAKER
- MCB - MINIATURE CIRCUIT BREAKER
- RPU - REMOTE PROCESSING UNIT



**PLC SYSTEM CONFIGURATION FOR  
AIR CONDITIONING & VENTILATION SYSTEM**

<b>DRG. NO.</b>	PES-145-36A		
<b>REV. No.</b>	00	<b>DATE</b>	19.03.16
<b>SHEET</b>	01	<b>OF</b>	01

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*Adarsh*  
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Technical specification for  
**CONTROL & INSTRUMENTATION**

**1X370 MW YELAHANKA CCPP**

SPEC NO.: **PE-TS-409-145-I**

VOLUME

SECTION

REV. NO. 00

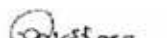
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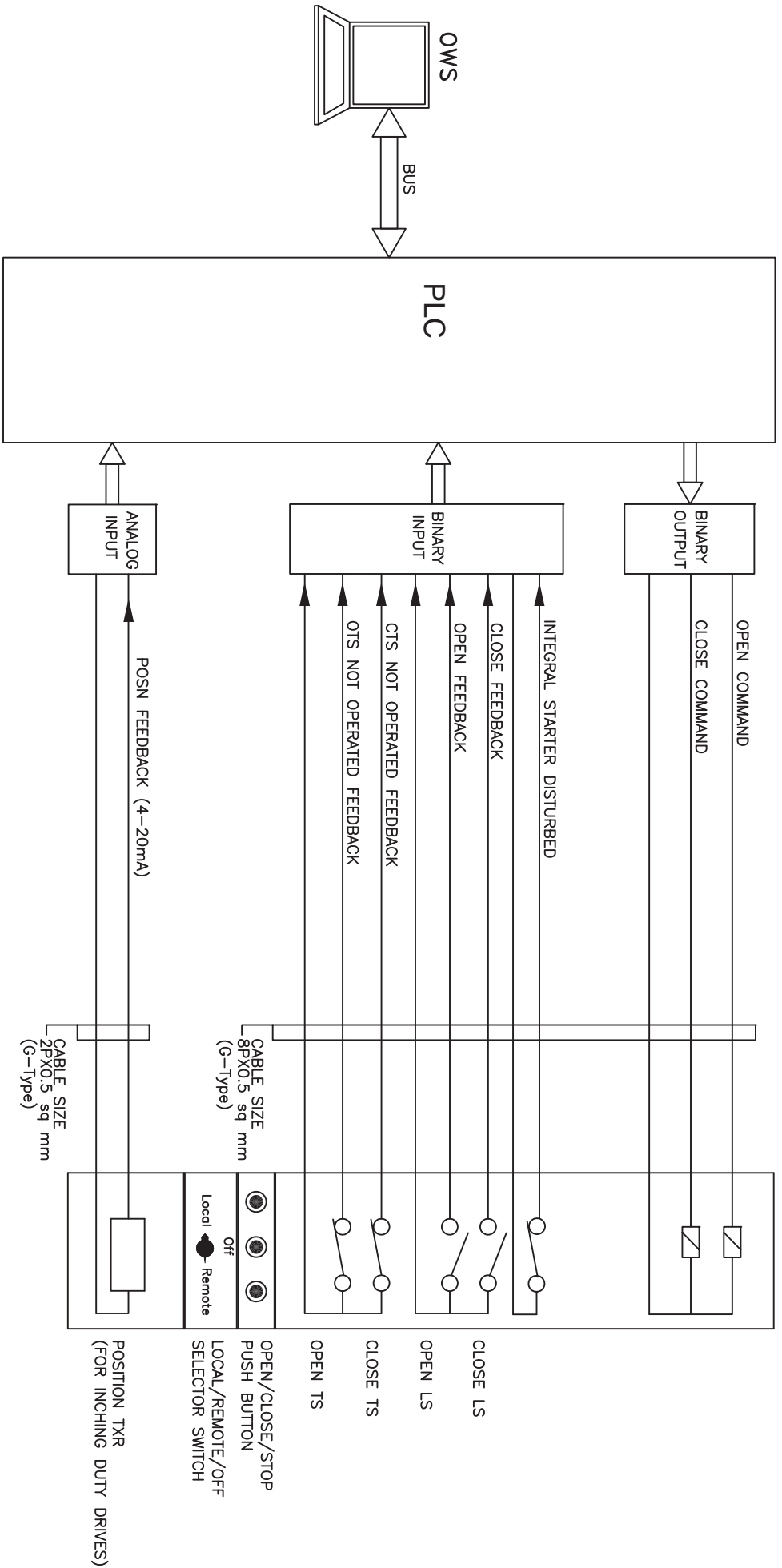
# Drive Control Philosophy

  
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P. S. Rao


  
Prasen Kumar

# PLC INTERFACE FOR BIDIRECTIONAL DRIVE (WITH INTEGRAL STARTER)



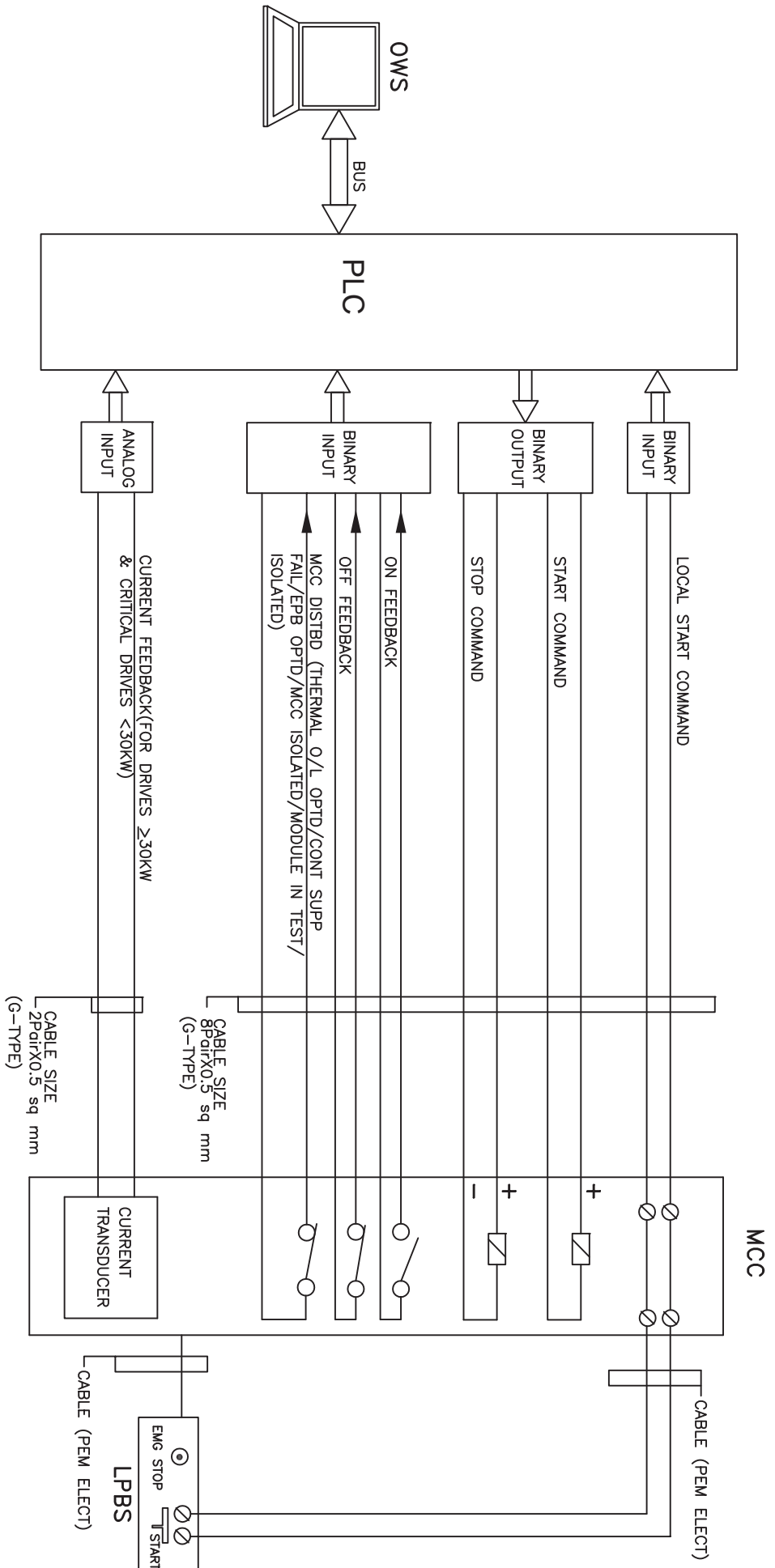
NOTE:

1. DISTURBED= Loss of Power supply (1 Phase/3 Phase),  
Loss of control supply, Motor thermostate trip,  
Thermal over load relay trip etc.

		PROJECT:	KARNATAKA POWER CORPORATION LIMITED	DRG. NO.	PE-DM-409-145-1002
		TITLE	1x370 MW YELAHANKA COMBINED CYCLE POWER PLANT	DATE	19.01.2016
PLC INTERFACE FOR BIDIRECTIONAL DRIVE		REV. NO.	00	SHT	8 OF 13

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 P. S. S. S.  
 P. S. S. S.

# PLC INTERFACE FOR UNIDIRECTIONAL LT DRIVE-CONTACTOR OPERATED



PROJECT:		KARNATAKA POWER CORPORATION LIMITED	
TITLE		1x370 MW YELAHANKA COMBINED CYCLE POWER PLANT	
UNIDIRECTIONAL LT DRIVE-CONTACTOR OPERATED		DRG. NO.	PE-DM-409-145-1002
PLC INTERFACE FOR	DATE	REV. NO.	19.01.2016
SHT	9	OF	13

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 Pawan Katar



Technical specification for  
**CONTROL & INSTRUMENTATION**

**1X370 MW YELAHANKA CCPP**

SPEC NO.: **PE-TS-409-145-I**

VOLUME

SECTION

REV. NO. 00

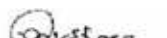
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SHEET OF

# INSTRUMENTATION DATA SHEET

  
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P. S. Rao

  
Prasen Kumar

2.16 **General Guidelines for Provision of Instruments**

**FIELD INSTRUMENTS SHALL BE SUPPLIED AS PER AGREED PID :**

- PRESSURE TRANSMITTERS
- DIFF. PRESSURE TRANSMITTERS
- DISPLACEMENT TYPE LEVEL TRANSMITTERS
- THERMOCOUPLES WITH THERMOWELLS
- RESISTANCE TEMPERATURE DETECTORS (PT 100)
- PRESSURE GAUGES
- DIFFERENTIAL PRESSURE GAUGES
- TEMPERATURE GAUGES
- LEVEL GAUGES
- PRESSURE SWITCHES
- DIFFERENTIAL PRESSURE SWITCHES
- LEVEL SWITCHES
- ~~SIGHT FLOW INDICATOR~~
- ~~OIL FLOW METER~~
- ~~ROTAMETERS~~
- FLOW SWITCH
- ~~ANUBAR~~

**TECHNICAL SPECIFICATIONS FOR FIELD INSTRUMENTS, PLC, VMS, CCTV AND OTHER EQUIPMENT/SYSTEMS**

- All instruments offered by the Contractor shall be from reputed experienced manufacturers of specified type and range of equipment, whose guaranteed and trouble free operation has been proven as mentioned in design criteria. Further, all instruments shall be of proven reliability, accuracy, and repeatability requiring a minimum of maintenance. They shall comply with the acceptable international standards and shall be subject to Employer's approval. All instrumentation equipment and accessories under this specification shall be furnished as per technical specifications.
- The Contractor shall furnish all Instrumentation/ Control equipment & accessories under this specification as per technical specification, ranges, makes & model as approved by the Employer during detailed engineering. The necessary root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifolds and all the other accessories required for mounting/ erection of these transmitters shall be furnished, even if not specifically asked for, on as required basis. Double root valves shall be provided for all pressure tapping where the pressure exceeds 40 Kg./sq.cm

**Smart Electronic Transmitters for Measurement of Pressure, Differential Pressure(DP) & Flow/Level(DP Type):**

- Micro-processor based indicating type (LCD display), rack mounted with accuracy of +/- 0.1% of span, Repeatability :+0.05% of FSR or better, Linearity :+0.1% of FSR or better. Hysteresis: +0.1% of FSR or better. external zero and span adjustment, self diagnostics, temperature sensor for compensation. Power supply 24 V DC; output signal of 4- 20 mA DC. IP 65 or equivalent degree of protection with epoxy coating, 316 SS/ haste alloy/ other suitable sensing element. Accessories like snubbers for pump discharge applications and chemical diaphragm with 15 m PVC covered SS armoured capillary for corrosive and oil services, etc. Material for accessories will be SS. HART protocol output shall be available in each transmitter. In case it becomes necessary to use a DP transmitter for pressure measurement then a 3-valve manifold should be used in place of 2-valve manifold. LVDT type is not acceptable.
- Wherever, the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application

**In Detail Technical Specification:**

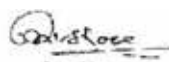
- 1)Type of Transmitter: Microprocessor based 2 wire type HART protocol compatible,
- 2) Accuracy : - +/- 0.1 % of span



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Prasenjit

- 3) Output Signal Range: 4-20 mA DC(Analog) Super imposed digital on HART protocol
- 4) Turn Down Ratio : 10:1 for vacuum/very low pressure applications  
30:1/100:1 for other applications
- 5) Stability: +/-0.1% of calibrated span for 6 months up to 70 KSC & +/- 0.25% for range more than 70 KSC(g).
- 6) Zero and Span Drift: +/- 0.015% per Deg.C at max. span and 0.11% per Deg.C at Minimum Span
- 7) Load Impedance: 500 ohm (Min)
- 8) Housing: Weather proof as per IP-65 with durable corrosion resistant coating
- 9) Over Pressure - 150 % of Max. operating pressure
- 10) Connection(Electrical)- Plug and socket type
- 11) Process Connection - 1/2 inch NPT (F)
- 12) Span and Zero: Continuous, tamper proof, Remote Adjustability as well as manual from instrument with zero suppression and elevation facility.
- 13) Accessories
  - a) Diaphragm seal, pulsation dampeners syphon etc. as required by service and operating condition.
  - b) 2/3/5 Valve manifold as applicable
- 14) Diagnostics: Self Indicating Feature
- 15) Power Supply: 24 V DC +/- 10%
- 16) Adjustment : Calibration facility via Centralized PC based HART management system

In addition to the transmitters 6 Nos. of hand held calibrators for configuration shall be provided for maintenance of units

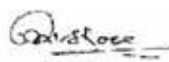
2.16.1 **Pressure indicators** shall be provided for

Suction and discharge lines of pumps including on header section if two or more pumps are employed for the same service and transmitters.

2.16.2 **Pressure switches** shall be provided for

- (a) On all process lines / equipment where parameter abnormality / status including pre-trips alarms to be communicated to the operator in control room.
- (b) For all permissives and protection conditions governed by safety operation of the equipment e.g., pressure adequate, pressure very high / low conditions.
- (c) For all interlock conditions which governs starting of standby equipment or subsequent equipment for safety operation of the system.





- (d) 3 switches shall be employed for protection in case of critical applications.

Inlet and outlet of filters / strainers.

2.16.3 **Differential Pressure Switches** shall be provided

- (a) Across filters / strainers for remote monitoring
- (b) Across condenser CW line for remote monitoring and interlocks.

2.16.4 **Differential pressure indicators** shall be provided

- (a) Across filters / strainers for local monitoring.
- (b) Across condenser CW line for local monitoring

2.16.5 **Pressure Transmitters** shall be provided

- (a) At suction and discharge of all major pumps.
- (b) For all control applications as demanded by the process. It shall be noted that for all critical control applications, 3 transmitters shall be provided.
- (c) Pressure conditions of all major vessels / tanks like deaerator, hotwell, HP / IP / LP drums, etc.
- (d) All inputs for equipment / unit performance calculation.

2.16.6 **Differential pressure transmitters** shall be provided for

- (a) all the requirements of differential pressure, flow and level measurements.
- (b) control applications.

All inputs for equipment / unit performance calculation.

2.16.7 **Temperature indicators (Thermometers)** shall be provided.

- (a) On all process lines where local indication is warranted by the system either for monitoring or testing.

- (b) On the inlet / outlet equipment such as heaters, desuperheaters, Heat exchangers and coolers for both the fluid media.

2.16.8 **Temperature switches** shall be provided

- (a) On all process lines where parameter abnormality is to be communicated to the operator in control room.
- (b) For all permissive, interlock and protection conditions governed by the safety operation of the equipment. For all critical services 3 nos., shall be provided for protection application.

2.16.9 **Resistance temperature detectors (RTD's)** shall be provided for all services where maximum temperature does not exceed 150 degree centigrade. RTD shall be 3 wire type, duplex with thermowell.

E.g., Suction / Discharge of pumps, inlet / outlet of heat exchangers, pump / motor bearings, motor windings, etc. RTD is employed for remote display, for control applications and density correction for flow measurement.

2.16.10 **Thermocouple**: Shall be provided for all services where normal operating temperature exceeds 150<sup>0</sup>C.

- (a) The element shall be duplexed integral with thermowell, K-type for temperature upto 600<sup>0</sup>C and R-type for temperature above 600<sup>0</sup>C.
- (b) The thermocouple is employed for remote display, for control applications and density correction for flow measurements.
- (c) Compensating cable shall be provided with all thermocouples as required to make the system complete.

2.16.11 **Temperature transmitters**: Shall be provided where thermocouples / RTD are used for control application. For bearing temperature, winding temperature and metal temperature, field located remote multiplexing units with digital communication to control room electronics can be considered. Otherwise, thermocouples with compensating cable to control room also can be run.

Temperature transmitters shall be mounted in marshalling cabinets in electronic cubicle room, compensating cables shall be run from the temperature element to the temperature transmitters.

2.16.12 **Level gauges:** Shall be provided on all tanks and the maximum length of one gauge glass shall not exceed 1 metre. The gauge glasses shall be stacked to cover the complete height of the tanks including over flow level. All high pressure vessel shall be provided with level gauges on either end as per Boiler statutory requirement.

2.16.13 **Level switches** : The instrument shall be provided on all equipment (storage vessel) where parameter abnormality / status to be communicated to the operator in the control room.

All permissive, interlock and protection conditions governed by the safety operation of the equipment. For all critical services, 3 switches shall be provided for protection application.

The instrument shall be external cage type with SW connection with isolation facility for surface mounted tanks and top mounted with still pipe for all sumps.

2.16.14 **Level transmitters** shall be provided on process equipment where continuous remote monitoring and/or control of level is envisaged.

The instrument shall be differential pressure type or displacement type.

2.16.15 **Flow Glasses** shall be provided at the outlet of the pipe line shall be employed under the following conditions:

Coolant from the equipment (coolers).

The instrument shall be rotary type with glass mounted for indication.

Upto 4 inch on-line flow glasses shall be supplied and above 4 inch bypass type flow glasses shall be provided.

2.16.16 **Flow Switches** shall be provided at different outlet header of identical equipment to alarm in the event of inadequate coolant requirement. (or) lub oil.

~~2.16.17 **Flow elements** shall be provided as mentioned below.~~

~~Orifice plate shall be provided for spray water, condensate, makeup water, LP steam/feed water. Flow nozzle shall be provided for HP/IP Feedwater, HP/IP steam, HP / LP Bypass system. The flow element connection shall be Butt welded except for DM water application where flanged connection shall be used.~~

~~2.16.18 **Control valves** shall be provided for all control application as required and in line with the system requirement. If the process~~

(b) **Gas analysers**

The following gas analysers shall be provided at the location indicated below:

- HRSG stack for each HRSG: SO<sub>2</sub>, NO<sub>x</sub>, SPM.

2.16.25 **Transmitter racks**

All the pressure, flow and level transmitters shall be grouped depending the geographical locations and mounted on transmitter racks.

2.16.26 **Junction boxes shall be provided for :**

- (a) Termination of all sensors and transmitters located area-wise.
- (b) Termination of transmitters mounted on the transmitter racks.
- (c) Termination of both the contacts of switches and duplex elements of temperature measurement.

2.17 **Instrumentation and Control Cables**

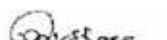
Instrumentation and control cables and power cables shall be supplied to :

- (a) Connect field instruments to marshalling cabinets in the control room through field junction boxes.
- (b) Connect limit switches, torque switches, proximity switches, and position transmitters to their respective motor control centres / switchgears and marshalling cabinets through field junction boxes.
- (c) Connect interposing relay contacts from relay cabinet in the control room, the motor control centres / switchgears and solenoid valves through power supply distribution board.
- (d) Control desk cabling, annunciation/SER system cabling, power supply cables from distribution board to system cabinet.

Specification for cables is covered in Electrical Section.

  
Anshul

  
S. S. Saha

  
Prasenjit Ghose

2.18 **Impulse Pipes and Fittings**

Impulse pipes, tubes, fittings and air supply and signal piping / tubing shall be supplied for all the instruments under the scope of this specification as per Table 1 in this section.

2.19 **Selection of Ranges for Instruments**

The ranges of the instruments shall be selected based on the philosophy indicated below:

- (a) For pressure and draft measurements, the maximum operating pressure shall be within 70 to 80% of the maximum scale range. All pump suction measurement will cover the negative pressure range also and all draft gauges will cover the negative pressure as well as the positive pressure as the case may be.
- (b) For temperature measurement, the maximum operating temperature will be within 80 to 90% of the maximum scale range.
- (c) For pressure switches and temperature switches, the set points shall fall within 40% to 70% of the scale range selected.
- (d) For level measurement, the maximum of the range will cover the overflow point or six inches from the top of the vessel and the minimum of the range will be stacked with overlap to cover permissive, alarm and trip levels.

2.20 **Performance Test Points**

- (a) Pressure, temperature and flow test points shall be provided in line with performance test code requirements
- (b) Pressure test points shall be complete with root valves and shall terminate with a nipple
- (c) Temperature test points shall be provided with thermowell.
- (d) All instruments required for performance testing to prove the performance of the Instrumentation and Control Equipment shall be provided by the Contractor for the duration of the performance test. These test instruments shall have test certificates from reputed test house valid for the duration of the performance test.

2.22.3.6 Tables suitable for dot matrix/laser/inkjet printers shall be provided. The exact details shall be finalised & approved during detailed engineering.

## 2.23 **Specifications for Instruments**

### 2.23.1 **Pressure Indicators**

Direct reading, pipe mounted Pressure gauges of aluminium casing with 150 mm inch phenolic dial (white dial with black numerals), 316 SS Bourdon tube, nylon movements and micrometer type adjustable pointer, accuracy of  $\pm 0.5\%$  of span including accessories like syphons for steam services, snubbers for pump discharge applications and chemical diaphragm for corrosive and oil services and name plate. Material of accessories will be SS. IP65 or equivalent degree of protection for enclosure. Over range protection will be 25% above maximum pressure. Armoured capillary of 15m shall be provided. Bourdon tube shall be drawn tube for pressure < 70 bar (g) and bored tube for > 70 bar (g).

### 2.23.2 **Pressure Switches**

Non indicating type, field mounted Pressure Switches of aluminium casing (epoxy coated), and 316 SS element and accuracy of  $\pm 1\%$  of span, including accessories like syphons for steam services, snubbers for pump discharge applications and chemical diaphragm for corrosive and oil services, name plate and mounting brackets. Material of accessories will be SS. Auto reset micro switch with internal adjustment for set values with 2 SPDT contacts rated for 0.2 A at 220 V DC. IP 65 or equivalent degree of protection for enclosure. Over range protection 50% above maximum pressure. Scale for setting shall be provided repeatability shall be  $\pm 0.5\%$  of full scale range.

### 2.23.3 **Pressure Transmitters**

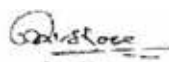
Micro-processor based **Smart Electronic Transmitters**, rack mounted with accuracy of  $\pm 0.1\%$  of span, field zero and span adjustment, self diagnostics, temperature sensor for compensation. Power supply 24 V DC; output signal of 4-20 mA DC and digital signal with HART protocol. Two nos. HART communicator with pre-loaded device program shall be provided for smart pressure / differential pressure transmitters. IP 65 or equivalent degree of protection. Aluminium housing with epoxy coating, 316 SS sensing element. Accessories like snubbers for pump discharge applications and chemical diaphragm with 15 m PVC covered SS armoured capillary for corrosive and oil services. Material for accessories will be SS.



Anshul



S. S. Saha



S. S. Saha  
Process Control

#### 2.23.4 **Differential Pressure Indicators**

Direct reading type, pipe mounted, bellows or diaphragm operated differential pressure indicators; aluminium casing (epoxy coated) with 150 mm dial, 316 SS pressure element; accuracy of  $\pm 0.5\%$  of span including accessories like snubbers for pump discharge application, chemical diaphragm with 15 m PVC covered SS armoured capillary for each limb for corrosive and oil services and 3 way manifold. Material of accessories will be SS. IP 65 or equivalent degree of protection. Over range protection will be 50% above maximum pressure.

#### 2.23.5 **Differential Pressure Switches**

Bellows or diaphragm operated non-indicating field mounted type; aluminium casing (epoxy coated); 316 SS pressure element nylon movement; accuracy of  $\pm 1\%$  of span with an adjustable contact including accessories like snubbers for pump discharge applications, chemical diaphragm with 15 m capillary for each limb for all corrosive and oil services and 3 way manifold. Material of accessories will be SS. Auto reset micro switch with tamper proof external adjustable set values with 2 SPDT contacts rated for 0.2 A at 220 V DC. IP 65 or equivalent degree of protection over range protection 50% above maximum pressure. Repeatability shall be  $\pm 0.5\%$  FSR.

#### 2.23.6 **Smart Electronic Transmitters for Measurement of Pressure, Differential Pressure(DP) & Flow/Level(DP Type):**

Micro-processor based indicating type (LCD display), rack mounted with accuracy of  $\pm 0.1\%$  of span, Repeatability  $\pm 0.05\%$  of FSR or better, Linearity  $\pm 0.1\%$  of FSR or better. Hysteresis:  $\pm 0.1\%$  of FSR or better external zero and span adjustment, self diagnostics, temperature sensor for compensation. Power supply 24 V DC; output signal of 4- 20 mA DC. IP 65 or equivalent degree of protection with epoxy coating, 316 SS/ Hastelloy/ other suitable sensing element. Accessories like snubbers for pump discharge applications and chemical diaphragm with 15 m PVC covered SS armoured capillary for corrosive and oil services, etc. Material for accessories will be SS. HART protocol output shall be available in each transmitter.

In case it becomes necessary to use a DP transmitter for pressure measurement then a 3-valve manifold should be used in place of 2-valve manifold. LVDT type is not acceptable.

Wherever, the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application.

#### 2.23.7 **Thermometers**

Indicating type, field mounted, filled system with ten (10) metres capillary and six (6) inch white dial with black numerals with micrometer pointer housed in aluminium casing (epoxy coated) with an accuracy of  $\pm 1\%$  of span, response time of 2-4 seconds, auto temperature calibration, linear calibration over the range and 316 SS thermowell having a process connection of M33 x 2 thread. Material of accessories will be SS. IP 54 or equivalent degree of protection for enclosure. Thermowell with Hex head of fabricated assembly for air and flue gas system for rest of the services bar stock assembly. The thermowell construction shall meet the ANSI 19.3 (latest) requirements.

#### 2.23.8 **Thermowells**

Pipe/equipment mounted temperature test wells of 316 SS (SS 446 for flue gas services) with a process connection of M33x2 thread. Material of accessories will be SS. Thermowell with hex head of fabricated assembly for air and flue gas system, for rest of the services bar stock assembly. In case flanged wells are required for any specific application, the same shall be supplied as required. The thermowell construction shall meet the ANSI 19.3. (latest) requirements.

#### 2.23.9 **Temperature Switch**

Non-indicating type, field mounted, filled system with ten (10) metre capillary housed in Aluminium casing (epoxy coated) with an accuracy of  $\pm 1\%$  span, auto temperature calibration, linear calibration over the range and 316 SS thermowell having a process connection of M33x2 thread. Micro switch with reset type with adjustable set values with 2 SPDT contacts rated for 0.2 A, 220 V DC. IP 54 or equivalent degree of protection for enclosure. Thermowell with hex head of fabricated assembly for air and flue gas system, for rest of the services bar stock assembly. Material of accessories will be SS. The thermowell construction shall meet the ANSI 19.3 (latest) requirements. Scale shall be provided for setting. Repeatability shall be  $\pm 0.5\%$  of full scale. For ambient temperature applications switches designed for cross ambient operation shall be used.

#### 2.23.10 **Thermocouple Assembly**

Duplex type with accuracy of  $\pm 0.5\%$  of span, response time of 2 to 6 sec, Spring loaded mineral insulated thermocouple assembly with 316 SS thermowell housed in aluminium casing (epoxy coated) having a process connection of M33 x 2 thread. Material of accessories will be SS. IP 54 or equivalent degree of protection for enclosure. Thermowell with hex head of fabricated assembly for air and flue gas system, for rest of the services bar stock assembly with ungrounded junction. For metal temperature measurement weldable thermocouple pads shall be provided with thermocouple extension wires of required length. Element size shall be 18 AWG. Insulation resistance at 540°C shall not be less than 5 M  $\Omega$ . Temperature devices provided with thermowells shall be calibrated with the associated thermowell as an assembly construction and shall meet the ANSI 19.3 (latest) requirements.

#### 2.23.11 **Resistance Temperature Detectors (RTD)**

Duplex type with accuracy of  $\pm 0.5\%$  of span, response time 1-2 seconds; Spring loaded mineral insulated three (3) wire RTD assembly with 316 SS Thermowell housed in aluminium casing (epoxy coated) having a process connection of M33 x 2 thread. IP 54 or equivalent degree of protection for enclosure. Material of accessories will be SS.

#### 2.23.12 **Temperature Transmitters Smart Electronic Transmitters:**

Temperature transmitters shall be provided where thermocouples/RTD'S are used for control application.

Indicating type, control room mounted temperature transmitters with an accuracy of  $\pm 0.25\%$ , ref. junction compensation, span/zero adjustment, burn out protection upscale, input/output isolation, circuit ungrounded, ambient temperature error 0.1%/10°C to provide linear output of 4-20 mA DC (2 wire system). Nema 4 or equivalent degree of protection for enclosure. Material of accessories will be SS.

#### 2.23.13 **Level Gauges**

Reflex / tubular type with automatic ball check valves, illuminator, pyrex / borosilicate glass, guard rods and Holders. Material of accessories will be SS.

2.23.14 **Level Switches**

External magnetic float operated level switches for tanks and vessels and top mounted level switches for sumps and underground tanks. Micro switch with 2 SPDT contacts rated for 0.2 A, 220 V DC. Material of float will be 316 SS and the material of accessories will be SS. IP 54 or equivalent degree of protection for enclosure.

2.23.15 **Displacement Type Level Transmitters Smart Electronic Transmitters:**

Displacement type level transmitters of float length of 14 inches or 32 inches with an accuracy of  $\pm 0.5\%$  of span, 4-20 mA DC output (2 wire system), +24 V DC supply, isolated and ungrounded electrical circuits, zero adjustment (100% of sensing element) for control application and measurement purposes. IP 54 or equivalent degree of protection for enclosure. Displacer / float material of 316SS. The material of accessories will be SS.

2.23.16 **Flow Glasses**

Online flow glasses for pipe size up to 80 mm with a rotary wheel (not a flapper type) suitable for installation on vertical or horizontal pipe lines, material pyrex tempered glass. The material of accessories will be SS.

2.23.17 **Flow Elements**

316 SS long radius, weld in flow nozzles with D and D/2 pressure tappings; 316SS flow orifice plate assembly with flange tap connections;  $\beta$  ratio of 0.5 to 0.7. Element material of SS 316. The material of accessories will be SS. End connections for flow elements will be butt welded except orifice plate on condensate return line to CST which will be flanged. The flow elements shall be designed in accordance with ISO 5167 / BS 1042. The accuracy of the flow element for steam flow / feed water flow measurement shall be  $\pm 2\%$  or better. Unit of measurement shall be metric tonnes / hour.

2.23.18 **Air Filter Regulator (AFR)**

Constant bleed type AFR with an accuracy of  $\pm 0.1\%$ , inlet pressure range of 5-8 kg/ cm<sup>2</sup> and suitable spring ranges (AFR) for use with positioners in control valves, control damper, E/P convertors and shut off valves for phosphor bronze filter element; Filtering particles above five microns. Weather and water proof enclosure. Material of accessories will be SS.

2.23.19 **Electro-Pneumatic Convertors (E/P)**

Two wire type E/P convertors with an accuracy of  $\pm 0.5\%$  accepting 4-20 mA dc signals from control system and converting to 0.2 to 1 kg/cm<sup>2</sup> air pressure to operate valve positioner of all final control elements; Housed in cast aluminium casing (with polyurethane paint); NEMA 4 or equivalent degree of protection for enclosure. Material of accessories will be SS.

2.23.20 **Pressure and Differential Pressure Transmitter Racks**

Open type transmitter racks to mount all pressure, differential pressure and flow transmitters with vibration damper (Keldur); air supply lines and header will be provided with bulk head fittings to receive impulse lines; Also provided with blow down/drain header. The material of accessories will be SS.

2.23.21 **Junction Boxes**

Wall/column mounted junction boxes having screwed terminals and cable entry only at the bottom and sealed with fire proof compound; The material of accessories will be SS. IP 54 or equivalent degree of protection for enclosure. Separate terminal blocks shall be used for analog and digital signals and also for signals with different voltages.

2.23.22 **Interposing Relays (IPR)**

Electro magnetic type IPRs with plug-in type connections, suitable for channel/rail mounting in cabinets; coil rating 24V D.C; 2 set of change over contacts rated for 0.2A 220 V DC. Free wheeling diode across relay coil and self reset type status indicator flag (electronic) shall be provided.

2.23.23 **System Cabinets**

Indoor located, free standing vertical type system cabinets with 3 mm thick sheet metal of cold rolled steel; double doors; antivibration pads of 15 mm thick; Fluorescent lighting; cooling fans in each cabinet fire proof compound for sealing cable entry; fire detector for each cabinet; space heater for each cabinet (strip type). Door locking facility shall be provided. Beacon lamp shall be provided in each row of cabinet to indicate the cabinet having fault condition. The racks in system cabinets shall have provision along with plug in sockets / back plane to house atleast 10% additional cards, to accommodate for engineering flexibility or future expansion.



Technical specification for  
**CONTROL & INSTRUMENTATION**

**1X370 MW YELAHANKA CCPP**

SPEC NO.: **PE-TS-409-145-I**

VOLUME

SECTION

REV. NO. 00

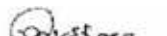
DATE : 05.01.2016


SHEET OF

# JUNCTION BOX SPECIFICATION

  
Anshul

  
P. S. Rao

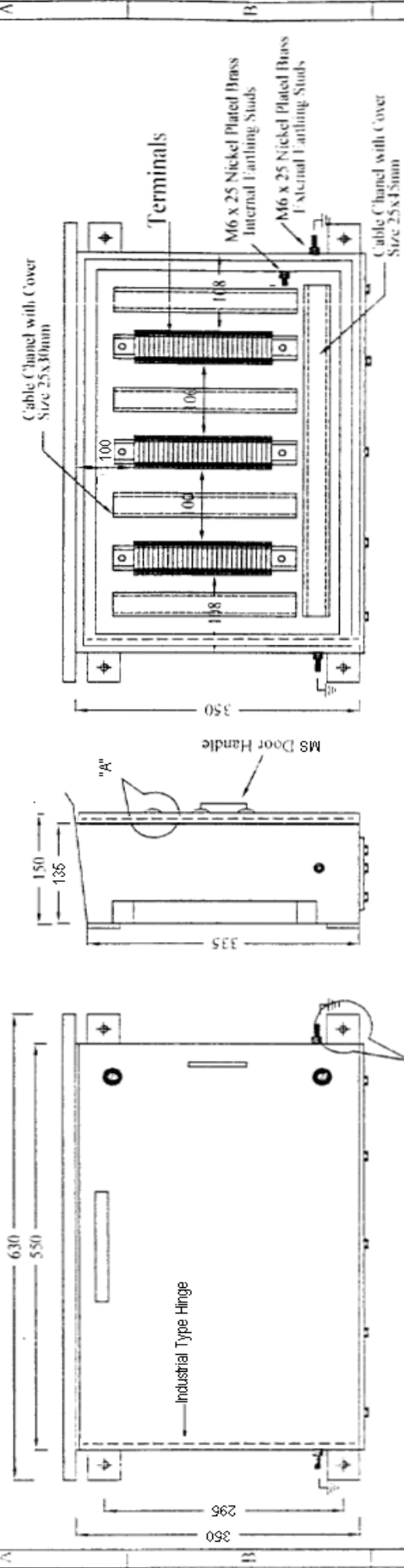
  
Prasen Kumar

	TITLE:	SPECIFICATION NO. PES-145-070
	STANDARD TECHNICAL SPECIFICATION (CONTROL & INSTRUMENTATION)	VOLUME II B
		SECTION D
		REV. 00   DATE: 31.12.2008
		SHEET 2 OF 3

### JUNCTION BOXES (JB) METAL TYPE

01. The Junction box enclosures shall comprise of a case and cover/door constructed from cold rolled sheet steel of thickness 3 mm. The construction shall ensure adequate strength and rigidity. Junction boxes and pull boxes shall be hot dipped galvanized and confirm to meet IP 65 class as per IS : 2147 with providing all facilities as below .
02. The junction boxes shall also be meet the following minimum requirements :
  - a) Junction boxes shall be provided with lockable door on the front side. The locks of the junction boxes shall be(Industrial Type) identical and operable by one key . Top of the boxes shall be arranged to slope towards rear of the box. Junction box shall have gland plate of 3mm sheet at bottom for indoor mounted boxes with neoprene/synthetic gasket lining of 6mm thick including door lining also. Suitable industrial type hinges & MS handle shall be provided for opening of the boxes smoothly & able to take load of door without any trouble /hampering IP 65 protection class.
  - b) All the junction boxes shall be suitable for mounting on walls, columns, structures etc. The brackets, nuts, bolts, screws. Glands and lugs required for erection shall be included in Supplier's scope of supply.
  - c) M6 Ni plated brass earthing stud 3 nos (2 external & 1 inside the JB)shall be provided for each junction boxe.
  - d) Terminal blocks shall be of **Cage Clamp Terminal blocks of Wago/Phoenix Make suitable for 2.5 mm<sup>2</sup> cable shall be** properly arranged inside JB with end plate & end clamp in DIN rail mounted & marked up with TB nos from top to bottom to facilitate easy termination of the cables. Adequate space from left/right hand ,top/bottom side of wall of JB to TB end & in between TB's shall be min. **100mm** gap all around shall be provided.
  - e) 20 % Spare terminals shall be provided for each of the junction boxes distributed overall terminal blocks.
  - f) Construction details shall be as per enclosed drawing attached in page 03 of 03 of this technical requirements. The exact size and dimensions of junction boxes shall be as decided during detailed during detailed engineering stage keeping in view the nos of terminals required etc. The same shall be subject to approval during detailed engineering stage.
  - g) The Supplier shall furnish general arrangement, cross section details of junction boxes and the same shall be subject to BHEL/CUSTOMER's approval during detailed engineering stage.
  - h) The color of the Junction Boxes shall be Exterior Epoxy based to shade **Opaline Green to shade 275 of IS 5(Semi glossy)** , interior **brilliant white(Glossy)** & paint thickness shall be 100-150 micron.
- 03 **REMARKS**  
Subsequent to order, bidder to furnish filled in BOM schematics / GA drgs etc.
- 04 TESTING  
High voltage & Insulation Resistance test. & IP 65 (if not conducted earlier)

**Typical Drg. for 72 Ways JB**



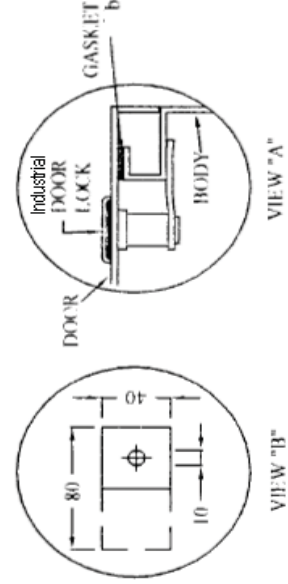
**OPEN DOOR VIEW**

**SIDE VIEW**

**FRONT VIEW**

**NOTE:**  
All Dimensions are in mm.

- 1) Sheet Thk . 3.0mm CIRCA
- 2) Protection IP65
- 3) Paint :
  - a) Hot Dip Galvanizing.
  - b) External:- Epoxy based to shade Opaline Green to shade 275 of IS 5 (Semi glossy)
  - Internal:- Brilliant white (Glossy)
- 4) Panels are Wall mounting type with smooth finish.
- 5) All doors are open throughing with handle & lock arrangement.
- 6) All doors gland plate & removables are to be gasketed.
- 7) Fixing Bolts :- 4 Set of zinc plated Fasteners each Set Consists of INo - M10 x 60mm Bolt, 1 No - Spring washer, 2 Nos Plain washer & INo - M10 nut.
- 8) Terminal blocks are to be provided with number markers continuously from top to Bottom
- 9) Paint thickness shall be 100-150 micron, 80-100 micron for Powder coating.
- 10) Door locks for all the boxes will have identical with a common key
- 11) Quantity - As per scope of supply.



**VIEW "A"**

**VIEW "B"**

**BILL OF MATERIAL.**

Sl	Description	Make	Qty
1	2.5 Sq mm Cage Clamp type With 6.6 Polyamide Terminal block	WAGO / Phenix	87 Nos.

Amshul  
S.A. Rao  
Praveen Kishore

Drw	Name	Date	Sign	Customer Project	
01					
Rev	Appd.	Title	GA FOR 72 WAY JUNCTION BOX		
01					

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Scale - N.T.S.	



Technical specification for  
**CONTROL & INSTRUMENTATION**

**1X370 MW YELAHANKA CCPP**

SPEC NO.: **PE-TS-409-145-I**

VOLUME

SECTION

REV. NO. 00

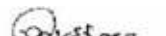
DATE : 05.01.2016

SHEET OF

# MOTOR OPERATED VALVE ACTUATOR DATASHEET

  
Anshul

  
P. S. Rao

  
Prasen Kumar



**SPECIFICATION  
FOR  
MOTORISED VALVE ACTUATOR**

SPECIFICATION NO.: PE-SS-999-145-1007	
VOLUME	II B
SECTION	D
REV. NO.	03
DATE:	20.06.13
SHEET	1 OF 3

**Data Sheet A & B**

DATA SHEET-A  
(TO BE FILLED BY PURCHASER)

DATA SHEET-B  
(TO BE FILLED-UP BY BIDDER)

<b>GENERAL *</b>	* PROJECT	1x370 MW YELAHANKA CCPP	
	OFFER REFERENCE		
	* TAG NO. SERVICE		
	* DUTY	<input checked="" type="checkbox"/> ON / OFF <input checked="" type="checkbox"/> INCHING	AS REQUIRED
	* LINE SIZE (inlet/outlet): MATERIAL		
	* VALVE TYPE	<input checked="" type="checkbox"/> GLOBE <input type="checkbox"/> GATE <input type="checkbox"/> REG. GLOBE <input type="checkbox"/> BUTTERFLY	
	* OPENING / CLOSING TIME		
	* WORKING PRESSURE		
	AMBIENT CONDITION	SHALL BE SUITABLE FOR CONTINUOUS OPERATION UNDER AN AMBIENT TEMP. OF 0-55 DEG C AND RELATIVE HUMIDITY OF 0-95%	
	VALVE SEAT TEST PRESS	BIDDER TO SPECIFY	
	REQUIRED VALVE TORQUE	BIDDER TO SPECIFY	
ACTUATOR RATED TORQUE	BIDDER TO SPECIFY		
<b>CONSTRUCTION AND SIZING</b>	CONSTRUCTION	TOTALLY ENCLOSED, WEATHER PROOF, IP:55	
	MECHANICAL POSITION INDICATOR	TO BE PROVIDED FOR 0-100% TRAVEL	
	BEARINGS	DOUBLE SHIELDED, GREASE LUBRICATED ANTI-FRICTION.	
	GEAR TRAIN FOR LIMIT SWITCH/TORQUE SWITCH OPERATION	METAL (NOT FIBRE GEARS). SELF-LOCKING TO PREVENT DRIFT UNDER TORQUE SWITCH SPRING PRESSURE WHEN MOTOR IS DE-ENERGIZED.	
	SIZING	OPEN/CLOSE AT RATED SPEED AGAINST DESIGNED DIFFERENTIAL PRESSURE AT 85% OF RATED VOLTAGE. FOR ISOLATING SERVICE THREE SUCCESSIVE OPEN-CLOSE OPERATIONS OR 15 MINS. WHICHEVER IS HIGHER. <b>FOR INCHING SERVICE - 150 STARTS/HR MINIMUM &amp; FOR REGULATING SERVICE - 600 STARTS/HR MINIMUM.</b>	
<b>HANDWHEEL</b>	* REQUIRED	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	
	* ORIENTATION	<input type="checkbox"/> TOP MOUNTED <input checked="" type="checkbox"/> SIDE MOUNTED	
	*TO DISENGAGE AUTOMATICALLY DURING MOTOR OPERATION.		
<b>ELECTRIC ACTUATOR</b>	ACTUATOR MAKE/MODEL	BIDDER TO SPECIFY	
	MOTOR MAKE / MODEL / TYPE / RATING (KW)	BIDDER TO SPECIFY	
	@ MOTOR TYPE	SQUIRREL CAGE INDUCTION MOTOR, STARTING CURRENT LIMITED TO SIX TIMES THE RATED CURRENT- <b>INCLUSIVE OF I.S. TOLERANCE</b>	
	ACTUATOR APPLICABLE WIRING DIAGRAM	<input checked="" type="checkbox"/> ENCLOSED (BIDDER TO CONFIRM) A: <input checked="" type="checkbox"/> DRG. NO. 3-V-MISC-24227 R00 B: <input type="checkbox"/> DRG. NO. 3-V-MISC-24550 R00 C: <input type="checkbox"/> DRG. NO. 3-V-MISC-24283 R00 D: <input type="checkbox"/> DRG. NO. 4-V-MISC-90271 R11 E: <input type="checkbox"/> For Thyristor based Integral starter, Bidder/Vendor to furnish wiring diagram	
	* COLOUR SHADE	<input type="checkbox"/> BLUE (RAL 5012) <input type="checkbox"/> .....	
	PAINT TYPE (## Refer Notes)	<input type="checkbox"/> ENAMEL <input type="checkbox"/> EPOXY <input type="checkbox"/> .....	
	SHAFT RPM	BIDDER TO SPECIFY	
	OLR SET VALUE	BIDDER TO SPECIFY	
	@ STARTING / FULL LOAD CURRENT	BIDDER TO SPECIFY	
	NO. OF REV FOR FULL TRAVEL	BIDDER TO SPECIFY	
	@ PWR SUPP TO MTR / STARTER	415V, 3PH, AC	
	@ CONTROL VOLTAGE REQUIREMENT	TO BE DERIVED FROM THE POWER SUPPLY TO THE STARTER <input type="checkbox"/> 230 V <input type="checkbox"/> 110 V	



**SPECIFICATION  
FOR  
MOTORISED VALVE ACTUATOR**


SPECIFICATION NO.: PE-SS-999-145-I007		
VOLUME	II B	
SECTION	D	
REV. NO.	03	DATE: 20.06.13
SHEET	2	OF 3

**Data Sheet A & B**

DATA SHEET-A  
(TO BE FILLED BY PURCHASER)

DATA SHEET-B  
(TO BE FILLED-UP BY BIDDER)

	@ ENCLOSURE CLASS OF MOTOR	<input checked="" type="checkbox"/> p IP 67 <input type="checkbox"/> FLAME PROOF	
	@ INSULATION CLASS	<b>CLASS-F TEMP. RISE LIMITED TO CLASS-B</b>	
	@ WINDING TEMP PROTECTION	<input checked="" type="checkbox"/> THERMOSTAT (3 Nos., 1 IN EACH PHASE) <input type="checkbox"/> .....	
	SINGLE PHASE / WRONG PHASE SEQUENCE PROTECTION	REQUIRED	
<b>INTEGRAL STARTER</b>	INTEGRAL STARTER	<input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED	
	TYPE OF SWITCHING DEVICE	<input checked="" type="checkbox"/> CONTACTORS <input type="checkbox"/> THYRISTORS	
	TYPE	<input checked="" type="checkbox"/> CONVENTIONAL <input type="checkbox"/> SMART (NON-INTRUSIVE)	
	<b>IF SMART</b>		
	a) SERIAL LINK INTERFACE	<input type="checkbox"/> INTEGRAL <input type="checkbox"/> FIELD MOUNTED	
	b) SERIAL LINK PROTOCOL	<input type="checkbox"/> FOUNDATION FIELD-BUS <input type="checkbox"/> PROFI-BUS <input type="checkbox"/> <b>DEVICE NET</b> <input type="checkbox"/> .....	
	c) SERIAL LINK MEDIA	<input type="checkbox"/> TWISTED PAIR Cu-CBL <input type="checkbox"/> CO-AXIAL Cu-CBL <input type="checkbox"/> OFC	
	d) HAND HELD PROGRAMMER	<input type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED	
	e) <b>TYPE OF HAND HELD PROGRAMMER</b>	<input type="checkbox"/> <b>BLUETOOTH</b> <input type="checkbox"/> <b>INFRARED</b> <input type="checkbox"/> .....	
	f) MASTER STATION	<input type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED	
	g) MASTER STN INTRFACE WITH DCS	<input type="checkbox"/> MODBUS <input type="checkbox"/> TCP/IP	
	h) DETAILS OF SPECIAL CABLE	<input type="checkbox"/> ENCLOSED <input type="checkbox"/> NOT REQUIRED	
	STEP DOWN CONT. TRANSFORMER	<input checked="" type="checkbox"/> REQUIRED	
	OPEN / CLOSE PB	<input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED	
	STOP PB	<input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED	
	INDICATING LAMPS	<input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED	
LOCAL REMOTE S/S	<input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED		
STATUS CONTACTS FOR MONITORING	<input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED		
INTEGRAL STARTER DISTURBED SIGNAL	REQUIRED (O/L RELAY OPERATED, CONT./POWER SUPPLY FAILED, S/S IN LOCAL, TORQUE SWITCH OPTD. MID WAY)		
<b>INTERPOSING RELAY/OPTO COUPLER</b> (Applicable for integral Starter)	<b>TYPE OF ISOLATING DEVICE</b>	<input checked="" type="checkbox"/> <b>INTERPOSING RELAY</b> <input type="checkbox"/> <b>OPTO COUPLER</b> <input type="checkbox"/> <b>EITHER</b>	
	QUANTITY	<input checked="" type="checkbox"/> 2 NOs. <input type="checkbox"/> 3 NOs.	
	DRIVING VOLTAGE	<input checked="" type="checkbox"/> 20.5 – 24V DC <input type="checkbox"/> _____ V DC	
	DRIVING CURRENT	<input checked="" type="checkbox"/> 125mA MAX <input type="checkbox"/> _____ mA MAX	
	LOAD RESISTANCE	<input checked="" type="checkbox"/> > 192 ohms - <25 k ohms <input type="checkbox"/> > _____ ohms - < _____ ohms	
<b>TORQUE SWITCH</b> (Not Applicable for Smart Actuator) <b>(\$\$ Refer Notes)</b>	MFR & MODEL NO.	BIDDER TO SPECIFY	
	OPEN / CLOSE	<input checked="" type="checkbox"/> 1 No. <input type="checkbox"/> 2Nos. / <input checked="" type="checkbox"/> 1 No. <input type="checkbox"/> 2Nos	
	CONTACT TYPE	2 NO + 2 NC	
	RATING	5A 240V AC AND 0.5A 220V DC	
	CALIBRATED KNOBS(OPEN&CLOSE TS)	REQUIRED FOR SETTING DESIRED TORQUE	
	ACCURACY	+3% OF SET VALUE	
<b>LIMIT SWITCH</b> (Not Applicable for Smart Actuator) <b>(\$\$ Refer Notes)</b>	MFR & MODEL NO.	BIDDER TO SPECIFY	
	OPEN : INT : CLOSE	<input checked="" type="checkbox"/> 1 No <input type="checkbox"/> 2 Nos. <input type="checkbox"/> 2 Nos. (ADJ.) <input checked="" type="checkbox"/> 1 No. <input type="checkbox"/> 2Nos.	
	CONTACT TYPE	2 NO + 2 NC	
	RATING (AC / DC)	5A 240V AC AND 0.5A 220V DC	

	<b>SPECIFICATION FOR MOTORISED VALVE ACTUATOR</b>	SPECIFICATION NO.: PE-SS-999-145-1007	
		VOLUME	II B
		SECTION	D
		REV. NO.	03
		SHEET	3 OF 3

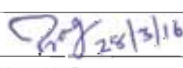
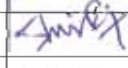
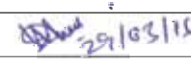
**Data Sheet A & B**

DATA SHEET-A (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
---	---

<b>POSITION TRANSMITTER</b>	POSITION TRANSMITTER (For inching duty & other specific applications)	<input type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED	AS REQUIRED
	MFR & MODEL NO.	BIDDER TO SPECIFY	
	TYPE	<input type="checkbox"/> ELECTRONIC (2 WIRE) R/I CONVERTER <input checked="" type="checkbox"/> ELECTRONIC (2 WIRE) CONTACTLESS	
	SUPPLY	<input checked="" type="checkbox"/> 24V DC <input type="checkbox"/> .....	
	OUTPUT	<input checked="" type="checkbox"/> 4-20mA	
	ACCURACY	± 1% FS	
<b>SPACE HEATER</b>	@SPACE HEATER	REQUIRED	
	@ POWER SUPPLY (NON INTEGRAL)	230V AC, 1 PH., 50 Hz	
	@ POWER SUPPLY (INTEGRAL)	BIDDER TO SPECIFY	
	@ RATING		
<b>TERMINAL BOX</b>	ACTUATOR/MOTOR TERMINAL BOX	REQUIRED	
	ENCL CLASS ACTUATOR/MOTOR T.B.	@ <input type="checkbox"/> IP 68                      @ <input type="checkbox"/> .....	
	@ EARTHING TERMINAL	REQUIRED	
	PLUG & SOCKET (9 PIN) (FOR COMMD, LS/TS FEED BACK, PoT)	<input type="checkbox"/> REQUIRED <input checked="" type="checkbox"/> NOT REQUIRED <input type="checkbox"/> 2 NOS. <input type="checkbox"/> .....	
<b>CABLE GLANDS</b>	@ POWER CABLE GLAND	SIZE:-----	
	@ SPACE HEATER CABLE GLAND	SIZE:-----	
	OTHER CONTROL CABLE GLANDS-1	<input type="checkbox"/> 1No. for BFV of CW PUMP(Cable size 2Px1.5mm2)	
	OTHER CONTROL CABLE GLANDS-2	QUANTITY & SIZE :-----	
<b>WEIGHT</b>	TOTAL WEIGHT (ACTUATOR + ACCESSORIES)	BIDDER TO SPECIFY	_____ Kg.

**NOTES**

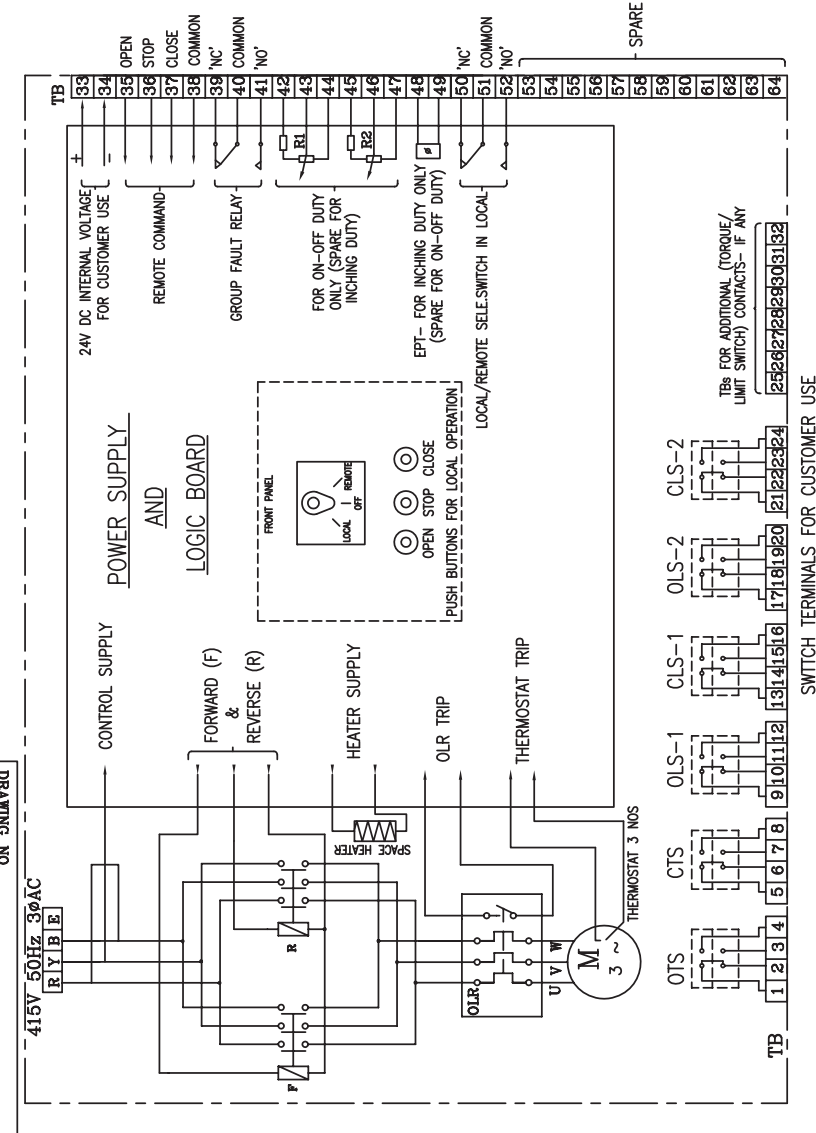
1. **SCOPE:** DESIGN, MANUFACTURE, INSPECTION, TESTING AND DELIVERY TO SITE OF ELECTRIC ACTUATOR FOR INCHING OR OPEN / CLOSE DUTY.
  2. **CODES & STANDARDS:** DESIGN AND MATERIALS USED SHALL COMPLY WITH THE RELEVANT LATEST NATIONAL AND INTERNATION STANDARD. AS A MINIMUM, THE FOLLOWING STANDARDS SHALL BE COMPLIED WITH:  
IS-9334, IS-2147, IS-2148, IS-325, IS-2959, IS-4691 AND IS-4722
  3. TEMPERATURE RISE SHALL BE RESTRICTED TO 70 DEG. C FOR AMBIENT TEMPERATURE OF 50 DEG C.
  4. CABLE GLANDS OF DOUBLE COMPRESSION TYPE, BRASS MATERIAL SHALL BE PROVIDED.
  5. THE TORQUE SWITCHES SHALL BE PROVIDED WITH MECHANICAL LATCHING DEVICE TO PREVENT OPERATION WHEN UNSEATING FROM THE END POSITIONS. THE LATCHING DEVICE SHALL UNLATCH AS SOON AS THE VALVE LEAVES THE END POSITION. IF SUCH PROVISION IS NOT POSSIBLE, THE TORQUE SWITCHES SHALL BE BYPASSED BY END-POSITION LIMIT SWITCHES WHICH OPENS ON VALVE LEAVING END POSITION.THESE LIMIT SWITCHES ARE ADDITIONAL TO THE NUMBER OF LIMIT SWITCHES SPECIFIED ELSEWHERE.
  6. THE MOTOR SHALL OPERATE SATISFACTORILY UNDER THE +/- 10% SUPPLY VOLTAGE VARIATION AT RATED FREQUENCY, -5% TO +3% VARIATION IN FREQUENCY AT RATED SUPPLY VOLTAGE, SIMULTANEOUS VARIATION IN VOLTAGE & FREQUENCY THE SUM OF ABSOLUTE PERCENTAGE NOT EXCEEDING 10%.
  7. THE MOTOR SHALL BE SUITABLE FOR DIRECT ON LINE STARTING.
- \$\$ TORQUE SWITCH & LIMIT SWITCH SHALL ACT INDEPENDENT OF EACH OTHER. TANDEM OPERATION IS NOT ACCEPTABLE.**
- # EPOXY PAINT IS RECOMMENDED FOR COASTAL AREAS.**

	<b>PREPARED BY</b>	<b>CHECKED BY</b>	<b>APPROVED BY</b>	<b>VENDOR COMPANY SEAL</b>
<b>NAME</b>	PRAG JAIN	S.S.BANSALA	M.A.MANSOORI	NAME
<b>SIGNATURE</b>				SIGNATURE
<b>DATE</b>	28.03.2016	28.03.2016	28.03.2016	DATE
NOTES* = TO BE FILLED BY MPL (LEAD AGENCY).    @= TO BE FILLED BY ES				

 Anshul     
  S.S. Bansala     
  M.A. Mansoori

FOR TOLERANCES OF UNTOLERANCED DIMENSIONS DURING MANUFACTURE REFER RELEVANT QCP / QP.

DRWING NO. 2227-SSM-A-3



**CONTACT DEVELOPMENT DIAGRAM**

OTS	1-2	OPEN AT OVER TORQUE DURING OPENING TRAVEL
	3-4	CLOSE AT OVER TORQUE DURING OPENING TRAVEL
CTS	5-6	OPEN AT OVER TORQUE DURING CLOSING TRAVEL
	7-8	CLOSE AT OVER TORQUE DURING CLOSING TRAVEL
OLS-1	9-10	
	11-12	
CLS-1	13-14	
	15-16	
OLS-2	17-18	
	19-20	
CLS-2	21-22	
	23-24	
SWITCH	TERMINAL NO.	FULL OPEN
		INTERMEDIATE
		b
		FULL CLOSE

INDICATES CONTACT CLOSED  
 - - - - - INDICATES CONTACT OPEN  
 CONTACT RATING: 5A AT 250V AC & 0.5A AT 220V DC

**SETTING PROCEDURE OF POSITION LIMIT AND TORQUE SWITCH**

VALVES	OPEN			CLOSE		
	MAIN	BACK UP	MAIN	BACK UP	MAIN	BACK UP
GATE VALVE OF 100 mm AND ABOVE IN 1500 CL AND ABOVE RATINGS	OLS	OTS *	CLS	CLS	OTS *	CTS
ALL OTHER GATE & GLOBE VALVES	OLS	OTS *	CLS	CLS	OTS *	#

# - CLS NOT TO BE CONNECTED IN TRIP CIRCUIT  
 \* - BYPASS OTS FOR INITIAL 5% OF TRAVEL (FOR GATE VALVES ONLY)

**TYPE OF PRODUCT** ELECTRICAL VALVE ACTUATORS (AC) WITH INTEGRAL STARTERS  
**OR NAME OF CUSTOMER/PROJECT** (DRAWN FOR INTERMEDIATE POSITION OF VALVES)

**BHARAT HEAVY ELECTRICALS LTD.**  
 UNIT: HIGH PRESSURE BOILER PLANT.  
 TIRUCHIRAPPALLI-620014.

365-121

DRPT	VL	SCALE	WEIGHT (KG)	REFERENCE INFORMATION	NO. OF TRIMS

NAME	SIGN	DATE	NO. OF VAR.
N.P.ESWAR	N.P.	07.10.04	
DRN	SIGN	DATE	NO. OF VAR.
CHD	D.DINAKARAN	D.D	07.10.04
APPD	K.ARUINACHALAM	K.A	07.10.04

**WIRING DIAGRAM (TERMINAL PLAN)**  
 FOR ACTUATOR WITH INTEGRAL STARTER

U 01

3-V-MISC-24227

REV 0

- NOTE:-**
- ALL TORQUE AND LIMIT SWITCHES (OTS,CTS,OLS1&2, CLS1&2) ARE WITH 2NO+2NC CONTACTS '1NO+1NC' IS TERMINATED IN TBS 1-24, REMAINING CONTACTS ARE FOR INTERNAL USE.
  - ANY SPARE CONTACTS WHICH ARE NOT USED INTERNALLY ARE TO BE TERMINATED IN TBS 25-32
  - CTS - TORQUE SWITCHES FOR CW ROTATION (CLOSE)
  - OTS - TORQUE SWITCHES FOR CCW ROTATION (OPEN)
  - OLS-1, OLS-2 - LIMITSWITCHES FOR POSITION OPEN
  - CLS-1, CLS-2 - LIMITSWITCHES FOR POSITION CLOSE
  - EPT - ELECTRONIC POSITION TRANSMITTER (CONTACTLESS TYPE. FOR INTCHING DUTY)
  - R1-R2 - POTENTIOMETER 2 x 100 OHMS (FOR ON-OFF DUTY)
  - FOR COMMANDS & EPT EITHER INTERNALLY GENERATED 24 VDC OR EXTERNAL SUPPLY OF 24VDC CAN BE USED
  - M - MOTOR 3φ 415V 50 Hz AC SUPPLY

Size A3



Technical specification for  
**CONTROL & INSTRUMENTATION**

**1X370 MW YELAHANKA CCPP**

SPEC NO.: **PE-TS-409-145-I**

VOLUME

SECTION

REV. NO. 00

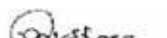
DATE : 05.01.2016

SHEET OF

# Instrumentation Check list

  
Anshul

  
P. S. Rao

  
Prasen Kumar



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

**CHECK LIST FOR PRESSURE SWITCH**

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

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

**Note :**

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

*Anshul*  
Anshul

*Prasen*  
Prasen

*Prasen*  
Prasen



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

**CHECK LIST FOR TRANSMITTER**

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

**Legend :**

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

**Note :**

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

*Anshul*  
Anshul

*Prasen*  
Prasen

*Prasen*  
Prasen



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

**CHECK LIST FOR PRESSURE & DP GAUGE**

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

**Legend :**

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

**Note :**

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

*Anshul*

*Prasen Kishore*

*Prasen Kishore*



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

**CHECK LIST FOR LEVEL GAUGE**

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS / DRWGS	P	W	V	
	TYPE						
	MODEL/ TAG NO.						
	DAIL SIZE						
	RANGE/SCALE						
	END CONNECTION						
2	DIMENSIONS, PROCESS CONNECTION	ONE / LOT		P	W	V	
3	ACCURACY			P	W	V	
4	MATERIAL TC FOR			P	V	V	
	BODY ISO.						
	VALVE						
	GAUGE GLASS						
5	HYD. TEST	SEE NOTE-1 BELOW		P	W	V	
6	ACCESSORIES AS APPLICABLE			P	W	V	

**Legend :**

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

**Note :**

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



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

**CHECK LIST FOR ANNUNCIATORS**

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

**Legend :**

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

**Note :**

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

*Anshul*  
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*Prasen*  
Prasen

*Prasen*  
Prasen



Technical specification for  
**CONTROL & INSTRUMENTATION**

**1X370 MW YELAHANKA CCPP**

SPEC NO.: **PE-TS-409-145-I**

VOLUME

SECTION

REV. NO. 00

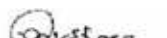
DATE : 05.01.2016


SHEET OF

# FURNITURE SPECIFICATION

  
Anshul

  
P. S. Rao

  
Prasen Kumar

	Technical specification for Furniture	SPEC NO.: PE-TS-409-145-I	
	1X370 MW YELAHANKA CCPP	VOLUME	
		SECTION	
		REV. NO. 00	DATE : 05.01.2016
		SHEET 1 OF 1	

## SPECIFICATION FOR FURNITURE

- 2 Nos. cushioned revolving, independently adjustable seat and back chairs. Chairs shall be capable of being adjusted for height and position of backrest. The chairs shall be mounted on five castors, shall swivel and shall have arm rests'. One table and chair shall be provided for each operator station and separate table for each printer.
- Glass top Teak wood / MDF table for mounting Operator Station monitors.
- Printer tables.
- Glass top Teak wood / MDF table for System Engineering Room / Engineering stations with drawer at end.
- Glass top teak wood / MDF table with vertical file mounting arrangement (two layer to house approx. 40 Nos of files and lockable drawers at both end for System Engineering Room / Engineers.
- Dimensions of the tables shall be as follows :-

DIMENSIONS	WIDTH X DEPTH X HEIGHT (mm)
PC TABLE	1500 X 750 X 735
COLOR LASER PRINTER table	900 X 650 X 740



Technical specification for  
**CONTROL & INSTRUMENTATION**

**1X370 MW YELAHANKA CCPP**

SPEC NO.: **PE-TS-409-145-I**

VOLUME

SECTION

REV. NO. 00

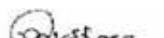
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SHEET OF

# SIGNAL EXCHANGE FORMAT TO PLANT DCS

  
Anshul

  
P. S. Rao

  
Prasen Kumar





Technical specification for  
**CONTROL & INSTRUMENTATION**

**1X370 MW YELAHANKA CCPP**

SPEC NO.: **PE-TS-409-145-I**

VOLUME

SECTION

REV. NO. 00

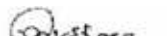
DATE : 05.01.2016

SHEET OF

## APPLICABLE CABLE TYPES

  
Anshul

  
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Prasen Kumar

CABLE SIZES FOR 1X370 MW CCPP AT YELHANKA	
SI no.	Cable Type
<b>G-TYPE</b>	
1	2P X 0.5 sqmm
2	4P X 0.5 sq mm
3	8P X 0.5 sqmm
<b>F-TYPE</b>	
1	4P X 0.5 sqmm
2	8P X 0.5 sqmm
3	12P X 0.5 sqmm
4	20P X 0.5 sqmm
<b>CONTROL CABLE</b>	
1	3C X 2.5 sqmm

  
Anshul

  
SA

  
Rakesh



Technical specification for  
**CONTROL & INSTRUMENTATION**

**1X370 MW YELAHANKA CCPP**

SPEC NO.: **PE-TS-409-145-I**

VOLUME

SECTION

REV. NO. 00

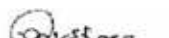
DATE : 05.01.2016

SHEET OF

# KKS PHILOSOPHY

  
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Prasenjit Ghosh

**KKS NUMBERING PHILOSOPHY**

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

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

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

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

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

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

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

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

- 1) AIR CONDITIONING SYSTEM: QKA,QKB,...QKZ
- 2) VENTILATION SYSTEM: SAA,SAB,....SAZ

**ANNEXURE-2****Standard Equipment Codes:**

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

**Standard Apparatus Codes:**

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

**Standard Measuring Circuits Codes:**

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



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

**ANNEXURE-3****Numerical Keys****A) Numerical Keys at System Code Level**

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

**B) Numerical keys at Equipment Code level:**

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

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

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



DOCUMENT TITLE

**KKS NUMBERING PHILOSOPHY**

1 X 370 MW YELAHANKA CCPP

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

ii) **Field Instruments**

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

**Example of Numerical Key Usage:**

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



Technical specification for  
**CONTROL & INSTRUMENTATION**  
1X370 MW YELAHANKA CCPP

SPEC NO.: PE-TS-409-145-I

VOLUME

SECTION

REV. NO. 00

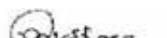
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SHEET OF

# LIST OF DELIVERABLES

  
Anshul

  
P. S. Rao

  
Prasen Kumar

LIST OF DELIVERABLES OF PEM - C&I DEPARTMENT FOR MAUX PACKAGES

1 X 370MW YELAHANKA CCPP

DOCUMENT NUMBER PE-GL-409-145-I100

Sl.No.	DRAWING NO.	DRAWING/DOCUMENT TITLE	CATEGORY	CUSTOMER	FROM	USER	REMARKS
INSTRUMENTATION							
1	PE-V9-409-XXX-1901	INSTRUMENT DATA SHEETS	A	-	VENDOR	C&I	
2	PE-V9-409-XXX-1902	INSTRUMENT SCHEDULE	I	-	VENDOR	C&I	
3	PE-V9-409-XXX-1903	INSTRUMENT INSTALLATION/ HOOK UP DIAGRAMS	A	-	VENDOR	C&I	
4	PE-V9-409-XXX-1904	FIELD JB TERMINATIONS /GROUPING DOCUMENT	I	-	VENDOR	C&I	
5	PE-V9-409-XXX-1905	QUALITY PLANS (CV,FE, Tx and Analyser)	A	-	VENDOR	C&I	
PLC PANEL							
1	PE-V9-409-XXX-1906	PLC CONFIGURATION DRAWING	A	A	VENDOR	C&I	
2	PE-V9-409-XXX-1907	PLC PANEL GA (INTERNAL & EXTERNAL) DRAWING	A	-	VENDOR	C&I	
3	PE-V9-409-XXX-1908	CONTROL SCHEMES (BLOCK LOGIC)	A	-	VENDOR	C&I	
4	PE-V9-409-XXX-1909	PLC INPUT / OUTPUT SIGNAL LIST	I	-	VENDOR	C&I	
5	PE-V9-409-XXX-1910	UPS BATTERY CHARGER/ BATTERY DATASHEET & SLD	I	\$\$	VENDOR	C&I	
6	PE-V9-409-XXX-1911	UPS SIZING CALCULATIONS	I	-	VENDOR	C&I	
7	PE-V9-409-XXX-1912	BATTERY SIZING CALCULATIONS	I	-	VENDOR	C&I	
8	PE-V9-409-XXX-1913	CONTROL DESK LAYOUT / GA DRAWING	A	-	VENDOR	C&I	
9	PE-V9-409-XXX-1914	PLC-OWS/PRINTER FURNITURE BOM	A	-	VENDOR	C&I	
10	PE-V9-409-XXX-1915	PLC CONTROL ROOM LAYOUT DRAWING	A	-	VENDOR	C&I	
11	PE-V9-409-XXX-1916	PLC CATALOGUE	I	-	VENDOR	C&I	
12	PE-V9-409-XXX-1917	PLC QUALITY PLAN & FAT PROCEDURE	A	-	VENDOR	C&I	
13	PE-V9-409-XXX-1918	LIST OF SIGNAL EXCHANGE WITH DDCMIS (BOTH HARDWIRED & SERIAL INTERFACE IN BHEL FORMAT)	A	-	VENDOR	C&I	
14	PE-V9-409-XXX-1919	PROCESS GRAPHIC MANUSCRIPTS PLC	I	-	VENDOR	C&I	
15	PE-V9-409-XXX-1920	PROCESS GRAPHIC MANUSCRIPTS FOR DDCMIS	I	-	VENDOR	C&I	
16	PE-V9-409-XXX-1921	CABLE SCHEDULE (IN BHEL EXCEL FORMAT) & CABLE INTERCONNECTION DETAILS	I	-	VENDOR	C&I	
17	PE-V9-409-XXX-1923	PANEL & ELECTRONIC EARTHING REQUIREMENT	I	-	VENDOR	C&I	
18	PE-V9-409-XXX-1924	PANEL HEAT DISSIPATION DATA	I	-	VENDOR	C&I	
19	PE-V9-409-XXX-1925	MANDATORY SPARES BILL OF MATERIAL	A	A	VENDOR	C&I	
20	PE-V9-409-XXX-1926	PLC O & M MANUAL	I	-	VENDOR	C&I	
21	PE-V9-409-XXX-1927	PLC EARTHING SCHEME	I	-	VENDOR	C&I	
	Notes:	409 - Project No					
		XXX -SI No of MAX Package					
		\$\$ -Approval by BHEL if Vendor BBU Item Approval by Customer if Customer BBU Item					

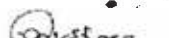
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Praveen Kishore

# Mandatory Spares

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Anshu

  
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Prasen Khatun

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1.25.1	EPABX System			Lot price quoted for applicable items	
	a) Extension PCB	1 No.			
	b) Trunk line PCB	1 No.			
	c) Instruments	5% of the total number supplied, with a min. of 5.			
1.25.2	Loud speaker for PA system	Indoor type (600) : 2 Nos. Outdoor type (15 W) : 3 Nos.			
1.26	Fire detection and Alarm System			Lot price quoted for applicable items	
1.26.1	Fire detectors and Manual call points	5% of the total Nos. supplied for each type, with minimum 2 Nos.			
1.26.2	Control Card	1 No. of each type			
1.27	415V Motors			BOP area scope have been considered under Mechanical item Sl. No. 20 & 29; 1.9 General,	
1.27.1	Bearings	2 sets of each type			
1.27.2	Cooling fan	2 Nos. of each type			
1.27.3	Motor	1 No. of each type, rating & frame size		Price of motors for BOP area included in Mechanical Table 1.4 AIR COMPRESSORS AND ACCESSORIES. 2) price of BOP area spares applicable for water chemistry packages have been considered under Mechanical Sl.No. 20 & 29; 1.9 General	
1.28	Control Panels (for Miscellaneous systems like Air conditioning, fire protection, evaporative air cooling etc.)				
1.28.1	Air break switch	1 No. of each rating.			
1.28.2	Aux. relays, contactors	Two of each type			
1.28.3	Clustered type LEDs of different colours	20 Nos.			
1.28.4	Push Buttons	6 nos.			

 Anshul  
 Praveen Kishore

1.28.5	Fuses for power and control circuit	5 sets of each rating		
1.28.6	Control switches	1 of each type.		
1.29	<b>Un-interruptible Power Supply System</b>			
1.29.1	HRC fuses of each rating	Three sets		
1.29.2	Semi conductor fuses of each rating	Six sets		
1.29.3	Control cards	Two sets		
1.29.4	Driver cards	Two sets		
1.29.5	Thyristors/Power Transistors of each rating	One set		
1.29.7	Auxiliary relays of each rating	2 nos.		
1.29.8	Filter capacitors	One set		
1.29.9	Filter chokes	One set		
1.29.10	Control Cards (PCB with components)	One of each type		
1.30	PLCC & Telemetering			
1.30.1	Outstation Spares			
a)	Analogue input module	1 No.		
b)	Binary Input (Alarm/Status) Module	1 No.		
c)	Analogue output module	1 No.		
d)	Binary Output (Command) Module	1 No.		
e)	DCE/Modem Module	1 No.		
f)	Common Equipment / Controller	1 No.		
g)	Processor Modules	1 No.		
h)	Power Supply System	1 No.		
i)	Card Extender	1 No.		
j)	Fuses of each rating	8 Nos. each		
1.30.2	Master Station Spares			
(a)	Ammeter/Voltmeter interface Module	1 No. each range		
(b)	Command Interface module	1 No.		
(c)	Alarm Status Interface module	1 No.		
(d)	DCE/Modem module	1 No.		
(e)	Controller/Processor modules	1 No.		
(f)	Power supply unit	1 No.		
(g)	Set point interface module	1 No.		
(h)	Card extender	1 No.		
(i)	Peripheral bit serial interface	1 No.		
(j)	Fuses of each rating	2 Nos. each		
1.30.3	PCB cards (PCB with components)	One of each type		
1.30.4	Filters	2 Nos.		
1.30.5	Telephone handset & card & Jack	1 Set		

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Anshul  
S A Khan  
Pravin Kishore



**1x370MW YELAHANKA CCPP  
AIR CONDITIONING SYSTEM**

**STANDARD TECHNICAL SPECIFICATIONS**

**SPECIFICATION No: PE-TS-409-553-A001**

**VOLUME: II B**

**SECTION : D**

**REV. 00**

**DATE: MARCH 2016**

**SECTION: D  
STANDARD TECHNICAL SPECIFICATIONS**



**STANDARD TECHNICAL  
SPECIFICATION  
FOR  
CENTRAL AIR-CONDITIONING**

**SPECIFICATION NO.PES-553-01**

**VOLUME II B**

**SECTION D**

**REV. 02**

**DATE: 17.09.2012**

**SHEET 1 OF 6**

**STANDARD TECHNICAL SPECIFICATION  
FOR  
CENTRAL AIR-CONDITIONING PLANT**



**STANDARD TECHNICAL  
SPECIFICATION  
FOR  
CENTRAL AIR-CONDITIONING**

**SPECIFICATION NO.PES-553-01**

**VOLUME II B**

**SECTION D**

**REV. 02**

**DATE: 17.09.2012**

**SHEET 2 OF 6**

**1. GENERAL**

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

**2. CODES & STANDARDS**

2.1 The design, manufacture and performance of air conditioning equipment shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment are to be installed. The equipment shall also conform to the latest applicable Indian/British/American standards. Nothing in this specification shall be construed to relieve the tenderer of this responsibility. In particular the equipment shall conform to the latest editions of the following standards.

- 2.1.1 IS-660 : Safety code for Mechanical Refrigeration.
- 2.1.2 ARI 520-90 : Standard for Positive Displacement Refrigerant compressors and condensing units.
- 2.1.3 IS-5111 : Code of Practice of Measurement for Testing Refrigeration compressors.
- 2.1.4 ASHRAE/23-93 : Method of Testing for Rating Positive Displacement Refrigerant compressors and condensing units.
- 2.1.5 ARI-450: Standard for water-cooled Refrigerant condensers, Remote Type.
- 2.1.6 ASME : Unfired pressure Vessels Code.  
(Section VIII)
- 2.1.7 IS-2825 : -do-
- 2.1.8 IS-4503 : Shell and tube type heat exchangers.
- 2.1.9 ASHRAE/22-92 : Method of Testing for rating of Water Cooled refrigerant condensers.
- 2.1.10 IS-659 : Safety code for Air conditioning.
- 2.1.11 IS-2379 : Color Code for Identification of pipe lines.
- 2.1.12 TEMA : Standards of Tubular Exchanger manufacturers Association.
- 2.1.13 IS-1239 (Part-I) : Seamless steel tubes (Up to & including 168.2 mm OD.).
- 2.1.14 IS-3589 : For piping above 168.2mm to 2032mm Outside Diameter.
- 2.1.15 IS-778 : Valves up to 50 MM.
- 2.1.16 IS-780 : Valves 50 MM to 300 MM.
- 2.1.17 ASHRAE 24 : Method of Testing for Rating liquid coolers.



**STANDARD TECHNICAL  
SPECIFICATION  
FOR  
CENTRAL AIR-CONDITIONING**

**SPECIFICATION NO.PES-553-01**

**VOLUME II B**

**SECTION D**

**REV. 02**

**DATE: 17.09.2012**

**SHEET 3 OF 6**

2.1.18 ARI-480: Standard for refrigerant cooled liquid coolers-Remote type.

**3. DESIGN & CONSTRUCTION REQUIREMENTS**

3.1 The components of Central air conditioning plant comprising compressor, chiller refrigerant piping, valves and fittings etc. Shall be as given in Data sheet A. The type of all accessories, controls and instrumentation shall also be as indicated in data sheet A.

3.2 The various equipments supplied under this specification shall be fully compatible with each other & capable of operating as fully balanced integrated system to deliver the specified output under design conditions.

**4. TESTING AND INSPECTION**

(Refer standard quality plan)

4.1 Hydrostatic, Volumetric and refrigerant leak tests etc. shall be carried out at manufacturers works before dispatch of equipment in accordance with the applicable codes and standards.

Following minimum tests amongst others shall be conducted.

4.1.1 Material analysis, testing and identification (Data sheet/ Drg. Shall clearly indicate the specification, grade, class and Heat treatment condition of material for which TC will be furnished)

4.1.2 Hydrostatic pressure test of all pressure parts.(Testing pressure shall be clearly indicated for each component/ subassembly/ assembly)

4.1.3 Static and Dynamic balancing test of rotating parts at rated and over speed and to determine vibration & noise level.( Grade of balancing, type- whether dynamic or single plane balancing for components/ subassembly/ assembly shall be clearly indicated in data sheet/ approved drg.. Permissible vibration (velocity and displacement –peak to peak and noise level in dB(A) to be indicated in Data Sheet/Approved Drg.)

4.1.4 Radiography & magna-flux examination of materials & welds.(Components to be subjected to NDT with applicable, procedures and acceptance norms to be clearly indicated in Data sheet/ approved drg. If in a component only certain areas are to be subjected to NDT same shall be clearly brought out else it will be understood that the entire component is subject to NDT)

4.1.5 Ultrasonic test of castings & forgings.(Procedure and acceptance norms with areas subject to NDT to be clearly indicated in Quality Plan).

4.1.6 Performance test including determination of capacity, efficiency & characteristics etc.(Applicable standard, Acceptance norms, Procedure for test (if not covered in applicable standard),performance characteristics with applicable tolerances and drive to be used during shop test to be clearly indicated in Quality Plan). Performance data to be indicated in Approved Drg./ Data Sheet)



**STANDARD TECHNICAL  
SPECIFICATION  
FOR  
CENTRAL AIR-CONDITIONING**

**SPECIFICATION NO.PES-553-01**

**VOLUME II B**

**SECTION D**

**REV. 02**

**DATE: 17.09.2012**

**SHEET 4 OF 6**

4.1.7 Functional checks and adjustments of controls & instrumentation. (Functional checks required to be clearly indicated with extent of check and applicable standard in approved check list / Quality plan. Class of instruments / tolerances and performance data to be incorporated in Approved Data Sheet / Drg.)

4.1.8 Checking of working clearances.(desired working clearances to be indicated in approved Drg.)

4.1.9 Examination after selective opening up after testing.(basis/ reasons for selective opening up, areas to be examined and parameters to be checked to be brought out in Quality Plan)

**4.2 TESTS AT SITE**

Tests to prove guaranteed performance of the air conditioning plant, shall also be carried out at site after proper installation. The site test shall include performance testing (as per FQP) of equipment for 72 continuous hours each in all three seasons i.e. Summer, Winter and Monsoon. Unless specified elsewhere. All instruments, tools etc. as may be required to carry out site tests shall be arranged by the tenderer.

**5. PERFORMANCE GUARANTEE**

5.1 Each equipment of air conditioning system shall be guaranteed for its rated capacity under the specified site conditions.

5.2 If the shop/site performance tests indicate failure of equipment to meet specified requirement, it would be tenderer's responsibility to carry out required alterations at no extra cost to purchaser. Tests shall be repeated after carrying out the modifications to demonstrate the performance.

5.3 The air conditioning plant before being taken over by purchaser shall be subjected to running test for a minimum period of one week during which all readings shall be recorded. Any deficiencies noted during this period, shall be rectified by the tenderer /at no extra cost to purchaser. These running tests shall be in addition to the seasonal performance test specified under clause 4.2. The inside design conditions shall be guaranteed throughout the year.



**STANDARD TECHNICAL  
SPECIFICATION  
FOR  
CENTRAL AIR-CONDITIONING**

**SPECIFICATION NO.PES-553-01**

**VOLUME II B**

**SECTION D**

**REV. 02**

**DATE: 17.09.2012**

**SHEET 5 OF 6**

- 6. DRAWINGS/DOCUMENT/DATA REQUIRED AFTER AWARD OF CONTRACT**
- 6.1 Final version of all drawings & data submitted with the along with technical schedules enclosed in Volume III.
- 6.2 Drawings including equipment layout, foundation & loading details etc. for civil works for the entire plant. These drawings must cover sufficient details so that design of civil works can be completed.
- 6.3 Inspection, operation & Maintenance Manuals.
- 6.4 Manuals for method of testing & calibration of all instruments.
- 6.5 Equipment description giving complete design calculations, basis of design, selection criteria etc.
- 6.6 Schematic piping diagrams.
- 6.7 Layout of piping.
- 6.8 Electrical drawings.
- 6.9 Test Certificates.
- 6.10 Final as built documentation i.e. final-version of all drawings, data & information as per the requirement specified elsewhere.



**STANDARD TECHNICAL  
SPECIFICATION  
FOR  
CENTRAL AIR-CONDITIONING**

**SPECIFICATION NO.PES-553-01**

**VOLUME II B**

**SECTION D**

**REV. 02**

**DATE: 17.09.2012**

**SHEET 6 OF 6**



**CENTRAL AIR-CONDITIONING PLANT**  
**DATA SHEET - A**

VOLUME II-B

SECTION D

REV 00

DATE 17.09.2012

SHEET 1 OF 4

**DESCRIPTION**

**DATA**

**1. GENERAL**

- |     |   |   |
|-----|---|---|
| 1.1 | Type of AC plant  | : Chilled Water Type.   |
| 1.2 | Plant configuration/capacity.   | : Refer to Section-C of Specific Technical Requirements.                  |
| 1.3 | Location of AC plant rooms  | : As per Tender drawings.   |
| 1.4 | Type of lifting facility provided.                                    | : Chain Pulley block with monorail (by BHEL)                              |
| 1.5 | Electrical work scope: -  |   |
|     | i) MCC for AC plant   | : By Others   |
|     | ii) Power cables / Control cables.                                    | : By Others   |
|     | iii) Drives   | : By Bidder.  |
|     | iv) Whether separate alarm/annunciation Panel/control panels required | : Yes (By bidder), Refer to Section-C of Specific Technical Requirements. |
|     | v) Termination of cabling & earthing at Equipment end.                | : By Bidder for bidder supplied equipment.                                |

**2. REFRIGERATION COMPRESSOR**

- |       |                          |  |
|-------|--------------------------|--|
| 2.1.  | Type                     | : SCREW CHILLE   |
| 2.2.  | Nos. (working + standby) | : Refer to Section-C of Specific Technical Requirements. |
| 2.3.  | Type of capacity control | : Automatic.   |
| 2.4.  | Type of drive            | : Direct driven.   |
| 2.5.  | Restart after tripping   | : Manual.  |
| 2.6.  | Type of start            | : As per manufacturing standard.                         |
| 2.7.  | Shaft Seal               | : Mechanical shaft seal.                                 |
| 2.8.  | Purge Recovery unit      | : As per manufacturing standard.                         |
| 2.9.  | Type of lubrication      | : As per manufacturing standard.                         |
| 2.10. | Refrigerant used         | : Environment friendly HCFC,<br>(CFC is not acceptable)  |



**CENTRAL AIR-CONDITIONING PLANT**  
**DATA SHEET - A**

VOLUME II-B

SECTION D

REV 00

DATE 17.09.2012

SHEET 2 OF 4

**3. DESIGN REQUIREMENTS**

- 3.1. Minimum capacity at Design conditions : Refer to Section-C of Specific Technical Requirements.
- 3.2. Capacity control : Microprocessor based Control Panel sheet metal panel, located on each Compressor/chiller unit including protection devices
- 3.3. Vibration isolator : Neoprene rubber pads/Equivalent approved to suit chiller package.
- 3.4. Type of foundation : Floating / As per manufacturing standard

**4.0 CONDENSER**

- 4.1 Type : Horizontal shell & tube type water-cooled
- 4.2 Number required : One no. for each machine.
- 4.3 Design requirements
- 4.3.1 Fluid : Refrigerant (Shell side) Water (tube side)
- 4.3.2 Cooling Water Quantity : To suit requirement.
- 4.3.3 Capacity of condensers : To match compressor & to provide at least 2°C sub cooling.
- 4.3.4 Cooling water inlet temp. : Refer to Section-C of Specific Technical Requirements.
- 4.3.5 Leaving Water Differential. : Refer to Section-C of Specific Technical Requirements.
- 4.3.6 Max. flow velocity through tubes. : 2.5 m/sec.
- 4.3.7 Design fouling factor : 0.0002 (MKS Unit)
- 4.3.8 Maximum pressure drop. : 0.6 Kg/cm<sup>2</sup> (g)
- 4.3.9 Tube wall Thickness : Not less than 18 SWG
- 4.4 Materials of construction
- i/ Shell : M.S. Plate fusion welded.
- ii/ Tube : Integrally bonded Seamless copper



**CENTRAL AIR-CONDITIONING PLANT**  
**DATA SHEET - A**

VOLUME II-B

SECTION D

REV 00

DATE 17.09.2012

SHEET 3 OF 4

- iii/ Head ends : Cast Iron.
- iv/ Tube sheet material : Steel
- v/ Baffle plate : Steel.
- 4.5 Accessories required
- i/ Purge & drain connections with valves. : Yes
- ii/ Relief valves : Yes
- iii/ Liquid line shut off valve. : Yes
- iv/ Isolating valves on water side. : Yes
- v/ Flow switch : Yes (interlocked with control of individual refrigeration system)
- vi/ Pressure/temperature gauges at inlet/outlet : Yes
- vii/ Descaling tee : Yes
- viii/Charging valve : Yes
- ix/ MS supporting frame work : Yes
- viii/Cooling thermostat : Yes
- ix/ MS supporting frame work. : Yes
- 5.0 **CHILLER** (Applicable for chilled water type plant only.)
- 5.1 Type : Horizontal shell & tube flooded type
- 5.2 Number required/standby : One no. for each chiller package.
- 5.3 Design requirements
- 5.3.1 Fluid to be cooled : Water
- 5.3.2 Water flow rate (Inside tube) : To suit requirement.
- 5.3.3 Water inlet temperature : 12 °C approx.
- 5.3.4 Water outlet temperature : 7 °C approx.
- 5.3.5 Super heating of refrigerant material : By at least 3 deg. C.
- 5.3.6 Insulation /thickness/finish : As per the manufacture standard.
- 5.3.7 Design fouling factor : 0.00010(MKS Unit)



**CENTRAL AIR-CONDITIONING PLANT**  
**DATA SHEET - A**

VOLUME II-B

SECTION D

REV 00

DATE 17.09.2012

SHEET 4 OF 4

- 5.3.8 Maximum pressure drop. : 0.6 Kg/cm<sup>2</sup> (g)
- 5.3.9 Tube wall Thickness : Not less than 22 SWG.
- 5.4 Materials of construction
- i/ Shell : M.S. Plate fusion welded.
- ii/ Tube : Integrally Seamless copper (internally Corrugated)
- iii/ Head ends : Cast Iron.
- iv/ Tube sheet material : Steel.
- v/ Baffle plate : Steel.
- 5.5 Accessories required
- i/ Purge & drain : Yes
- ii/ Gate valves at water inlet/outlet. : Yes
- iii/ Flow switch : Yes
- iv/ Pressure/temperature gauges at inlet/outlet : Yes
- v/ Anti-freeze thermostat : Yes
- vi/ Thermostatic expansion valves : Yes
- vii/ Pilot solenoid valve : Yes
- viii/ Cooling thermostat : Yes
- ix/ MS supporting frame work. : Yes

**Note :-**

The system shall also incorporate:

- 1) Auto operation of chilling plant for operation of the whole AC system.
- 2) A Central Control Panel with fault annunciators with provision for remote extension besides local control kiosks.
- 3) Water Chiller package shall be skid-mounted unit with microprocessor based control panel complete with all accessories and controls are assembled at manufacturing works on single unit.
- 4) Screw chiller shall be suitable for 415V  $\pm$  10 %/50 Hz  $\pm$  3%/3 phase operation with voltage & frequency variation as specified with built in starter etc.
- 5) Only supply feeders shall be provided for chillers.



**TECHNICAL SPECIFICATION**  
**AIR HANDLING UNITS**

**SPECIFICATION NO.PES-553-02**

**VOLUME II B**

**SECTION D**

**REV. 02**

**DATE: 17.09.2012**

**SHEET 1 OF 6**

**STANDARD TECHNICAL SPECIFICATION**  
**FOR**  
**AIR HANDLING UNITS**



## TECHNICAL SPECIFICATION

### AIR HANDLING UNITS

SPECIFICATION NO.PES-553-02

VOLUME II B

SECTION D

REV. 02

DATE: 17.09.2012

SHEET 2 OF 6

#### 1. GENERAL

1.1 This specification covers the design, manufacture, Construction features, installation, commissioning, inspection and performance testing at site of AHUs.

#### 2. CODES AND STANDARDS

2.1 The design manufacture and performance of AHU shall comply with all currently applicable statutes, regulations and safety codes in the locality where the AHU is to be installed. The equipments shall also conform to the requirements of the latest editions of applicable Indian/British/US standards. Nothing in this spec. shall be construed to relieve vendor of this responsibility. In particular the equipment shall conform to the latest editions of the following standards:

2.1.1 IS-659 : Safety code for air conditioning

2.1.2 IS-660 : Safety code for mechanical refrigeration

2.1.3 ASHRAE: Method of testing forced circulation air-cooling and air heating coils.  
standard 33

2.1.4 ARI 41 : Standard for forced circulation air cooling and air heating coils.

2.1.5 ARI 430/435 : Air-cooling and air heating coils Central Station AHU / Application  
of Central Station AHU.

2.1.6 AMCA : 211 and 311

In case of any conflict in the standards and this specification the decision of PEM,BHEL shall be final and binding.

#### 3. CONSTRUCTION FEATURES

3.1 The casing of AHU shall be made of insulated double wall construction of min. 24 gauge galvanized sheet steel - IS 277 Gr. 120 (parent sheet: D/DD-IS-513) ribbed and reinforced for structural strength and rigidity with 25 mm thick polyurethane insulation of minimum 40 kg/m<sup>3</sup> density in between. The external wall will be pre-plasticised over GI coating on the outside. Angle irons or channel sections made of 16 gauge galvanized sheet steel shall be used for reinforcing. The casing shall be of sectionalized construction with proper sealing at the joints to make them air tight. Fan section and panels with bearing support shall be reinforced with heavy gauge channels (min. 5 mm thick). Suitable number of forged hot dip galvanized (610 gm/sq.m) U brackets shall be provided for AHU suspended from ceiling/roof.

Necessary arrangement shall be provided on the casing for measuring temperature and pressure in cooling/heating coil. Class of instruments shall be min. 2.

3.2 Fan impeller shall be forwardly/backwardly inclined curved blade centrifugal type. Impeller shall be double width double inlet type. Fans shall be preferably low rpm (<=1500) to minimize vibration and noise. Noise shall be within 85 dB(A) at 1 metre distance from AHU casing. Max. Vibration level shall be acceptance and norms to be specified. Two to three wheels (impellers) shall be provided for each AHU. Impeller blades shall be fabricated from (min. 1.0 mm) galvanized/ epoxy powder coated sheet steel. Fan shall be of epoxy powder coated / galvanized sheet steel (min. 1.6



## TECHNICAL SPECIFICATION

### AIR HANDLING UNITS

SPECIFICATION NO.PES-553-02

VOLUME II B

SECTION D

REV. 02

DATE: 17.09.2012

SHEET 3 OF 6

mm) scroll with die formed inlets for uniform air flow. Fan shafts shall be solid cold rolled carbon steel (EN8 normalised), ground and polished. Fan shaft bearings shall be of heavy duty type selected for average operating life of 100,00 hours. Bearings shall be self-aligning, permanently lubricated type. Make of Brgs(SKF/FAG/NORMA/TATA) to be specified. Bearing Housing shall be of casting of min. IS Gr. 210, split type and suitably supported. The V-belt drive with belt guard shall be provided. Motors shall have minimum 15% margin over maximum BHP in working range.

3.3 DX or chilled water cooling coils and steam/hot water coils shall be internally corrugated copper/ cupronickel tubes (as per manufacturer's standard) with smooth non corrugated external fins of aluminium (thickness 0.14 mm and grade 1100 as per spec) unless specified otherwise in specification. At least 5 fins /per cm. shall be provided. The chilled water/hot water coils shall have suitable (standardize class, size, threading) drain and vent connections.

3.4 The filters in the filter section shall be provided as detailed in data sheet A.

3.5 Humidifier shall be Pan type/as specified in the specification.

Pan type Humidifier consisting of SS304/316 tank, heater, geyserstat with piping connection to supply air duct shall be provided unless specified otherwise in data sheet A.

Heaters and branch line shall be of galvanized steel and nozzles shall be of brass (matl. grade) /SS 304.

3.6 Condenser water from coil or surplus water from spray humidifier shall be collected in 16 gauge SS-304 pan. Minimum 50mm dia GI pipe nipple shall be provided on each end for drain connection. The drains for these points shall be extended to the main drain in AHU room. Condensate drain pipe (GI) of required length with sealing loop shall be provided and insulated as specified in the specification for insulation. Minimum requirement For GI Pipes and fittings shall be ERW/Seamless of medium thickness as per IS-1239/3589 and Hot dip galvanized

3.7 Suitable number of Spring type vibration isolators shall be provided for fan and motor assembly. Neoprene rubber pads shall be provided below the AHU.

The AHU shall be provided with 18 G SS drain pan.



**TECHNICAL SPECIFICATION**  
**AIR HANDLING UNITS**

**SPECIFICATION NO.PES-553-02**

**VOLUME II B**

**SECTION D**

**REV. 02**

**DATE: 17.09.2012**

**SHEET 4 OF 6**

**4.**

**TESTING AND INSPECTION AT MANUFACTURERS WORKS:**

List of TCs arranged as per Approved Quality Plan shall be furnished along with copy of TCs at the time of inspection.



## TECHNICAL SPECIFICATION

### AIR HANDLING UNITS

SPECIFICATION NO.PES-553-02

VOLUME II B

SECTION D

REV. 02

DATE: 17.09.2012

SHEET 5 OF 6

- 4.1 Visual inspection of GI sheets and angles, channels etc. – dents, black spots, chipping of zinc coating, white dust on galvanised sheets shall be avoided. Pitting, lamination in angles and channels shall be avoided.
- 4.2 Galvanised sheets - Test certificate shall be furnished for visual check, coating thickness, adhesion test, sheet thickness, uniformity of coating. For pipes and fittings compliance report shall be furnished by Manufacturer for visual check, coating thickness, adhesion test, sheet thickness, uniformity of coating.
- 4.3 Shaft: Mechanical and chemical.
- 4.4 Motors (of approved make): Routine TC.
- 4.5 Workmanship and dimensional check as per manufacturing drg. and approved Drgs.
- 4.6 Balancing of impellers- Dynamic balancing certificates shall be furnished –grade 6.3 or better to ISO-1940. Balancing weights shall be positively locked to avoid loosening. Balancing weights and fasteners used shall be galvanized.
- 4.7 Performance test of one Centrifugal fan/per type/per size as per AMCA standard (for indigenous make).
- 4.8 Centrifugal fans for AHUs will be 100% run tested by main contractor of BHEL. One centrifugal fan/per type/per size will be run tested. Vibration shall be within good zone of VDI 2056 / ISO 10816-1(group- K) machines when measured on bearing housing and noise level <85 dbA at 1 metre distance. Max. Temp. on bearing housing- 40 degrees Centigrade + ambient.
- 4.9 Complete assembly of one AHU/per type/ per size (excluding cooling coil and filter) shall be witnessed.
- 4.10 Run test of one complete assembly/per type/per size (excluding cooling coil and filter). Vibration shall be within satisfactory zone of VDI 2056 / ISO 10816-1(group- K) machines when measured on bearing housing and noise level <85 dbA at 1 metre distance. Max. Temp. on bearing housing- 40 degrees Centigrade + ambient.



## TECHNICAL SPECIFICATION

### AIR HANDLING UNITS

SPECIFICATION NO.PES-553-02

VOLUME II B

SECTION D

REV. 02

DATE: 17.09.2012

SHEET 6 OF 6

#### 5. DRAWINGS/DOCUMENT/DATA REQUIRED AFTER AWARD OF CONTRACT

- 5.1 GA drawing of AHU & data- sheet to be submitted along with technical schedules enclosed in Volume III.
- 5.2 Drawing including equipment layout, foundation & loading details etc. for civil works. These drawings must cover sufficient details so that design of civil works can be completed.
- 5.3 Inspection, operation & Maintenance Manuals.
- 5.4 Equipment description giving complete design calculations, basis of design, selection criteria etc.
- 5.5 Test Certificates.
- 5.6 Final as built documentation i.e. final-version of all drawings, data & information as per the requirement specified elsewhere.
- 5.7 Performance Test Certificates.



**AIR HANDLING UNIT**  
**DATA SHEET - A**

VOLUME - II-B

SECTION - D

REV 00

DATE 17.09.2012

SHEET 1 OF 2

**DESCRIPTION**

**DATA**

- |  |  |
|--|--|
| 1. Nos. required/working                           | : Refer to Section-C of Specific technical requirement.                      |
| 2. Location  | : Refer to Section-C of Specific technical requirement.                      |
| 3. Service/type                                    | : Air Conditioning /Double skin.   |
| 4. Fan type  | : Centrifugal (forward/backward curve Blade) limit load.                     |
| a) Capacity  | : To Suit as per calculation.  |
| b) Static pressure                                 | : To suit but not less than 60 mm wc for AHU's Micro-V filters.              |
| c) Discharge direction                             | : To suit layout.  |
| d) Motor   | : By Bidder,   |
| e) Local push button station (Start/Stop)          | : By Others  |
| f) Motor location                                  | : Inside AHU Casing.   |
| g) Drive   | : Belt, pulley, belt guard.  |
| 5. Face and Bypass Damper                          | : Required (Opposed blade type) DX AHU's having                              |
| 6. Cooling coil                                    |  |
| a) Duty sensible heat                              | : To suit as per calculations  |
| b) Duty latent heat                                | : -do-   |
| c) Type of coil                                    | : Chilled Water/DX/Hot Water.  |
| d) No. of rows                                     | : To suit but not less than four (4)   |
| e) Material of tube /Thickness                     | : Seamless Copper to ASTM E-75/Equivalent.                                   |
| f) Material of fins                                | : Aluminium to SAE-1100-/1145-0  |
| g) Number of fins                                  | : Not greater than 5 per cm (13 per inch).                                   |
| h) Max. face velocity                              | : 2.5 m/sec.   |
| i) Air flow quantity                               | : To suit as per tender drawings/documents.                                  |
| 7. 3 - way motorised mixing valve with thermostat. | : Required with thermostat & actuator for chilled water system for each AHU. |



**AIR HANDLING UNIT  
DATA SHEET - A**

VOLUME - II-B

SECTION - D

REV 00

DATE 17.09.2012

SHEET 2 OF 2

8. Damper at discharge : Manually operated at discharge of each AHU outlet.  
a) Material of construction : Mild Steel, galvanised.
9. Filters (Pre-filters)  
a) Type & thickness : Dry panel type/ 50 mm  
b) Filter area. : To suit as per velocity requirements. "V" - Bank.  
c) Filter efficiency : Average arrestance efficiency of 65-80 %  
d) Press drop (Clean) : Not to exceed 2.5 mmwc when clean & 6.5 mmwc while dirty.
10. Humidification section : As per the System requirement.  
a) Type : Pan type, unless otherwise specified.  
b) Operation : Automatic with Humidification.
11. Fresh air arrangement : Required.  
a) Fresh air fan : Tube axial flow fans with motor.  
b) Accessories : i) Inlet cone with Bird screen.  
: ii) Dry panel pre-filters,  
: iii) High efficiency filters for control room areas.  
: iv) Volume Control Dampers,  
: v) Supports etc.
12. Vibration isolator required. : Yes
13. Type of vibration isolator. : Neoprene ribbed Rubber for AHU's.
14. Any other requirement : i) In addition to dry panel filters on AHU, High efficiency filters(average arrestance efficiency of 80-90 %) shall be provided in supply air duct side of AHU for all control room and allied areas.  
: ii) Bidder to also provide suitable electrical strip heaters for winter heating & monsoon reheating with Contactor box etc. Heaters to be interlocked with airstat.
15. Instrument & controls : Lot.(including Control box for strip heaters, pan humidifiers etc. in each AHU room.)
16. Insulation of drain piping : Lot.



**STANDARD TECHNICAL  
SPECIFICATION  
FOR  
COOLING TOWER**

**SPECIFICATION NO.PES-553-03**

**VOLUME II B**

**SECTION D**

**REV. 02**

**DATE: 17.09.2012**

**SHEET 1 OF 5**

**STANDARD TECHNICAL SPECIFICATION  
FOR  
COOLING TOWER**



## TECHNICAL SPECIFICATION

### COOLING TOWER

SPECIFICATION NO.PES-553-03

VOLUME II B

SECTION D

REV. 02

DATE: 17.09.2012

SHEET 2 OF 5

#### 1. GENERAL

1.1 this standard specification covers the design, manufacture assembly, inspection & testing at manufacturer's works, suitable painting & packing, delivery, erection & commissioning at site of all materials and equipments for mechanical induced draught cooling tower complete with all accessories as specified hereinafter.

#### 2. CODES & STANDARDS

2.1 the design, manufacture, inspection & testing and performance of the cooling tower as specified hereinafter shall comply with the requirements of all applicable latest Indian/British/American standards and codes of practice. the latest editions of the following standards & publications shall be followed in particular:

2.1.1 Cooling tower institute USA bulletin ATP-10S: Acceptance test procedure for industrial water-cooling tower.

2.1.2 PTC-23 ASME performance test code for Atmospheric water-cooling equipment.

2.1.3 In case of any conflict between the above codes & standards and-this specification, the later shall prevail.

#### 3. DESIGN REQUIREMENTS

3.1 the cooling tower shall be designed for continuous operation to cool not less than design flow of water from specified inlet temperature to the outlet temperature at a design ambient wet bulb temperature as indicated under data sheet a.

3.2 all the components shall be capable of safe, proper and continuous operation at all cooling water flows upto & including those specified under data sheet a & shall be designed with regard to case of maintenance, repair, cleaning & inspection.

3.3 the cooling tower shall be of induced draught cross flow or counter flow type and with multiple cells (if specified in data sheet a.) the cooling tower shall be suitable for handling the fluid and also for achieving the specified parameter as per data sheet a. the cooling tower shall be designed such that the drift losses & evaporation losses are minimum.

#### 4. CONSTRUCTIONAL FEATURES

##### 4.1 CASING & LOUVERS

4.1.1 The cooling tower casing shall be made of FRP/as specified in data sheet A. The louvers shall be made of FRP/as specified. Louvers, if provided, shall be designed for air entry to the tower with low velocity for minimum pressure drop & less chance of recirculation of moist air. To eliminate splash out, louvers shall slope to shed water inwards. Air intake shall be all along the base circumference of the casing & hotdip galvanised expanded metal mesh shall be provided to protect the air intake.



## TECHNICAL SPECIFICATION

### COOLING TOWER

SPECIFICATION NO.PES-553-03

VOLUME II B

SECTION D

REV. 02

DATE: 17.09.2012

SHEET 3 OF 5

- 4.2 FILL
- 4.2.1 Cooling tower fills shall be made of noncombustible PVC/as specified in data sheet A. The design & arrangement of the fills shall be so as to expose maximum air/water surface with minimum pressure drop.
- 4.3 Drift Eliminators
- 4.3.1 Multi-pass drift eliminators with minimum two pass zig-zag path shall be provided so to minimise the drift losses.
- 4.3.2 In case of FRP cooling tower the drift eliminators shall be of multi-blade rotary type.
- 4.4 Fans & Accessories
- 4.4.1 The fans shall be multiple blade, low speed, high efficiency axial flow type located above the top deck level of the cooling tower. Fan rotating assembly shall be statically & dynamically balanced. The fan blades shall be preferably adjustable in stand still condition for propeller action. The fan shall be either directly mounted on the shaft of a totally enclosed weather proof motor or shall be suitable for V-belt drive.
- 4.4.2 The rating of drive motor shall have at least 15% margin over maximum fan power consumption. The design & construction of the drive motor shall be in accordance with enclosed specification for LVAC motors.
- 4.5 Water basin
- 4.5.1 The material of construction of water basin shall be FRP or RCC as specified in data sheet A. The basin shall be provided as a part of cooling tower in case of FRP construction. The sump shall have sufficient storage capacity for safe operation of AC plant.
- 4.6 Hot water distribution system
- 4.6.1 Manually operated flow control valves shall be provided in hot water distribution piping such that each cooling tower can be isolated without affecting the operation of other cells.
- 4.6.2 The nozzles shall be spaced to give even distribution of water over entire space occupied by top row of fills. The nozzles shall be made of brass /SS 304/316/316L (brass shall be as per manufacturer's standard) unless specified in data sheet A:
- 4.6.3 In case of FRP tower water shall be distributed over the fill by means of a multiple area fail safe rotary sprinkler made of PVC pipes fitted on a aluminium alloy (as per manufacturers standard) rotary head and mounted on sealed ball bearings (make) .
- 4.7 Access
- 4.7.1 A stair case paddle ladder (as per manufacturer's standard) shall be provided external to the cooling tower at one end of each tower along with stairways hand rails etc give safe & convenient access to the top deck from ground level.



## TECHNICAL SPECIFICATION

### COOLING TOWER

SPECIFICATION NO.PES-553-03

VOLUME II B

SECTION D

REV. 02

DATE: 17.09.2012

SHEET 4 OF 5

4.8 Painting

4.8.1 The cooling towers shall be painted with suitable anti-corrosive paint as per approval of purchaser. All galvanized external surfaces shall be painted to match colouring scheme. Before painting galvanized surfaces -etch primer to be applied.

#### 5. SHOP INSPECTION & TESTING

5.1 Compliance certificates for nozzles (Or rotary sprinkler), piping, fill material, drift eliminator, louvers components etc.

5.2 Certificate of conformance for all other material components.

5.3 Balancing report for Static & dynamic balancing of fan assembly.

#### 6. TESTS AT SITE

6.1 Hydrostatic testing of complete hot water distribution piping at site.

#### 7. PERFORMANCE GUARANTEE

7.1 The cooling tower shall be guaranteed to meet the performance requirements as specified & when tested in accordance with ATP-105.

7.2 The vendor shall furnish performance curves for the cooling tower showing variations in performance from design duty point with change in approach to wet bulb temperature, cooling range, water loading of cooling tower.



## TECHNICAL SPECIFICATION

### COOLING TOWER

SPECIFICATION NO.PES-553-03

VOLUME II B

SECTION D

REV. 02

DATE: 17.09.2012

SHEET 5 OF 5

- 8. DATA TO BE FURNISHED BY VENDOR AFTER THE AWARD OF CONTRACT**
- 8.1 General arrangement drawing of complete cooling tower (showing plan, front elevation and side elevation) incorporating principal dimensions, limits of scope of supply of piping, limits of civil works included showing extent of platforms, walkways, handrails, access doors, staircase etc. and the limits of scope of supply of electrical works.
- 8.2 General arrangement and sectional assembly drawings pertaining to the following components of the cooling tower:
- i) Tower fill with supporting arrangement.
  - ii) Drift eliminator installation and details.
  - iii) Complete hot water distribution system including flow regulating valves, distribution basin/pipes and nozzles etc.
- 8.3 Cooling tower performance curves showing WBT Vs cold-water temperature for design cooling range, 90% cooling range and 110% cooling range at 100%, 90%, and 110% design flow.
- 8.4 Performance curves of cooling tower fans.
- 8.5 Test procedure along with details of tests to be conducted for the offered cooling tower.
- 8.6 Quality Plan along with complete details of the testing and inspection requirements of mechanical and electrical items of the cooling tower in BHEL format.
- 8.7 Operation and maintenance instructions.



**COOLING TOWER  
DATA SHEET - A**

VOLUME II-B

SECTION D

REV 00

DATE 17.09.2012

SHEET 1 OF 2

**A. GENERAL DATA**

- 1) Service : Cooling of condenser water of AC plant.
- 2) Type : Fibreglass reinforced plastic construction induced draught.
- 3) Quantity : Refer to Section-C of Specific Technical Requirements.
- 4) Place of installation : Refer to Section-C of Specific Technical Requirements.

**B. DESIGN DATA**

- 1) Capacity at specified conditions. : To suit the system requirement.
- 2) Water flow rate : To suit the system requirement.
- 3) Design wet bulb temperature : 25 Deg. C.
- 4) Hot water inlet temperature : To suit requirement.
- 5) Cooled water temperature : To suit requirement.
- 6) Depth of sump Tank : As per manufacturer's standard.

**C. MATERIAL**

- 1) Sump tank & Casing : FRP
- 2) Louvers : FRP/PVC/Aluminium.
- 3) Type of fill : Non-combustible PVC/Eq.
- 4) Nozzles : Brass with chrome plating/polypropylene.
- 5) Ladder : Hot dip galvanized steel ladder for each tower.
- 6) Bird screen : 25 mm square made of GI/SS wire mesh of 16 gauge.
- 7) Fan impeller : Cast Aluminium Alloy/FRP propeller type and multi-blade aerofoil construction with adjustable pitch..
- 8) Supporting structure : MS with spray galvanization of epoxy painting.
- 9) Strainer : Plant strainer made of GI/SS wire mesh of 16 gauge.

**D. ACCESSORIES**

- 1) Make up connection : Yes.



**COOLING TOWER**  
**DATA SHEET - A**

VOLUME II-B

SECTION D

REV 00

DATE 17.09.2012

SHEET 2 OF 2

- 2) Quick fill connection : Yes.
- 3) Overflow & drain & blow down connection : Yes.
- 4) Access door in louvers/fan deck : Yes (if applicable).
- 5) Supports & supporting structure for mounting : Yes.
- 6) Level switch : Yes.
- 7) Rain protection for motor : Yes (suitable Canopy by Bidder)
- E. ELECTRICAL DATA
- i) Power supply : 415 V $\pm$  10%/50 Hz  $\pm$  3%/3 phase.
- ii) Motor : As per specification attached.
- F. INSPECTION & TESTING : As per approved quality plan.



**TECHNICAL SPECIFICATION**  
**LOW PRESSURE AIR DISTRIBUTION**  
**SYSTEM**

**SPECIFICATION NO.PES-553-07**

**VOLUME II B**

**SECTION D**

**REV. 02**

**DATE: 17.09.2012**

**SHEET 1 OF 9**

**STANDARD TECHNICAL SPECIFICATION**  
**FOR**  
**LOW PRESSURE AIR DISTRIBUTION SYSTEM**



**TECHNICAL SPECIFICATION**  
**LOW PRESSURE AIR DISTRIBUTION**  
**SYSTEM**

SPECIFICATION NO.PES-553-07

VOLUME II B

SECTION D

REV. 02

DATE: 17.09.2012

SHEET 2 OF 9

**1. GENERAL**

1.1 This specification covers the design, manufacture, construction features, installation, inspection testing and air balancing of air distribution system upto a total pressure of 95mm w.g. The specification is intended to cover the air distribution for air conditioning system and ventilation system not involving localised exhaust.

**2. CODES AND STANDARDS**

2.1 The design, construction and performance of complete system shall conform to all currently applicable statutes, regulations, safety codes in the locality where the equipment are to be installed

2.2 Unless specified otherwise the equipments shall generally conform to latest applicable Indian Standards. Nothing in this specification shall be construed to relieve the vendor of this responsibility. In particular the equipment shall generally conform to latest editions by the following standards:-

- a) IS: 655 - Specifications for metal air ducts.
- b) IS:277 - Specifications for galvanised steel sheets.
- c) IS:737 - Specification for wrought aluminium and aluminium alloy sheet and strip.

**3. MATERIAL**

3.1 Metal air ducts shall be either of galvanised steel sheets or aluminium sheets, as indicated in data sheet-A.

3.2 The rolled steel sheets before galvanising shall be properly annealed or normalised so as to allow fabrication of ducts without developing cracks. Zinc coating on the steel shall be as per technical requirement refer to Section-C of Specific Technical Requirements.

3.3 The aluminium sheets shall be of grade S1C or NS3 and shall be suitable for duct fabrication work as per IS-737 latest

**4. CONSTRUCTION/FABRICATION**

4.1 The thickness of sheets, the type of bracing and other fabrication details shall generally conform to requirements given hereunder unless specified otherwise in data sheet A and/or indicated on drawings.

**4.2 RECTANGULAR DUCTS**

4.2.1

S.No.	Max Side	Sheet Thickness	Type of transverse	Bracings
-------	----------	-----------------	--------------------	----------



**TECHNICAL SPECIFICATION**  
**LOW PRESSURE AIR DISTRIBUTION**  
**SYSTEM**

SPECIFICATION NO.PES-553-07

VOLUME II B

SECTION D

REV. 02

DATE: 17.09.2012

SHEET 3 OF 9

		(mm) GI	(mm) AI	Joint connections	
a)	Up to 600	0.63 (24G)	0.80	S-drive, pocket or bar slips or flanged joints on 2.5m centres	None
b)	601 to 750	0.63 (24G)	0.80	S-drive, 25mm pocket or 25mm bar slips or flanged joints on 2.5m centres	25x25x3 mm MS angles, 1.2m from joints
c)	751 to 1000	0.80 (22G)	1.00	S-drive, 25mm pocket or 25mm bar slips or flanged joints on 2.5m centres	25x25x3 mm MS angles, 1.2m from joints
d)	1001 to 1500	0.80 (22G)	1.00	40x40x3mm MS angle, flanged connections or 40mm pocket or 40mm bar slips with 35x3mm bar reinforcing on 2.5m centres	40x40x3 mm MS angles, 1.2m from joints
e)	1501 to 2250	1.00 (20G)	1.50	40x40x3mm MS angle, flanged connections or 40mm pocket or 40mm bar slips, 1M maximum centres, with 35x3mm bar reinforcing	40x40x3 mm diagonal angles or 40x40x3mm angles, 600mm from joints
f)	2251 & above	1.25 (18G)	1.80	50x50x3mm MS angles, connections or 40mm pocket or 40 mm bar slips, 1M maximum centres with 35x3mm bar reinforcing.	50x50x3mm diagonal angles or 50x50x3mm angles 600 mm from joints.
g)	No bracing is required if transverse joints are less than 600mm apart				
h)	For ducts larger than 2250mm, special handling and supporting methods shall be provided as per the approval of Purchaser				

4.2.2 All rectangular ducts having either dimension larger than 450mm shall be cross broken except these ducts which are insulated with sand cement plaster. Air outlet connections on ducts need not be cross broken.

4.2.3 The seams on duct cones shall be of Pittsburgh type. Longitudinal seams shall be smooth inside the ducts.

4.2.4 The flanges used for transverse joints shall be joined together with GI bolts (grade 4.6) and nuts spaced at 125mm centres as per following:

- a) Upto 1000mm - 6 mm dia GI bolts
- b) 1001 to 1500 - 8 mm dia GI bolts
- c) 1501 and above - 10mm dia GI bolts



**TECHNICAL SPECIFICATION**  
**LOW PRESSURE AIR DISTRIBUTION**  
**SYSTEM**

SPECIFICATION NO.PES-553-07

VOLUME II B

SECTION D

REV. 02

DATE: 17.09.2012

SHEET 4 OF 9

4.2.5 The MS angle flanges shall be connected to ducts with rivets at approx. 100mm centres. The flanged joints shall have 6mm thick felt packing stuck to flanges with shellac varnish. The holes in the felt packing shall be burnt through. The ducts are to be tapped 6mm across the MS flanges.

4.2.6 MS angles used for bracings shall be tack welded to the ducts or rivetted at 125mm centres, as applicable.

**4.3 ROUND DUCTS**

**4.3.1**

S.No.	Duct dia-mm	Sheet Thickness		Reinforcing
		(mm)	(mm)	
		GI	Al	
a)	Up to 150	0.63 (24G)	0.80	None
b)	151 to 600	0.80 (22G)	1.00	None
c)	601 to 1000	1.00 (20G)	1.50	40x40x3mm girth MS
d)	1001 to 1250	1.00 (20G)	1.50	40x40x3mm girth MS angles at 2.0 meter centres
e)	1251 & above	1.25 (18G)	1.80	40x40x3mm girth MS angles at 1.2m centres

4.3.2 The seams on round ducts may be continuously welded or grooved longitudinal seam. In case of welding of GI sheet, zinc rich paint shall be applied on the welded zone.

4.3.3 Round ducts shall either be joined by welding or the ducts shall be swedged 40mm from the ends such that larger end will butt against the swedge and is held in place with sheet metal screws.

**4.4 DUCT SUPPORTS**

Unless specified otherwise on drawings, rectangular ducts with larger side of 2250mm or above shall be supported by 15mm MS rods and 50x50x3mm and MS angles while those below 2250 mm shall be supported by 10mm MS rods and all angles shall be given a coat of primer paint. The duct supports shall be at a distance not exceeding 1800mm. The MS rods shall be fixed to MS angle cleats, which in turn are fixed to ceiling slab by suitable anchor fasteners. All anchor fasteners, MS angle cleats, coach screws, hooks and other supporting material required shall be provided by vendor.

However, If ducts are thermally insulated, the MS angles and supports shall not be in



**TECHNICAL SPECIFICATION**  
**LOW PRESSURE AIR DISTRIBUTION**  
**SYSTEM**

SPECIFICATION NO.PES-553-07

VOLUME II B

SECTION D

REV. 02

DATE: 17.09.2012

SHEET 5 OF 9

direct contact with ducts, for which purpose wooden pieces/ Resin bonded fibre glass sheets (50 mm thick) shall be used in between.

**4.5 FLEXIBLE CONNECTIONS**

Wherever the sheet metal ducts connects to intake or discharge of fan units a flexible connection of at least 150mm width made by closely woven double layer Fire resistant or canvas shall be provided. The same shall be attached to angle iron frames on equipment and to similar frame on duct or casing by means of a steel band 9r (or) collar fitting over the end of the flexible connection and bolted through angle iron frame so as to clamp securely between the band and the angle frame.

**4.6 TRANSFORMATIONS AND BREACHES**

All curves, bends, offsets and other transformations shall be made for easy and noiseless flow of air. The throat of every branch duct shall be sized to have a velocity not exceeding that in the main duct to which the branch is connected.

**4.7 CAULKING**

Wherever duct passes through wall, the opening between masonry and duct work shall be neatly caulked or sealed to prevent movement of air from one space to adjoin by space with a rated fire resistant material.

**4.8 EASEMENT**

Normally pipe hangers, light fitting rods etc. shall not be allowed to pass through the ducts. Wherever, It becomes absolutely essential to pass these hangers/rods etc. Through the ducts, prior approval of purchaser shall be taken and light streamlines easement around the same shall be provided to maintain smooth air flow.

**4.9 ACCESS DOORS**

Access doors shall be provided in ducts, plenums etc. on both sides to allow access and servicing of equipment viz. pipes, dampers, coils, valves, heaters etc.

All access doors shall be adequately sized and lined suitably with felt to prevent air leakage. The doors shall be of built-up construction, structurally strong and shall have at least two hinges each, and shall be with two rust proof window sash locks of approved type. All doors shall be so set as to flush with outer finish of duct insulation etc.

**4.10 DAMPERS AND SPLITTERS**

**4.10.1** Dampers and splitters shall be provided at suitable points for proportional volume control of the system. Splitters and dampers shall be made of minimum 18 gauge GSS of quadrant type with locking device mounted outside the duct at accessible location.

**4.10.2 FIRE DAMPERS**

Fire dampers shall be provided as specified in Data Sheet -A and shall be installed at locations indicated on drawings and/or as required/approved by purchaser, including all openings in passage of duct work through fire walls and floors etc. The fire damper shall be of electrical type with damper motor actuated by thermal



**TECHNICAL SPECIFICATION**  
**LOW PRESSURE AIR DISTRIBUTION SYSTEM**

SPECIFICATION NO.PES-553-07

VOLUME II B

SECTION D

REV. 02

DATE: 17.09.2012

SHEET 6 OF 9

sensor or fusible link type.

**4.10.3 VANES**

Unless otherwise shown in the drawings all elbows shall be such that the throat radius is 75% of the duct width. In case throat radius is smaller, suitable single thickness vanes of approved details shall be provided.

**4.10.4 FLASHING**

For the ducts penetrating roofs or outside walls, provision of flashing shall be made by the ducting vendor.

**4.11 DIFFUSERS AND GRILLS**

The type and quantity of diffusers and grills is indicated on enclosed drawings/data sheet A. The size/quantity of diffusers/ grills indicated in the drawing/data sheet is indicative and is for vendor's reference purpose only. Vendor shall ensure that the diffusers/grills offered are of requisite capacity, throw and terminal velocity. The pressure drop and noise levels shall be as per data sheet. A enclosed. The diffusers/grills shall be approved by purchaser.

Unless specified otherwise the diffusers/grills shall be of mild steel and painted with two coats of primer paint. Supply air grills shall be complete with volume control dampers. Supply air grills shall be double deflection type while Return Air grills can be single deflection type. Ceiling outlets/diffusers shall have volume control dampers, fixed grids and blanking baffles. All volume control dampers shall be operated by a key from the front of grills/diffusers.

Suitable vanes shall be provided in duct collars to have uniform air distribution. Blank-off baffles wherever required, shall also be provided.

**4.12 PLENUMS AND RA BOXING**

All plenum chambers and/or connections to fans, dampers etc. shall be constructed in 18 gauge GI sheet. supported on 40x40x6mm MS angle frames. All vertical angles shall be riveted at approx. 125mm. centres to the casing. Suitable caulking compound (Pecora or equivalent) shall be inserted between the base of the angle and all masonry construction to which angles are fastened.

Return air boxing requirements if any are indicated in data sheet-A and the same shall be provided by vendor. The return air box shall be fabricated out of GI sheets shall be insulated with 25mm thick fibre-glass.

**4.13 ACCOUSTIC LINING**

The ducts shall be lined acoustically from inside as given in data- sheet A and/or section C of the specification.

**4.14 PAINTING**

Wherever specified the ducts shall be painted or lined with suitable anti-corrosive paint/ lining as per approval of purchaser. In particular the ducts coming in contact with acid fumes shall be epoxy coated, inside and outside.



**TECHNICAL SPECIFICATION**  
**LOW PRESSURE AIR DISTRIBUTION**  
**SYSTEM**

**SPECIFICATION NO. PES-553-07**

**VOLUME II B**

**SECTION D**

**REV. 02**

**DATE: 17.09.2012**

**SHEET 7 OF 9**

**4.15 THERMAL INSULATION**

Thermal insulation shall be as per data sheet - A and the insulation shall conform to enclosed spec. no. PES-553-08.

**5. INSPECTION AND TESTING**

**5.1 INSPECTION & TESTING DURING FABRICATION**

5.1.1 Visual inspection of GI sheets and angles, channels etc. – dents, black spots, chipping of zinc coating, white dust on galvanised sheets shall be avoided. Pitting, lamination in angles and channels shall be avoided.

5.1.2 Galvanised sheets - Test certificate shall be furnished for visual check, coating thickness, adhesion test, sheet thickness, uniformity of coating.

5.1.3 Check for dimensions & mass as per latest IS-277.

5.1.4 Check for defect, twists, ungalvanised spots as per IS-2629.

5.1.5 Bend test & wrapping test as per IS-277.

5.1.6 Zinc coating test on samples as per IS-6745.

**5.2 INSPECTION & TESTING AT SITE.**

5.2.1 The duct branches, elbows etc. shall be inspected and the joints and connections etc, are to be checked before they are assembled in position.

5.2.2 After completion, all duct systems shall be checked and tested for air leakage, tightness, velocity, pressure drop, vibration and noise etc.

**6. BALANCING**

6.1.1 The entire air distribution system shall be balanced by vendor to supply the air quantities as required in various rooms so as to maintain the requisite temperature and air flow in the conditioned spaces. The final balance of air quantities through each grill/diffuser etc. shall be recorded and submitted to purchaser for approval. Proper steps shall be taken to have a uniform temperature in all enclosures, with utmost care for noise level to be within tolerance limit

6.1.2 All instruments required for testing/balancing etc. of the air distribution system shall be provided by vendor.



**TECHNICAL SPECIFICATION**  
**LOW PRESSURE AIR DISTRIBUTION**  
**SYSTEM**

**SPECIFICATION NO.PES-553-07**

**VOLUME II B**

**SECTION D**

**REV. 02**

**DATE: 17.09.2012**

**SHEET 8 OF 9**

**7. DATA TO BE FURNISHED BY VENDOR AFTER THE AWARD OF CONTRACT**

- 7.1 Fabrication drawings of ducts and grilles, louvers, dampers, etc, including typical details of grilles dampers etc.
- 7.2 Test certificates in line with scope of inspection.
- 7.3 Other dimensional drawings & documents as may be required by purchaser for better understanding of the system & for preparation of operation, maintenance & instruction manual.



**TECHNICAL SPECIFICATION**  
**LOW PRESSURE AIR DISTRIBUTION**  
**SYSTEM**

**SPECIFICATION NO.PES-553-07**

**VOLUME II B**

**SECTION D**

**REV. 02**

**DATE: 17.09.2012**

**SHEET 9 OF 9**



## LOW PRESSURE AIR DISTRIBUTION SYSTEM

### DATA SHEET - A

VOLUME II-B

SECTION D

REV 00

DATE 17.09.2012

SHEET 1 OF 2

#### Description

#### Data

- |                                |   |
|--------------------------------|---|
| 1. General (List of areas)     | : As per Specification/Tender drawing.  |
| 2. GSS Duct Work               |   |
| a) Type                        | : GSS as per IS: 277<br>(Zinc coating as per Section-C of Specific Technical Requirements.)   |
| b) Size                        | : As per Section-C of Specific Technical Requirements and bill of quantity.   |
| 3. Acoustic lining             | : Up to 5m length from AHU Outlet.  |
| 4. Special painting            | : Galvanised.   |
| 5. Thermal Insulation          | : Required in supply air duct in AC entire length.  |
| 6. Diffusers (Circular/Square) |   |
| 300 mm size                    | } : Bidder to estimate as per drawings./specification.<br>All grille frame and louvers shall be manufactured of at least 16 SWG Aluminium |
| 350 mm size                    |   |
| 450 mm size                    |   |
| 550 mm size                    |   |
| 600 mm size                    |   |
| Any other size                 |   |
| 7. SA grilles (for each size)  | : To suit air flow as per System requirements / Tender Drawings.  |
| 8. RA grilles (for each size)  | : -do-  |

#### NOTE:

1. Duct sheet thickness shall be as per IS-655
2. Opposed blade type volume control damper shall be provided at each supply air diffusers/grilles.
3. Bidder to provide suitable gasketing at each duct flange.
4. Fire damper shall be motor operated type, when otherwise specified under Section-C.
5. Access door in ducting system shall be provided as required.
6. MS Angle (painted) shall be used for duct supports etc.
7. Velocity thru duct shall normally not exceed 9.0 M/sec for Air conditioning system. Maximum velocity (outlet) for supply air diffuser shall not exceed 2.5 m/sec.



**LOW PRESSURE AIR DISTRIBUTION SYSTEM**

**DATA SHEET - A**

VOLUME II-B

SECTION D

REV 00

DATE 17.09.2012

SHEET 2 OF 2

8. All Grilles & diffusers shall be supported with frame. Frame etc. shall be supplied by bidder.



**TECHNICAL SPECIFICATION**  
**CENTRIFUGAL PUMPS**

**SPECIFICATION NO.PES-553-04**

**VOLUME II B**

**SECTION D**

**REV. 02**

**DATE: 17.09.2012**

**SHEET 1 OF 10**

**STANDARD TECHNICAL SPECIFICATION**  
**FOR**  
**CENTRIFUGAL PUMPS**



**TECHNICAL SPECIFICATION**  
**CENTRIFUGAL PUMPS**

**SPECIFICATION NO.PES-553-04**

**VOLUME II B**

**SECTION D**

**REV. 02**

**DATE: 17.09.2012**

**SHEET 2 OF 10**

**1. GENERAL**

1.1 This specification covers the design, material, constructional features, manufacture, assembly, inspection and testing at manufacturer's or his subcontractor's works, suitable painting requirements of centrifugal pumps and drives complete with all accessories as specified hereinafter.

**2. CODES AND STANDARDS**

2.1 The design, manufacture, inspection, testing & performance of the pumps as specified hereinafter, shall comply with the requirements of the latest revision of the following standards as indicated below (as applicable):

2.1.1 IS-1520 : Horizontal centrifugal pumps for clear, cold and fresh water.

2.1.2 IS-5120 : Technical requirements - Rotodynamic special purpose pump.

2.1.3 IS-1710 : Vertical turbine pumps for clear, cold and fresh water.

2.1.4 BS - 599 : Method of testing Pumps.

2.1.5 PTC - '6' : Centrifugal Pumps Power test code

2.1.6 API - 610

2.1.7 Hydraulic Institute Standards of USA

Wherever standards for certain aspects materials etc., not mentioned, the same shall be as per the applicable Indian or International standards.

2.2 In case of any conflict between the above codes/standards and this specification, the later shall prevail and in case of any further conflict in this matter, the decision of Purchaser's engineering shall be final and binding.



**TECHNICAL SPECIFICATION**  
**CENTRIFUGAL PUMPS**

**SPECIFICATION NO.PES-553-04**

**VOLUME II B**

**SECTION D**

**REV. 02**

**DATE: 17.09.2012**

**SHEET 3 OF 10**

**3. DESIGN REQUIREMENTS**

- 3.1 The pumps shall be of heavy duty suitable for long periods of uninterrupted service and shall be standard product of the manufacturer thoroughly proven for satisfactory performance and reliability.
- 3.2 The materials of construction of various components shall be as indicated under Data Sheet-A and where not specified to the applicable Indian/British/American standards..
- 3.3 All pressure containing components including the pump casing, nozzles and stuffing box housing shall be designed, fabricated and tested in accordance with applicable Indian standards if not specified otherwise.
- 3.4 The pump shall be suitable for handling the fluid as specified in Data Sheet-A.

**4. CONSTRUCTION FEATURES:**

**4.1 PUMP CASING**

- 4.1.1 Pump casing may be axially or radially split or barrel type construction as specified in the pump data specification sheet. The casing shall be designed to withstand 1.5 times the maximum pressure developed by the pump at the pumping temperature.
- 4.1.2 Pump casing shall be provided with adequate number of vent and priming connections with valves, unless the pump is made self venting & priming. Casing drain, as required, shall be provided complete with drain valves or plugged with threaded plugs as required.
- 4.1.3 Pump shall preferably be of such construction that it is possible to service the internals of the pump without disturbing suction and discharge piping connections.
- 4.1.4 Under certain conditions, the pump casing nozzles will be subjected to reactions from external piping. Pump design must ensure that the nozzles are capable of withstanding external reactions not less than those specified in API-610

**4.2 IMPELLER**

- 4.2.1 Unless specifically indicated under Data Sheet-A enclosed, the pump impellers shall be of closed vane type. The impellers shall be secured to the shaft and shall be retained against circumferential movement by keying, pinning or lock rings. Impellers shall be checked for eccentricity and statically and dynamically balanced individually. The assembled rotor shall be dynamically balanced and checked for eccentricity. Supplier shall ensure during balancing that wall thickness of impeller vane, shroud etc is maintained above the minimum thickness requirement as per design.

**4.3 WEARING RING**

- 4.3.1 Renewable wearing rings for the casing and/or the impellers and renewable shaft sleeves, shall be provided for all pumps. Length of the shaft sleeves must extend



**TECHNICAL SPECIFICATION**  
**CENTRIFUGAL PUMPS**

**SPECIFICATION NO.PES-553-04**

**VOLUME II B**

**SECTION D**

**REV. 02**

**DATE: 17.09.2012**

**SHEET 4 OF 10**

beyond the outer faces of gland packing or seal and plate so as to distinguish between the leakage between shaft & shaft sleeve and that past the seals/gland.

**4.4 SHAFT**

4.4.1 Shaft size selected shall take into consideration the critical speed which shall be away from the operating speed as recommended in applicable Code/Standard. The critical speed shall also be at least 10% away from runaway speed.

**4.5 BEARING**

4.5.1 Bearings and hydraulic devices, of approved make, (if provided for balancing axial thrust) of adequate design shall be furnished for taking the entire pump load arising from all probable conditions of continuous operation throughout its Range of Operation and also at the shut off condition. The bearing shall be designed on the basis of 20,000 working hrs minimum for the load corresponding to the duty point. Proper lubricating arrangement for the bearings shall be provided. The design shall be such that the bearing lubricating element does not contaminate the liquid being pumped. Where there is a possibility of liquid entering the bearing, suitable arrangement in the form of deflectors or otherwise shall be provided ahead of bearing assembly. Bearings shall be easily accessible without disturbing the pump assembly.

**4.6 STUFFING BOX**

4.6.1 Packed type stuffing boxes of adequate depth with lantern rings shall be provided to minimize the leakage. In all cases where the pump suction is below atmospheric pressure, the shaft packing shall be sealed by the liquid pumped by tapping off from the pump discharge itself and all pipes, valves, fittings etc., required for this shall be furnished by the manufacturer. Tubings used for connections shall be flexible metallic type preferably SS-304/316. PVC/ rubber tubings are not acceptable.

**4.7 SHAFT COUPLING**

4.7.1 The pumps shall be directly coupled to their drives through heavy-duty flexible coupling. Suitable sturdy coupling guards of min. 1.5 mm MS sheet/ Aluminium sheet shall be provided along with the coupling. The pump and its drive motor shall be mounted on a common base plate.

**4.8 BASE PLATE AND SOLE PLATE**

4.8.1 Unless otherwise stated the data specification sheet, a common base plate mounting both for the pump and drive shall be furnished. The base plate shall be of rigid construction, suitably ribbed and reinforced. Base plate and pump supports shall be so constructed and the pumping unit so mounted as to minimize misalignment caused by mechanical forces such as normal piping strain, hydraulic piping thrust, etc. Suitable drain taps and drip lip shall be provided. The external corners of the base plate shall be rounded to avoid sharp corners. Drilled holes shall have sufficient space around for proper seating of washer with nut. If required in the data specification sheet, steel sole plates shall be provided, below the base plate.



## TECHNICAL SPECIFICATION

### CENTRIFUGAL PUMPS

SPECIFICATION NO. PES-553-04

VOLUME II B

SECTION D

REV. 02

DATE: 17.09.2012

SHEET 5 OF 10

#### 4.9 PRIME MOVER

4.9.1 The drive motor selected shall conform to the requirements of the enclosed motor specifications.

#### 4.10 LIFTING ARRANGEMENT

4.10.1 Each pump and motor shall incorporate suitable lifting attachments e.g. lifting lugs or eye bolts etc., to facilitate erection and maintenance..

### 5. PERFORMANCE REQUIREMENTS

5.1 The pump shall be designed to have best efficiency at the specified duty point. The pump set shall be suitable for continuous operation at any point within the Range of Operation as stipulated in the data specification sheets.

5.2 Pump shall have a continuously rising head capacity characteristics from the specified duty point towards shut off point, the maximum being at shut off. Power capacity characteristic will be non-overloading type i.e. 110% of the design flow the power required to drive the pump will be practically the same as that at the design flow.

5.3 Wherever specified in data sheet, pumps of each category shall be suitable for parallel operation. The head vs capacity, input power vs. capacity characteristics, etc., shall match to ensure equal load sharing and trouble free operation throughout the range.

5.4 The pump motor set shall be designed in such a way that there is no damage due to the reverse flow through the pump which may occur due to any malfunction of the system.

### 6. DRIVE RATING

6.1 The power rating of the drive shall be selected such that a minimum margin of 15% is available over the pump input power required at the rated duty point. However, the drive rating shall not be less than the maximum power requirement at any point within the 'Range of Operation' specified.

6.2 In cases where parallel operation of the pumps are specified the actual drive rating is to be selected by the bidder considering overloading of the pumps in the event of tripping of one of the operating pumps.

6.3 The bidder under this specification shall assume full responsibility in the operation of the pump and the drive as one unit.

### 7. SCOPE OF INSPECTION AND TESTING

#### 7.1 CASTING

7.1.1 The Witnessing pouring and thereafter physical testing of castings of 'Critical' nature such as casings, impellers, diffusers. Castings shall have 'as cast' heat numbers



## TECHNICAL SPECIFICATION

### CENTRIFUGAL PUMPS

SPECIFICATION NO. PES-553-04

VOLUME II B

SECTION D

REV. 02

DATE: 17.09.2012

SHEET 6 OF 10

unless they require overall machining. For partially machined components manufacturer shall ensure availability of as cast heat nos. on unmachined area.

- 7.1.2 Identification and correlation with test reports for all tests as per the relevant material specifications for castings of 'Major' nature such as suction bell, discharge elbow, stuffing box, gland, wearing rings, shaft sleeves etc.
- 7.1.3 Foundry's conformity certificate for castings of 'Minor' nature such as base plates, covers etc.
- 7.1.4 Verification of Heat treatment charts (as applicable)
- 7.1.5 Castings may be required to meet NDT requirements such as Radiography, Magnetic Particle Testing or Dye-penetrant testing prior to Hydro-test as per requirements specified in Quality Plan.
- 7.1.6 Surface finish of Steel castings shall meet MSS SP-55.

#### 7.2 FORGING

- 7.2.1 Identification and correlation with mill test certificates for all tests as per the relevant specifications for important forgings like casings, stage bodies, diffusers, shaft material.
- 7.2.2 Verification of heat treatment charts (time temperature) (as applicable).
- 7.2.3 Forgings may be required to meet NDT requirements such as Radiography, Magnetic Particle Testing or Dye-penetrant testing prior to Hydro-test as per requirements specified in Quality Plan.

#### 7.3 FABRICATED ITEMS

- 7.3.1 Identification and correlation with mill test certificates for material of items such as discharge bellows, column pipes etc.
- 7.3.2 Approval of welding procedure specifications and qualifications of weld procedures and personnel as per ASME Sec IX.
- 7.3.3 Dye penetrant tests of weldment as per ASTM E-165 and acceptance norm as per ASME Sec.VIII, Div.1, Appendix 8
- 7.3.4 Verification of heat treatment charts (time temperature), (as applicable)
- 7.3.5 **Note:** For para 7.1.2, 7.2.1 and 7.3.1 above; in case correlating original test certificates are not available, material shall be identified by Main Vendor and test conducted at NABL approved Laboratory.

#### 7.4 IN PROCESS INSPECTION AND TESTING

- 7.4.1 Identification Dye penetrant testing after machining for impellers including vanes, pump shaft, diffusers as per applicable code; in absence of which, as per ASTM E - 165. Permissible defects and acceptance norms need to be specified. On static parts acceptance norms are as per ASME Sec.III NB 2546.
- 7.4.2 Ultrasonic testing of dynamic duty component, i.e. pump shafts (50mm dia and above) and static duty forgings i.e. Barrel, casting (15mm and above wall thickness)



**TECHNICAL SPECIFICATION**  
**CENTRIFUGAL PUMPS**

**SPECIFICATION NO. PES-553-04**

**VOLUME II B**

**SECTION D**

**REV. 02**

**DATE: 17.09.2012**

**SHEET 7 OF 10**

as per applicable code, in absence of which as per ASTM E388 and acceptance norms as stipulated hereunder. Probe shall be of min. 2 MHz frequency.

7.4.3 Acceptance norms for UT for dynamic duty components. the following defects are unacceptable

- a) Cracks, flakes, seams and laps
- b) Defects giving indications longer than that from a 4mm equivalent flaw.
- c) Group of defects with maximum indications less than that from a 4mm equivalent flaw, which cannot be separated at testing sensitivity, if the back echo is reduced to less than 50%.
- d) Defects giving indications of 2 to 4mm dia. equivalent flaw separated by distance less than four times the size of the larger of the adjacent flaw.

7.4.4 For static duty components - as per NB 2542.2 of ASME Sec. III

7.4.5 Hydro tests of all pressure parts such as casings, column pipes, discharge elbows etc., at two times duty point pressure or 1.5 time shut off pressure, whichever is higher for 30 min., without any leakage.

**Note** : In case the pump is required to boost certain pressure, the inlet pressure head shall also be taken into consideration to compute test pressures

7.4.6 Static and dynamic balancing of individual impellers and also assembled rotors as per V.D.I. 2060 Q 6.3 or ISO 1940 G 6.3.

**7.5 PERFORMANCE TEST**

7.5.1 Pump testing with unit supply motor as per specifications and acceptance norms cited elsewhere, in absence of which as per IS 5120 latest edition. Performance shall be checked for minimum of 7 points (including shut off head and over load) following characteristics shall be checked.

- a) Capacity V/s Head
- b) Capacity V/s Power absorbed by pump
- c) Capacity V/s pump efficiency

**Note** : For pump of fire protection system, performance test shall be conducted up to 150% of rated capacity.

7.5.2 NPSH test in case specifically mentioned elsewhere.

7.5.3 Vibration, noise level and temperature rise measurement. Noise level shall be within 85dB(A) at 1 metre distance. Vibration within satisfactory zone of VDI 2056 Group G machines. Temperature shall not exceed ambient + 40 deg. C.

7.5.4 Overall dimensions as per GA drawings. One pump/type/size assembly with job motor shall be mounted on base plate, provided the components are ordered on the same manufacturer.

7.5.5 Examination after selective opening up after running for pumps operating at speed over 1800 rpm and capacity exceeding 68M<sup>3</sup>/hr.

7.5.6 Painting and packing as per technical specification.



**TECHNICAL SPECIFICATION**  
**CENTRIFUGAL PUMPS**

**SPECIFICATION NO.PES-553-04**

**VOLUME II B**

**SECTION D**

**REV. 02**

**DATE: 17.09.2012**

**SHEET 8 OF 10**

**7.6 TEST AT SITE**

7.6.1 The pumps will be tested at site by the purchaser to verify their performance. If the pumps fail to operate smoothly or within the required performance all such deficiencies shall be rectified by the manufacturer by making suitable alternatives in the pump set and additional tests required to show the effect of such alterations shall be performed by him.

**7.7 PERFORMANCE GUARANTEE**

7.7.1 The vendor shall guarantee the material and workmanship of all components as well as the operation of the pump as per requirement of this specification. The vendor shall also guarantee for each pump the total dynamic head at the specified rated capacity and also corresponding efficiency, brake horse power and shut off head

**8. CLEANING, PROTECTION , PAINTING & PACKING**

8.1 Before shipment of the equipment to be supplied under this specification the necessary cleaning, flushing etc., as per manufacturers standard/ as specified for the contract in Data Sheet A/ elsewhere shall be done to remove all dirts, scales etc. Shop coats of rust inhibiting paints, lacquers etc., shall be applied to various parts as per manufacturers standard/ as specified for the contract in Data Sheet A/ elsewhere. Flanges, inlet and outlet pipe, etc shall be protected. Packing shall be done as per manufacturers standard/ as specified for the contract in Data Sheet A/ elsewhere.

**TECHNICAL SPECIFICATION****CENTRIFUGAL PUMPS**

SPECIFICATION NO.PES-553-04

VOLUME II B

SECTION D

REV. 02

DATE: 17.09.2012

SHEET 9 OF 10

- 9. DRAWINGS, TECHNICAL DOCUMENTS AND OTHER INFORMATION REQUIRED WITH THE PROPOSAL**
- 9.1 Fully dimensioned outline GA drawings of the pump motor assembly unit for each type and size offered. This drawing should include:
- Foundation base plate and sole plate details as applicable
  - Civil foundation and anchor bolts details and loading data
  - Minimum submergence required for the pump (if applicable)
- 9.2 Cross sectional drawing of the equipment showing the details of assembly of components and their material of construction and/ make with standard applicable codes.
- 9.3 Performance characteristics (Discharge capacity vs head, BHP and efficiency of the pumps.
- 9.4 Motor speed torque curve superimposed on pump speed torque curve. Required NPSH of pump.
- 9.5 Experience list about the supply and successful operation of similar pumps for similar application.
- 9.6 A comprehensive write up or brochure on the details of manufacturing and testing facilities in the shop of the manufacturer.
- 9.7 Quality plan for the equipment being offered, in BHEL format as practiced in the manufacturer's works and Field Quality Plan for receipt, storage erection, commissioning & testing at site.
- 9.8 Data sheet-B with all the particulars filled in.
- 10. MANUFACTURERS NAME AND TAG. PLATES**
- 10.1 Each pump shall have a permanently attached brass/ Stainless steel tag on the body indicating the following information both in Hindi and English:
- Manufacturer's name and trade mark.
  - Design Capacity and Head.
  - Design.
  - Purchaser's tag no. as furnished during the contract. The purchaser's tag no. will be indicated by the Purchaser on the drawing submitted for approval by the vendor.



**TECHNICAL SPECIFICATION**  
**CENTRIFUGAL PUMPS**

**SPECIFICATION NO.PES-553-04**

**VOLUME II B**

**SECTION D**

**REV. 02**

**DATE: 17.09.2012**

**SHEET 10 OF 10**

**11. DRAWINGS/DOCUMENT/DATA REQUIRED AFTER AWARD OF CONTRACT**

- 11.1 Certified GA drawings of pump motor assembly weights, crane.
- 11.2 Detailed cross sectional drawings of the pump and motor assembly and all equipment & accessories supplied under the this specification along with details of material of construction with applicable standard codes.
- 11.3 Foundation drawings with details of foundation pocket indicating static as well as dynamic load and other data with dimensions.
- 11.4 Certified characteristics curves (discharge capacity vs. head, BHP and efficiency) of each type of pump and motor.
- 11.5 Material and other test certificates as required by the application clauses of this specification.
- 11.6 Motor speed torque curves super imposed on pump speed torque curves.
- 11.7 Quality plan along with complete details of testing and inspection requirements of centrifugal pumps in BHEL format. Vendor shall also furnish Field Quality Plan.
- 11.8 Installation , operation and maintenance manual.
- 11.9 Other drawings and data, if necessary.





**CENTRIFUGAL PUMPS**  
**DATA SHEET - A**

VOLUME II-B

SECTION D

REV 00

DATE 17.09.2012

SHEET 2 OF 2

- i) Stuffing box Packing. : Flexible Graphite or PTFE (Asbestos shall not be used)
- j) Pump motor coupling. : Flexible.

**15. ACCESSORIES REQUIRED:-**

The following accessories shall be provided by the bidder for each pump:

- a) Suction & Discharge pressure gauges. : Yes.
- b) Vent connection : Yes.
- c) Drain piping up to common drain point in plant room. : Yes
- d) Companion flanges. : Yes
- e) Common base plate. : Yes.
- f) Suction strainer. : Yes
- g) Isolating valve : Yes
- h) NRV at pump outlet at inlet/outlet : Yes
- i) Any special requirements : The Chilled Water pumps shall be suitably insulated as per spec.
- j) Inspection & Testing : As per specification enclosed elsewhere.



**TECHNICAL SPECIFICATION  
FOR  
PACKAGE CONDITIONING UNIT**

**SPECIFICATION NO.PES-553-05**

**VOLUME II B**

**SECTION D**

**REV. 02**

**DATE:17.09.2012**

**SHEET 1 OF 6**

**STANDARD TECHNICAL SPECIFICATION  
FOR  
PACKAGE CONDITIONING UNIT**



**TECHNICAL SPECIFICATION  
FOR  
PACKAGE CONDITIONING UNIT**

**SPECIFICATION NO.PES-553-05**

**VOLUME II B**

**SECTION D**

**REV. 02**

**DATE:17.09.2012**

**SHEET 2 OF 6**

**1** **GENERAL**

1.1 This specification covers the design, manufacture, inspection and testing at the manufacturer's works and suitable packing delivery and testing of the packaged air conditioning unit.

**2** **CODES AND STANDARDS**

2.1 The design, manufacture, inspection, testing and performance of the packaged type air conditioning unit shall comply with all statutes, regulations and safety codes currently applicable in the locality where the equipment will be installed. The equipment shall also conform to the latest editions of the codes and standards specified herein under. Nothing in this specification shall be construed to relieve the vendor of this responsibility.

In particular, the packaged air conditioning Unit (max 7.5 TR capacity, ductable or non ductable type) or cassette type (up to 5 TR) shall conform to the latest editions of the following standards:

- 2.1.1 I.S.660 : Safety code for Mechanical Refrigeration.
- 2.1.2 I.S.5111 : Code of practice for measurement, and testing of refrigerant compressor.
- 2.1.3 I.S.659 : Safety code for air conditioning.
- 2.1.4 I.S.2494 : V Belt for industrial purpose.
- 2.1.5 I.S.3142 : V grooved pulleys for V Belts.
- 2.1.6 I.S.4503 : Shell and tube type heat exchanger.
- 2.1.7 ARI 210 : Standard for/unitary air conditioning equipment
- 2.1.8 ARI 270 : Standard for application installation and servicing of unitary equipment.
- 2.1.9 ASHRAE-37 : Standard methods of testing for rating unitary air conditioning and heat pump / equipment.
- 2.1.10 ANSI-B9-1 : Safety code for mechanical refrigeration.

**3** **DESIGN AND CONSTRUCTIONAL REQUIREMENTS**

3.1 Compressor

The compressor shall be hermetic or semi-hermetic or screw rotary type or scroll type. The same shall be suitable for R410A/R407C/R134A refrigerant. The compressor shall be mounted on anti-vibration spring/rubber pads and shall be positioned in such a way that it is freely accessible with sufficient space all around for easy maintenance. Safety controls like High and Low pressure cut-out overload and single phasing protection for the motors shall be provided. A crankcase heater shall also be provided, if considered necessary by the vendor.

3.2 **CONDENSING UNIT**

Shell and tube type water cooled condenser or air cooled condenser with adequate area shall be provided as specified in Data Sheet-A. The condensing unit shall be complete with



**TECHNICAL SPECIFICATION  
FOR  
PACKAGE CONDITIONING UNIT**

**SPECIFICATION NO.PES-553-05**

**VOLUME II B**

**SECTION D**

**REV. 02**

**DATE:17.09.2012**

**SHEET 3 OF 6**

multipass heads and shall be fitted with the following:

- 3.2.1 Hot gas inlet and liquid outlet connection with shut off valve for liquid.
- 3.2.2 Drain plug, air vent and test valve.
- 3.2.3 Water inlet and outlet connection with thermowell and suitable cocks respectively.
- 3.2.4 Relief valve and air purge valve (Fusible plug in place of relief valve not acceptable)
- 3.2.5 Any other accessory as recommended by the manufacturer for proper functioning of the equipment.

**3.3 AIR HANDLING FAN**

The air handling fan shall be of the centrifugal type and with forward curved blades. This shall be driven by means of a three phase induction motor through V belt drive. The fan static pressure shall be selected for passing air through high efficiency absolute filters, if specified in Data Sheet-A.

**3.4 FILTERS**

Filters shall be of dry panel type and shall be cleanable. The velocity of air across the filters shall not exceed 1.75m/sec (350FPM).

**3.5 COOLING COIL**

The cooling coil shall be of direct expansion type and shall be made of heavy gauge copper with aluminium fins. The fins shall be bonded to the copper tubes under hydraulic pressure. A distributor shall be provided for feeding the refrigerant to different sections of the coil. Rows shall be staggered in the directions of airflow. The velocity of air across coil shall not exceed 2.5M/Sec. (500 FPM).

**3.6 CONTROLS**

All necessary controls and accessories like thermostatic expansion valve, refrigerant solenoid valve, distributor, filter drier in the liquid lines, shut off valves, HP/LP cut out for compressor, thermostat with adjustable settings, overload and single phasing preventer for motor etc. are to be provided. The microprocessor based control panel shall be provided outside the packaged unit on one side. The control panel shall generally be in line with the specification for control panels given elsewhere.

The control shall be so interlocked that the fan shall be started independently first, and then only the compressor. Tripping of the compressor by the thermostat or compressor cut outs shall not trip the fan. The thermostat setting shall be adjustable

**3.7 REFRIGERANT PIPING**

The refrigerant piping shall be either heavy gauge copper as furnished in Data Sheet-A. The piping shall be completely factory assembled, pressure tested, dehydrated and initially charged with FREON gas and compressor oil. The line accessories shall include liquid line shutoff valve dehydrator, strainer, flow indicator and distributor etc.

**3.8 CABINET**

All the equipments, except control panel, mentioned above shall be provided within a heavy gauge sheet metal cabinet, of floor/ wall mounted type. This shall be given two coats of anti-corrosive and rust proof paint, finished with two coats of final paint . Painting shall be as per manufacturers std unless specified otherwise in data sheet 'A'. The interior of the cabinet shall be provided with thermal and acoustic insulation of minimum 25mm thick. The insulating material shall be fire proof.



**TECHNICAL SPECIFICATION  
FOR  
PACKAGE CONDITIONING UNIT**

**SPECIFICATION NO.PES-553-05**

**VOLUME II B**

**SECTION D**

**REV. 02**

**DATE:17.09.2012**

**SHEET 4 OF 6**

The front and back side of the cabinets shall be easily removable providing maintenance to all the interior parts.

All the electric wires within the cabinet shall run in flexible conduits and carry identification tags. The bottom side of the panel shall be specially ribbed to take care of the transportation.

**3.9 OTHER ACCESSORIES**

Each packaged air conditioner shall be provided with required number of neoprene rubber isolating pads.

**4 CONTROL AND INTERLOCK REQUIREMENTS**

The compressor shall have all protective devices like HP/LP cutouts, overload protection for the motor, single phasing preventor for motor etc.

The interlocking requirement shall be as indicated below:

4.1 The compressor shall not start, unless condenser water flow is achieved for water cooled condenser. The condenser flow shall be sensed by means of a flow switch.

4.2 The compressor shall not start unless the evaporator fan is started.

4.3 The tripping of compressor on HP/LP, overload or on thermostat shall not trip the fan.

4.4 Strip heater (if provided in the ducting system) shall not be switched on, unless the evaporator fan is started and airflow is established. For this purpose, an air stat on flow switch shall be used. The heater shall be separately controlled by humidistat/thermostat

4.5 A humidifying package, if specified in data sheet A, shall be controlled by humidistat.

**5 TEST AND INSPECTION**

5.1 Inspection and Testing at Manufacturer's Works

5.1.1 static and dynamic test for fans

5.1.2 Hydrostatic static test on condenser and cooling coil.

5.1.3 vacuum/pressure test for the complete refrigeration circuit.

5.1.4 Visual and Free running test of the packaged unit on test bed.

5.1.5 Free running test on compressor.

5.1.6 AIR CAPACITY WITH ANEMOMETER.

5.1.7 NOISE LEVEL-  $\leq 85$  dB(A).

5.1.8 Other tests as per approved qualities plan/scope of inspection.

5.2 Inspection and Testing at Site

5.2.1 Performance testing of the packaged unit for 72 hours in summer / monsoon & 24-hours in winter- Up-to 3 TR (individual M/c capacity) inside room temperature (Dry & wet bulb) will be checked with all machines in the room operating.

The actual days of testing shall be mutually agreed. During the above testing, the following readings shall be taken to compare the same with guaranteed performance data.

5.2.1.1 Condenser inlet and outlet pressure and temperature

5.2.1.2 Entering and leaving air temperature of the cooling coil air filters.



**TECHNICAL SPECIFICATION  
FOR  
PACKAGE CONDITIONING UNIT**

**SPECIFICATION NO.PES-553-05**

**VOLUME II B**

**SECTION D**

**REV. 02**

**DATE:17.09.2012**

**SHEET 5 OF 6**

- 5.2.1.3 Motor current for the compressor and blower.
- 5.2.1.4 Air quantity delivered by the fan. This shall be computed by adding air quantity leaving all the grilles entering the air filters.  
Room temperature (Dry & wet bulb)
- 5.2.1.5 Test to ensure all controls and safety instruments are working properly.  
During the above testing, noise level also will be checked to ensure that the same are within acceptable limits. Any undue vibration detected physically will be corrected.  
All tools and instruments required for the above testing will be provided by the vendor.

**6**

**PAINTING:**

The packaged unit shall be given two coats of primer paint finished with two coats of finish paint as per Manufacturers std. unless specified otherwise elsewhere/ Data sheet 'A'. The colour of finish paint will be as specified in Data Sheet-A.

**7**

**GUARANTEES**

The package unit shall be guaranteed for performance measured in terms of the inside temperature maintained.

The packaged unit shall also be free from any manufacturing defects and shall be guaranteed as per contract after the first test as per 5.0 is successfully carried out, and the plant taken over by the purchaser.

**8**

**NAME PLATES**

Suitable Name plate as per Data Sheet 'A', depicting the equipment number as designated in Data Sheet A shall be provided for each packaged unit and screwed to a prominent position on the packaged unit.



**TECHNICAL SPECIFICATION  
FOR  
PACKAGE CONDITIONING UNIT**

**SPECIFICATION NO.PES-553-05**

**VOLUME II B**

**SECTION D**

**REV. 02**

**DATE:17.09.2012**

**SHEET 6 OF 6**

**9. DATA TO BE FURNISHED AFTER AWARD OF CONTRACT**

- 9.1 Final technical data as per Data Sheet-B
- 9.2 G.A. and interior view of packaged unit
- 9.3 Electrical wiring diagram
- 9.4 Catalogues for all controls
- 9.5 O & M Manual
- 9.6 Erection Manual



**PACKAGE-CONDITIONING UNIT**  
**DATA SHEET - A**

VOLUME II-B

SECTION D

REV 00

DATE 17.09.2012

SHEET 1 OF 1

**DESCRIPTION**

**DATA**

- |  |   |
|--|---|
| 1) Capacity of the unit at operating conditions.                                 | : As specified  |
| 2) Numbers required  | : Refer to Section-C of Specific Technical Requirements                 |
| 3) Designation of the unit   | : Package AC Unit   |
| 4) Whether air cooled/water cooled   | : Refer to Section-C of Specific Technical Requirements                 |
| 5) The plant shall be suitable for maximum-ambient temp.                         | : Refer outdoor design condition as specified.                          |
| 6) Whether a plenum Chamber required   | : Units shall be connected to fresh air ducts.                          |
| OR   |   |
| Whether to be connected duct system.   | : Yes.  |
| 7) Whether Humidifier required for humidity-control.                             | : Refer to Section-C of Specific Technical Requirements                 |
| 8) Whether strip heaters required for winter heating.                            | : Refer to Section-C of Specific Technical Requirements                 |
| 9) Whether strip heater required for Humidity control.                           | : Refer to Section-C of Specific Technical Requirements                 |
| 10) Final painting colour shade  | : Subject to approval / during detail engineering stage.                |
| 11) Whether fan static pressure is to be designed for filters arrangement shown. | : Yes.  |
| 12) Installation supporting structure/drain piping, insulation.                  | : Required. Drain piping with insulation up to the nearest drain point. |
| 13) Controls & Instruments   | : Yes (Lot)   |
| 14) Isolation Switch   | : Yes   |



**STANDARD TECHNICAL SPECIFICATION  
FOR  
AIR FILTER**

**SPECIFICATION NO.PES-553-06**

**VOLUME II B**

**SECTION D**

**REV. 02**

**DATE: 17.09.2012**

**SHEET 1 OF 4**

**STANDARD TECHNICAL SPECIFICATION  
FOR  
AIR FILTER**



**STANDARD TECHNICAL SPECIFICATION  
FOR  
AIR FILTER**

**SPECIFICATION NO.PES-553-06**

**VOLUME II B**

**SECTION D**

**REV. 02**

**DATE: 17.09.2012**

**SHEET 2 OF 4**

**1. GENERAL**

This specification covers the design, manufacture, inspection and testing at manufacturer's work or his sub-contractor's works of Air filters to be used for air-conditioning and ventilation system.

**2. CODES AND STANDARDS**

This design, manufacture and performance of AIR FILTERS shall comply with all currently applicable statutes, regulation and safety codes in the locality where the equipment will be installed. The equipment shall also conform to latest applicable Indian/British/USA standards. Nothing in this specification shall be construed to relieve the vendor of this responsibility. The following standards, in particular, shall be applicable for certified ratings of filters and for conducting performance test, if required.

a) BS EN - 779 -Methods of test for air filters used in air conditioning and general ventilation.

**3. GENERAL**

The enclosed Data sheet A gives the type and other particulars of filters required.

**3.1 POLY FIBRE AIR FILTERS**

Filtering media shall consist of a suitable fibrous material (e.g. polyethylene extruded sections coir etc.) packed into a 20 gauges GSS framework, complete with handles etc. The filter element shall be supported by galvanised steel wire mesh of 10mm. sq. on either side, Velocity across the filters shall not exceed 2.5 M/sec. Average efficiency  $E_m$  (%) shall be  $\geq 80$  as per BS EN - 779.

**3.2 DRY FABRIC AIR FILTERS**

Filter element shall be pressed felt filter fabric or suitable material recommended by the manufacturer, stitched on to galvanised wire gauge support and crimped to form deep folds. Suitable aluminium spacers shall be provided to ensure uniform distribution of air flow through filters. Filter casing shall be provided with neoprene sponge rubber sealing, The filter shall have Average efficiency  $E_m$  (%) of  $\geq 95$  as per BS EN - 779.

**3.3 PANEL TYPE METALLIC FILTERS (DRY/VISCOUS)**

Filter shall consist of V-fold galvanised wire mesh interspaced with flat layers of galvanised wire mesh. The density of media shall increase in the direction of air flow. Edges of wire mesh shall be suitably hemmed to prevent abrasion during handling. The media shall be supported on either side by galvanised expanded metal casing. The framework shall be at least 18 gauge GSS. Filter shall be either dry or wetted type as per data sheet=A. The oil shall be mineral oil of approved quality and make. As a the filter frame made of Aluminium alloy conforming to IS:737 can be considered unless use of aluminium is prohibited otherwise due to site conditions being saline/corrosive.

All filters shall be capable of being cleaned of their accumulated dust by tap water flushing. The dry metallic filter shall have Average arrestance  $A_m$  (%) shall be  $\geq 90$ .



**STANDARD TECHNICAL SPECIFICATION  
FOR  
AIR FILTER**

**SPECIFICATION NO.PES-553-06**

**VOLUME II B**

**SECTION D**

**REV. 02**

**DATE: 17.09.2012**

**SHEET 3 OF 4**

However oil wetted air filters shall have Average Efficiency Em (%)  $\geq$  90 as per BS EN - 779..

**3.4 AUTOMATIC CLEANING FILTERS**

This shall consist of a filter mat and drop eliminator, driven by a suitably rated geared motor unit being supported on a steel framework. The filter mat shall consist of an endless steel wire mat insets of steel mesh held between an upper & a lower shall drop eliminator shall consist of an endless steel wire without insets of steel mesh. The unit shall include a suitable oil pump, gludge raking mechanism and sludge container and tensioning device. Pressure drop shall be limited to 0.5 / mm WG when clean & 10 mm when dirty. Air velocity across filter shall not exceed 3 M/sec.

**3.5 ABSOLUTE FILTERS**

Filters shall be constructed by pleating a continuous sheet of filter medium into closely spaced pleats separated by heavy corrugated aluminium spacers. They shall be individually tested and certified to have an efficiency of not less than 99.97% when tested with 0.3 micron dioctylphalate smoke as per IS:2831. The clean filter initial static pressure drop shall not be greater than 25mm WC at rated capacity. A neoprene sponge rubber sealing shall be provided on either face of filter frame.

**3.6 WATER REPELLANT NYLON FILTERS**

This shall be constructed of water repellent nylon fabric with continuous water spraying on it from a header for keeping it clean. Efficiency of this filter shall be 85% down to 10 microns. This filter shall be used for unitary air filtration system only.

**4. INSPECTION & TESTING**

The scope of inspection for air filters shall be as below:

4.1 Dimensional inspection of frame & filter media.

4.2 Witnessing of type tests on one per type per size air filters for the following properties.

- a) Gravimetric efficiency.
- b) Pressure drop in clean & dirty (choked - %age to be specified ) condition.
- c) Efficiency as per BS EN - 779.

4.3 Verification of type test certificates for similar type & size of filters for sodium flame test as per BS-3928 (if applicable- refer data sheet).



**STANDARD TECHNICAL SPECIFICATION  
FOR  
AIR FILTER**

**SPECIFICATION NO.PES-553-06**

**VOLUME II B**

**SECTION D**

**REV. 02**

**DATE: 17.09.2012**

**SHEET 4 OF 4**

**5. DATA TO BE FURNISHED BY VENDOR AFTER AWARD OF CONTRACT**

- 5.1 GA Drawing.
- 5.2 Drawing showing material/construction detail
- 5.3 Installation and\service manual
- 5.4 Rating curves/charts
- 5.5 Test certificates
- 5.6 Elect. diagrams (when automatic cleaning type)



**AIR FILTER  
DATA SHEET - A**

VOLUME II-B

SECTION D

REV 00

DATE 17.09.2012

SHEET 1 OF 1

**DESCRIPTION**

**DATA**

**1) General**

- |                              |  |
|------------------------------|--|
| 1.1 Service                  | : Air Conditioning.  |
| 1.2 Location                 | : Central Air conditioning plant, & package AC plant, fresh air fan system. Also for split AC.   |
| 1.3 Nos.                     | : Refer Section 'C' of Specification.  |
| 1.4 Total air flow/type      | : Refer Section 'C' of Specification.  |
| 1.5 Temperature              | : As per project information.  |
| 1.6 Relative Humidity        | : 100%   |
| 1.7 Gas Composition          | : Atmospheric Air (Dusty) as prevalent in power Station.   |
| 1.8 Filter Media             | : Synthetic non-woven  |
| 1.9 Efficiency               | : Average arrestance efficiency of 65-80 % for Dry Panel filter (pre-filters) and average arrestance Efficiency of 80-90 % for fine filters. |
| 1.10 Allowable pressure drop | : 2.5 mm & 6.5 mm in clean and dirty condition respectively for dry panel filters(prefilters).<br>12 mm in clean condition for fine filters. |
| 1.11 Frame Work              | : 18 G, GSS.   |
| 1.12 Mounting                | : Ladder Type M.S Angles (galvanised)  |
| 1.13 Size                    | : 600 x 600 mm   |

Note:-

- 1) Face velocity of air across the filters shall not exceed 2.5 m/sec.



**TECHNICAL SPECIFICATION**  
**THERMAL INSULATION FOR COLD SURFACES**

**SPECIFICATION NO.PES-553-08**

**VOLUME II B**

**SECTION D**

**REV. 02**

**DATE: 17.09.2012**

**SHEET 1 OF 6**

**STANDARD TECHNICAL SPECIFICATION  
FOR  
THERMAL INSULATION FOR COLD SURFACES**



**TECHNICAL SPECIFICATION**  
**THERMAL INSULATION FOR COLD SURFACES**

**SPECIFICATION NO.PES-553-08**

**VOLUME II B**

**SECTION D**

**REV. 02**

**DATE: 17.09.2012**

**SHEET 2 OF 6**

**1. SCOPE**

This specification covers design, manufacture, testing at manufacturers works, supply, application & finishing of insulation for cold piping, air conditioning ducting & equipment for low temperature service.

**2. CODES & STANDARDS**

The design, manufacture and performance of materials covered under this specification shall comply with all currently applicable statues, regulations & safety codes in the locality where the equipment/material are to be installed. The material shall also conform to the latest applicable Indian/British/American codes & standards. Nothing in this specification shall be construed to relieve the vendor of his responsibility. In particular, the material shall conform to the latest editions of the following standards :-

**IS:3069: GLOSSARY OF TERMS & SYMBOLS & UNITS RELATING TO THERMAL INSULATION**

materials.

- 2.1 IS:4671 : Expanded polystyrene for thermal insulation purposes.
- 2.2 IS:3677 : Mineral wool for thermal insulation.
- 2.3 IS:8183 : Resin bonded mineral wool.

**3. DESIGN REQUIREMENTS**

- 3.1 The insulating material as well as protective covering shall be new & unused, non-corrosive, vermin/rodent proof and shall be guaranteed to withstand continuously & without deterioration the maximum/minimum temperatures to which they may be subjected to, under specified site conditions.
- 3.2 The insulation material must be light weight, strong, free from shots & coarse fibre & shall provide high insulation efficiency at low weight & coat. It should be non-hygroscopic & should not rot. It shall not settle or shake down even when subjected to prolonged vibrations.
- 3.3 The insulation material, density and thickness etc. Shall be as specified in DATA SHEET A.

**4. APPLICATION DETAILS**

- 4.1 The surface to be insulated shall be thoroughly cleaned and allowed to dry. Pressure/hydrostatic tests, if any, shall be carried out before application of insulation.
- 4.2 A layer of solvent free, anticorrosive paint shall be applied & allowed to dry.
- 4.3 Hot industrial bitumen of grade 85/40 or 85/25 conforming to latest IS:702 shall be uniformly applied @ 1.5 kg/sq.m on the surface to be insulated. A similar layer shall also be applied on the inside surface & edges of the insulation. A suitable cold adhesive compound may also be used in place of bitumen.
- 4.4 Insulation in the form of pipe sections/rolls slabs of specified density & thickness shall be stuck to the coated surface with joints staggered & well butted & secured. The adjoining sections shall be tightly pressed together. All the joints shall be sealed with





**TECHNICAL SPECIFICATION**  
**THERMAL INSULATION FOR COLD SURFACES**

**SPECIFICATION NO.PES-553-08**

**VOLUME II B**

**SECTION D**

**REV. 02**

**DATE: 17.09.2012**

**SHEET 4 OF 6**

5.4.4

3 mm (1/8") thick coat of water proofing compound shall be applied & wrapped with fibre glass RP tissue. A final coat of 3mm thick water RP proofing compound shall then be applied over the fiberglass RP tissue & allowed to dry. Alternatively, in place of water proofing as desired above, tar felt type 3 grade 1 of IS 1322 with joints overlapped by 75mm shall be fixed & sealed with bitumen & over this 24 SWG. 25mm hexagonal GI mesh shall be fixed with 22 swig. GI lacing wire & finally bitumen paint shall be applied over wire netting.



**TECHNICAL SPECIFICATION**  
**THERMAL INSULATION FOR COLD SURFACES**

**SPECIFICATION NO.PES-553-08**

**VOLUME II B**

**SECTION D**

**REV. 02**

**DATE: 17.09.2012**

**SHEET 5 OF 6**

**6. INSULATION OF PUMPS & VALVES**

6.1 For all inspection covers & hatches on equipment, pump casing & valve bodies, flanges etc. the insulation shall be applied such as to facilitate removal with minimum damage to the insulation. This shall be achieved by encasing the insulation in 22 gauge aluminum sheet metal boxes, which shall be bolted together around the equipment to permit easy removal & replacement. Proper care shall be taken to maintain continuity of vapor seal between the static & removable partitions of the insulation.

6.2 The tenderer may offer thickness of insulation & finishes other than that specified in DATA SHEET A. However, calculations/reasons in support of alternative proposal shall be furnished for purchaser's approval.

**7. INSPECTION & TESTING (REFER SPEC. NO - PES-553.00)**

7.1 All necessary tests, as required to ensure that the material supplied conform to the requirements of applicable codes & standards, shall be carried out at manufacturer's works & test certificates including these for material/accessories shall be furnished for purchaser's approval.

**8. PAINTING**

8.1 Pipe work having insulation & cladding shall be provided with color identification for the fluids handled and for indicating direction of flow.

8.2 Equipment surfaces having insulation and cladding shall also have identification numbers and any other relevant data provided on the insulated surface.

8.3 All painting for insulated surfaces shall conform to the requirement specified elsewhere.



**TECHNICAL SPECIFICATION**  
**THERMAL INSULATION FOR COLD SURFACES**

**SPECIFICATION NO.PES-553-08**

**VOLUME II B**

**SECTION D**

**REV. 02**

**DATE: 17.09.2012**

**SHEET 6 OF 6**

**9. DATA TO BE FURNISHED AFTER AWARD OF CONTRACT**

- 9.1 Final version of data sheet 'B' incorporating changes if any along with design data.
- 9.2 Test certificates/reports giving result of insulation to ensure conformance to applicable codes & standards & in particular the following:-
- a) Thermal conductivity test.
  - b) Sound absorption coefficient test.
  - c) Corrosion test.
  - d) Sulphur content, moisture content, shot content, moisture absorption etc.
  - e) Compressive strength & cross breaking strength test.
- 9.3 Sketches/technical literature/sectional drgs. indicating insulation materials finish and method of application etc.
- 9.4 Manual dealing with safety aspects & instructions for combating fire arising out of insulation work.
- 9.5 Instructions on maintenance of insulation work.



**THERMAL INSULATION**  
**FOR COLD SURFACE**  
**DATA SHEET - A**

VOLUME II-B

SECTION D

REV 00

DATE 17.09.2012

SHEET 1 OF 1

**Insulation Material**

Insulation	Code	Thermal Conductivity MW/cm <sup>0</sup> C	Density Kg/m <sup>3</sup>
Resin bonded mineral wool / glass wool	IS:8183	0.49 at 50 <sup>0</sup> C	At least 24 for duct insulation and 48 for acoustic lining.
Mineral Wool Pipe Section (min. Gr.2)	IS:9842	0.43 at 50 <sup>0</sup> C	At least 81
Expanded Polystyrene	IS:4671	0.37 at 10 <sup>0</sup> C	At least 15

**Type of Insulation**

S.No.	Surface	Insulation Material	Insulation Form	Thickness (mm)
i)	Supply & Return air duct for air-conditioning system	Resin bonded roll Mineral Wool (IS:8183)		25
ii)	Refrigerant Piping	a) Expanded Polystyrene or b) Mineral Wool	Pipe Section Pipe Section	75 75
iii)	AHU drain pipe	a) Expanded Polystyrene or b) Mineral Wool	Pipe Section Pipe Section	25 25
iv)	AHU drain pan coil section and fan section	a) Expanded Polystyrene or b) Mineral Wool	Slabs Slabs	25 25
v)	Chilled water piping, valves & specialties	a) Expanded Polystyrene or b) Mineral Wool	Pipe Section Pipe Section	75 75
vi)	Chiller	a) Expanded Polystyrene or b) Mineral Wool	Slabs Slabs	100 100
vii)	Chilled Water Pumps	a) Expanded Polystyrene or b) Mineral Wool	Slabs Slabs	50 50
viii)	Expansion tank with pipe	a) Expanded Polystyrene or b) Mineral Wool	Slabs/Pipe Section Slabs/Pipe Section	50 50



1x370MW YELAHANKA CCPP  
AIR CONDITIONING SYSTEM

LIST OF MAKES OF SUB-VENDOR ITEMS

SPECIFICATION NO. PE-TS-409-553-A001

VOLUME : II B

SECTION : E

REV 00

DATE: MARCH 2016

SHEET 1 OF 4

## ANNEXURE-I

### LIST OF MAKES OF SUB-VENDOR ITEMS



**1x370MW YELAHANKA CCPP  
AIR CONDITIONING SYSTEM**

**SPECIFICATION NO. PE-TS-409-553-A001**

**VOLUME : II B**

**SECTION : E**

**REV 00**

**DATE: MARCH 2016**

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

**SHEET 2 OF 4**

SI. NO.	ITEM / EQUIPMENT	SUB SUPPLIER
1	SCREW CHILLER	YORK / TRANE / CARRIER / KIRLOSKAR / DUNHAM BUSH / MCQUAY (DAIKIN) / BLUE STAR / VOLTAS
2	VAPOUR ABSORBTION MACHINE	VOLTAS / THERMAX
3	PRECISION PACKAGE UNITS	STULZ / UNIFLAIR / EMERSON / BLUEBOX / CLIMADENTA
4	PACKAGE UNIT	VOLTAS / BLUE STAR / CARRIER
5	SPLIT AIR CONDITIONER	VOLTAS / BLUE STAR / CARRIER / HITACHI / LG
6	AIR HANDLING UNITS	VOLTAS / BLUE STAR / ZECO / CARRYAIRE(FLAKT) / EDGETECH / ETHOS / SYSTEM AIR / WAVES AIRCON
7	AHU FAN (CENTRIFUGAL FAN)	CB.DOCTOR / FLAKT / KRUGER / NICOTRA / COMEFRI / MARATHON / PATEL AIR
8	CHILLED & CONDENSER WATER PUMP	BEST & CROMPTON / JYOTI / SAM TURBO / KBL / KSB / M&P / VOLTAS / BEACON-WEIR / WORTHINGTON / FLOWMORE / SULZER / BHARAT PUMPS & COMPRESSORS LTD / FLOWSERVE INDIA CONTROL PVT LTD / V-FLOW PUMPS & SYSTEMS CO
9	COOLING TOWER	PAHARPUR / MIHIR / PCT / FLOWTECH / BELL
10	INDUCTION MOTORS (LT)	SIEMENS / ABB / CGL / MARATHON / KEC / BHARAT BIJLEE / NGEF / JYOTI / LHP
11	AIR FILTER	PUROLATOR / FMI / ANFILCO / TENACITY / JOHN FOWLER / SPECTRUM / AIR TECH / PUROMATIC
12	AXIAL FANS / F.A. FANS	FLAKT / KHAITAN / PATEL / NICOTRA / SARLA / KRUGER / MARATHON / C DOCTOR
13	INSULTATION MATERIAL	BEARDSHELL / K-FLEX / PARAMONT/ ARMAFLEX / SUPREME / LLOYDS / UP TWIGA
14	BALANCING VALVE	ADVANCE
15	BUTTERFLY VALVE	AUDCO / FOURESS / INTER VALVE / BDK / WEIR BDK / TYCO / CRANE PROCESS / KEYSTONE
16	NON RETURN VALVE	LEADER / H.SARKAR / FLUID LINE / HI -TECH / CRESENT / A V VALVES / BANKIM & COMPANY / SHIVADURGA
17	GATE/GLOBE VALVES	CRESENT / BDK / AUDCO / FOURESS / KIRLOSKAR / SANT / BOMBAY METAL & ALLOYS / BANKIM / LEADER / H SARKAR / AV VALVES / VENUS PUMPS AND ENGG
18	3 WAY MIXING VALVE WITH ACTUATING MOTOR	SIEMENS BUILDING TECHNOLOGY / JOHNSON / BELIMO / HONEYWELL / RAPID CONTROL / ALC
19	MOTORIZED BUTTERFLY VALVE	ANERGY / ADVANCE / BELIMO / JOHNSON / HONEYWELL / SIEMENS



**1x370MW YELAHANKA CCPP  
AIR CONDITIONING SYSTEM**

**SPECIFICATION NO. PE-TS-409-553-A001**

**VOLUME : II B**

**SECTION : E**

**REV 00**

**DATE: MARCH 2016**

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

**SHEET 3 OF 4**

20	Y / POT STRAINER	MULTITEX / GREAVES COTTON / JAYPEE / SANT / OTOKLIN / GRAND PRIX / GUJARAT OTOLIFT / DS ENGG / SAROJINI ENTERPRISE / BHATIA ENGINEERING / FILTERATION ENGINEERS INDIA PVT LTD / SUNGOV ENGINEERING
21	PIPING - ERW	SURYA ROSHNI / TISCO / DADU PIPES / INDUS TUBE / WELSPUN / TATA / BST / JINDAL / SAIL
22	PIPING - CS SEAMLESS (ASTM A 106)	ISMT / MAHARASHTRA SEAMLESS
23	GI SHEETS FOR DUCTING	TISCO / INDIAN IRON & STEEL CO LTD. / RASHITRYA ISPAT NIGAM LTD. / ESSAR/ ISPAT INDUSTRIES / JSW STEEL / LLOYDS STEEL / BHUSHAN / TATA / SAIL / JINDAL
24	FIRE DAMPER	TSC / CARRYAIRE / RAVISTAR (SYSTEM AIR )
25	GRILL/DIFFUSER/VOLUME CONTROL DAMPER	AIR FLOW/ TSC /AIR MASTER/ CARYAIRE/RAVI STAR (SYSTEM AIR)
26	STRIP HEATER	ESCORTS / RACOLD / DASPASS/ ALCO/ HEATCO / HOTSET
27	PAN HUMIDIFIER	RAPID COOL/ HOTSET /ALCO
28	RELIEF / PURGE VALVE	BRASSOMATIC
29	THERMOSTATS	HONEYWELL / RANCO / PENN / DANFOSS / INDFOSS / JHONSON CONTROL /RANUTROL
30	HUMID STAT	JHONSON CONTROL / HONEYWELL / PENN
31	ANTI FREEZE THERMOSTAT	RANCO / HONEYWELL / PENN / DANFOSS / INDFOSS
32	PRESSURE GAUGE	GENERAL INST CONSORTIUM / BELL / H.GURU INST / WAAREE INSTRUMENTS / H. GURU IND / FORBES MARSHALL / MANOMETER / A.N. INST / GAUGES BOURDON / GLUCK / WIKA / ASHCROFT / BAUMER TECHNOLOGIES
33	TEMPERATURE GAUGE	H. GURU IND/ H.GURU INST/ FORBES MARSHALL/DETRIVE INST & ELECTRONICS / PYRO ELECTRIC /TOSHNIWAL BROSS / WAREE INSTRUMENTS / A.N.INST / GOA INSTRUMENTS / WIKA/ ASHCROFT / H GURU (SI)
34	LEVEL GAUGE	GENERAL INSTRUMENTS / CHEMTROLS / SBEM, PUNE/ AUTOMAT MUMBAI /SIGMA / TOSHNIWAL / TECHNOMATIC / TELACO /LEVCON / D K INSTRUMENTS / PUNE TECHTROL / FLOW STAR
35	PRESSURE SWITCH / DP SWITCHES	BELLS / DANFOSS / DK INSTRUMENTS/ DRESSER / SOR INC / VASU / SWITZER / INDFOSS / TRAFAG / GIC / ASHCROFT
36	TEMPERATURE SWITCH	INDFOSS/ SEIMENS / DANFOSS/ DK INSTRUMENTS/ SOR INC / VASU / DRESSER / TOSHNIWAL / SWITZER
37	FLOW SWITCH	SWITZER / LEVCON / DK INSTRUMENT / SBEM / V. AUTOMATE/ SIEMENS
38	LEVEL SWITCH	SBEM / BLISS ANAND / HI TECH / RAMAN INST / SIGMA / SOR INC / WAREE INST / LEVCON / DK INSTURMENT / V ATUOMATE /CHEMTROLS / SIMENS / FLOW STAR / TRAC



**1x370MW YELAHANKA CCPP  
AIR CONDITIONING SYSTEM**

**SPECIFICATION NO. PE-TS-409-553-A001**

**VOLUME : II B**

**SECTION : E**

**REV 00**

**DATE: MARCH 2016**

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

**SHEET 4 OF 4**

39	TRANSMITTERS	TAYLOR / ABB/BRISTOL BABCOCK / BIRLA KENT TAYLOR / BLISS ANAND /SBEM/ SMART INST / V AUTOMATION & INST / FISHER-ROSEMOUNT/ SIEMENS/ TATA HONEYWELL
40	SIGHT FLOW INDICATORS	SIGMA / LEVCON /V AUTOMAT / TELLACE /EUREKA / TATA HONEYWELL/BLISS
41	FLOW ELEMENT	BRISTOL BABCOCK / BALIGA /LIGHTING EQUIP /ENGINEERING SPECIALITIES /IL / MINCO/ MICRO PRECISION / STAR MECH
42	TEMPERATURE ELEMENT	GENERAL INST CONSORTIUM/ PYRO ELECTRIC /WAAREE INSTRUMENTS/ DETRIVE INST & ELECTRONICS / TOSHNIWAL
43	FLOW METER	EUREKA / INSTRUMENTATION ENGINEERS PVT LTD / PLACKA /TRAC / FLOW STAR/ SCIENTIFIC DEVICE
44	RH SENSOR/TEMP SENSOR	HONEY WELL /JOHNSON /SIEMENS / GENERAL INSTRUMENTS
45	PLC BASED PANEL	SIEMENS / SCHENIEDER / ROCKWELL / GE INTELLIGENT / HONEYWELL AUTOMATION / ABB
46	OWS / PC	HP / COMPAQ / DELL / HCL / IBM / LENOVO
47	PRINTER	HP / CANON / EPSON / XEROX / IBM / LEXMARK
48	UPS	HITACHI-HIREL / APC / DELTA / EMERSON / DB POWER / APLAB
49	FIBRE OPTIC CABLE	BIRLA ERICSON / FINOLEX / AKSH FIBRE
50	ANNUNCIATOR FOR PANEL	ICC / PECON/ PROCON
51	LT ADAPTER BOX FOR AL TO CU CABLE CONVERTOR	CONTROL DEVICE / SYSTEM POWER CONTROL / JACKSON / UNILEC / ELECTRIC ALLIED PRODUCT
52	METERING PUMP	SHAPO TOOLS / VK PUMPS
53	WATER SOFTENING PLANT	THERMAX / ION EXCHANGE / DOSI ION
54	PRESSURE TRANSMITTER	ABB / ENDRESS + HAUSER (INDIA) / MOORE / SIEMENS / SMART INSTRUMENT BRAZIL / SBEM / TOSHNIWAL / V. AUTOMAT / EMERSON / YOKOGAWA / HONEYWELL / FUJI
55	TEMPERATURE TRANSMITTER	ABB / ENDRESS + HAUSER (INDIA) / MOORE / SIEMENS / SMART INSTRUMENT BRAZIL / SBEM / TOSHNIWAL / V. AUTOMAT / EMERSON / YOKOGAWA / HONEYWELL
56	ROTAMETER	CHEMTROLS SAMIL / EUREKA IND / IL / TRANSDUCERS AND CONTROL
57	BATTERY CHARGER	AMARARAJA/ CHHABI ELECTRICAL / DUBAS ENGG. / HBL POWER SYSTEM / STATCON / CALDYNE
58	BATTERY (NI -Cd)	HBL POWER / AMCO SAFT / SAFT
<b>NOTE</b>		
		Above sub-vendor are also subjected to Customer approval during detailed engineering.





**1x370MW YELAHANKA CCPP  
AIR CONDITIONING SYSTEM**

**MANDATORY SPARE LIST**

**SPECIFICATION NO. PE-TS-409-553-A001**

**VOLUME : II B**

**SECTION : E**

**REV 00**

**DATE: MARCH 2016**

**SHEET 2 OF 10**

S.No.	Equipment / Package name	Qty. for TWO units	Remarks(BHEL)
	<b>AIR CONDITIONING SYSTEM</b>		
<b>A</b>	<b>Mechanical spares</b>		
<b>1.</b>	<b>Vapour Compression chiller</b>		
1.1	Oil filter "O" ring	1 set	
1.2	Refrigerant filter	1 set	
1.3	Master solenoid valve	1 No	
1.4	Master solenoid valve coil	1 set	
<b>2.</b>	<b>Refrigerant condenser</b>		
2.1	Gasket	1 set	
<b>3.</b>	<b>Refrigerant chiller</b>		
3.1	Gasket	1 set	
<b>4.</b>	<b>Air Handling Unit</b>		
4.1	V-Belt for AHU blower	1 set	
4.2	AHU blower bearing	1 set	
4.3	Filters	1 sq m / AHU	
4.4	Motor for each size of AHU	1 no.	
<b>5.</b>	<b>Induced draft FRP cooling tower</b>		
5.1	Fan impeller	1 no.	
5.2	Spray Nozzles	1 set	
<b>6.</b>	<b>Horizontal centrifugal pump (for each model)</b>		
6.1	Impeller	1 no of each type	
6.2	Shaft Sleeve	1 set	
6.3	Bearings	1 set	
6.4	Motor Bearing	1 set	
<b>B</b>	<b>ELECTRICAL SPARES</b>		
<b>1.</b>	<b>Control panel</b>		
1.1	Air break switch	1 no of each rating	
1.2	Aux relays, contactors	2 nos of each type	
1.3	Clustered type LED's of different colours	20 nos	
1.4	Push buttons	6 nos	
1.5	Fuses for power & control circuit	5 sets of each type	



**1x370MW YELAHANKA CCPP  
AIR CONDITIONING SYSTEM**

**MANDATORY SPARE LIST**

**SPECIFICATION NO. PE-TS-409-553-A001**

**VOLUME : II B**

**SECTION : E**

**REV 00**

**DATE: MARCH 2016**

**SHEET 3 OF 10**

1.6	Control switches	1 of each type	
<b>C</b>	<b>C&amp;I SPARES</b>		
<b>1.</b>	For all field instruments	1 no or 10% of the quantity of each type and range, whichever is higher.	
<b>2.</b>	Measurement and control system		
2.1	Input / output module	1 no or 10% of the quantity of each type, whichever is higher.	
2.2	Each type of fuse	5 nos or 30% of each type, whichever is higher	
<b>3.</b>	CPU for man machine interface		
3.1	CPU cards, memory modules, any other PCB/modules	1 no or 10% of the quantity of each type, whichever is higher.	
3.2	Power supply module	1 no or 10% of the quantity of each type, whichever is higher.	
<b>4.</b>	Panels, local panels		
4.1	Fuses of each type and rating	25 nos	
4.2	Mcb of each type and rating	5 nos	
4.3	Terminal of each type	5 nos	



**1x370MW YELAHANKA CCPP  
AIR CONDITIONING SYSTEM**

**PAINTING & COLOUR SCHEME**

**SPECIFICATION No: PE-TS-409-553-A001**

**VOLUME : II B**

**SECTION : E**

**REV 00**

**DATE: MARCH 2016**

**SHEET 1 OF 1**

## **ANNEXURE-III**

# **PAINTING & COLOUR SCHEME**

**(REFER SECTION C2-C)**



**1x370MW YELAHANKA CCPP  
AIR CONDITIONING SYSTEM**

**LIST OF TOOLS & TACKLES**

**SPECIFICATION No: PE-TS-409-553-A001**

**VOLUME : II B**

**SECTION : E**

**REV 00**

**DATE: MARCH 2016**

**SHEET 1 OF 2**

## **ANNEXURE-IV**

### **LIST OF TOOLS & TACKLES**



**1x370MW YELAHANKA CCPP  
AIR CONDITIONING SYSTEM**

**LIST OF TOOLS & TACKLES**

**SPECIFICATION No: PE-TS-409-553-A001**

**VOLUME : II B**

**SECTION : E**

**REV 00**

**DATE: MARCH 2016**

**SHEET 2 OF 2**

SL NO	ITEM DESCRIPTION	UNIT	QTY
1	FLAT D WRENCH - 6 MM TO 32 MM (12 Pcs)	SET	1
2	BOX WRENCHES - 6 MM TO 22 MM (14 Pcs)	SET	1
3	RING SPANNER - 6 MM TO 32 MM (12 Pcs)	SET	1
4	ALLEN KEYS - 2 MM TO 10 MM	SET	1
5	CRESCENT SCREW SPANNER	NO.	1
6	SCREW DRIVER	NO.	1
7	OFFSET SCREW DRIVER	NO.	1
8	INSULATED PLIER	NO.	1
9	TORCH LIGHT FOR 2 CELL	NO.	1
10	HAMMER 1 LB	NO.	1
11	OIL CAN	NO.	1
12	POCKET THERMOMETER - 0 TO 50 DEG. C)	NO.	1
13	INSULATION TAPE ROLL	NO.	1
14	STEEL FOOT RULE - 12"	NO.	1
15	FEELER GAUGE 9 BLADES	NO.	1
16	PIPE WRENCH	NO.	1
17	FLARE NUT (1/4")	NOS.	6
18	FLARING TOOL	NO.	1
19	TUBE CUTTER	NO.	1
20	GAS CHARGING PIPE	NO.	1
21	NITROGEN CHARGING ADAPTER	NO.	1
22	FREON PRESSURE GAUGE (2 1/2" DIA DIAL) ) 0 - 300 MM PSI	NO.	1
23	FREON PRESSURE GAUGE (2 1/2" DIA DIAL) ) 30 - 150 MM PSI	NO.	1
24	PSYCHRO METER	NO.	1
25	LOCK WITH KEY FOR TOOL BOX	NO.	1
26	RATCHET 1/4"	NO.	1
27	MS TOOL BOX	NO.	1
28	DIGITAL MULTIMETER	NO.	1
29	500V MEGGER	NO.	1



**1x370MW YELAHANKA CCPP  
AIR CONDITIONING SYSTEM**

**CLARIFIED WATER ANALYSIS, DM WATER  
ANALYSIS, FUEL OIL ANALYSIS**

**SPECIFICATION No: PE-TS-409-553-A001**

**VOLUME : II B**

**SECTION : E**

**REV 00**

**DATE: MARCH 2016**

**SHEET 1 OF 2**

# **ANNEXURE-V**

## **SERVICE WATER ANALYSIS**



1x370MW YELAHANKA CCPP  
AIR CONDITIONING SYSTEM

CLARIFIED WATER ANALYSIS, DM WATER  
ANALYSIS, FUEL OIL ANALYSIS

SPECIFICATION No: PE-TS-409-553-A001

VOLUME : II B

SECTION : E

REV 00

DATE: MARCH 2016

SHEET 2 OF 2

## PARAMETERS

1. TDS : 80 PPM
2. PH : 5 - 6



**1x370MW YELAHANKA CCPP  
AIR CONDITIONING SYSTEM**

**DRAWINGS / DOCUMENTS SUBMISSION  
PROCEDURE**

**SPECIFICATION No: PE-TS-409-553-A001**

**VOLUME : II B**

**SECTION : E**

**REV 00**

**DATE: MARCH 2016**

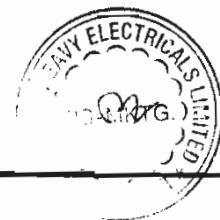
**SHEET 1 OF 1**

## **ANNEXURE-VI**

### **DRAWINGS / DOCUMENTS SUBMISSION PROCEDURE**

## DOCUMENT DISTRIBUTION SCHEDULE

Sl. No.	Description	customer			Contractor (BHEL)				
		Bangalore (Thermal Design)	(Site)	Consulting Engineer	PS- Marketing	Units/ PEM	Site	PMG	PSSR
<b>A Correspondence – soft copy (email) &amp; Hard copy as per requirement</b>									
1	Post	1	Nil	Nil	S	1*	1*	1	1*
	Contract	1	Nil	S	Nil	Nil	Nil	Nil	Nil
		1	S	Nil	Nil	1*	1	1	1
		S	1	1	Nil	1	1*	1	1*
		1*	1*	Nil	Nil	1*	1*	1	S
		1	1	Nil	1*	1*	1*	S	1*
<b>B (a) Contractor Drawings</b>									
1	Preliminary/ resubmission	PDF+1 Hard copy	Nil	PDF	Nil	S	Nil	P	Nil
2	Return preliminary with comments	PDF	Nil	S	Nil	PDF	Nil	P	Nil
3	Final approved drawings for stamping (Hard copy)	Nil	Nil	4	Nil	S	Nil	P	Nil
4	Return of stamped copies by EESI (Hard copy)	1	Nil	S	Nil	2	Nil	P	Nil
5	Distribution by contractor (Hard copy)	4	4	Nil	Nil	S	4	P	Nil
6	As-Built drawings/ Erection Drawings	1CD + 1 hard copy	1CD + 4 hard copies	Nil	Nil	S	1	P	Nil
<b>B (b) All design calculations/design memorandum/data sheet/MQP</b>									
1	Preliminary/ resubmission	1	Nil	1	Nil	S	Nil	P	Nil
2	Return preliminary with comments	1	Nil	S	Nil	1	Nil	P	Nil
3	Final approved documents for stamping (Hard copy)	Nil	Nil	4	Nil	S	Nil	P	Nil
4	Stamped copies	1	Nil	S	Nil	2	Nil	P	Nil
5	Distribution	2 CD	Nil	Nil	Nil	S	1*	P	1*



## DOCUMENT DISTRIBUTION SCHEDULE

Sl. No.	Description	customer			Contractor (BHEL)					
<b>C</b>										
<b>Progress Reports (Monthly)</b>										
1	Contractor	3	Nil	Nil	Nil	Nil	Nil	S	Nil	
2	Consultant	3	Nil	S	Nil	Nil	Nil	1	Nil	
<b>D</b>										
<b>Manuals</b>										
1	Erection & Commissioning	3	5	Nil	Nil	Nil	3	P	S	
2	Operation & maintenance	3	5	Nil	Nil	S	3	P	P	

Abbreviations:

- S: Source
- T: Transparency
- CD: Compact Disc
- 1\*: One copy case to case basis
- P: Only transmittal/covering letter
- PDF: Soft copy in pdf format





**1x370MW YELAHANKA CCPP  
AIR CONDITIONING SYSTEM**

**INSPECTION AND TESTING**

**SPECIFICATION No: PE-TS-409-553-A001**

**VOLUME : II B**

**SECTION : E**

**REV 00**

**DATE: MARCH 2016**

**SHEET 1 OF 4**

**ANNEXURE-VII**  
**INSPECTION AND TESTING**





**1x370MW YELAHANKA CCPP  
AIR CONDITIONING SYSTEM**

**INSPECTION AND TESTING**

**SPECIFICATION No: PE-TS-409-553-A001**

**VOLUME : II B**

**SECTION : E**

**REV 00**

**DATE: MARCH 2016**

**SHEET 3 OF 4**

Regulations shall be certified by a Competent Authority under the regulations in the specified format.

1.01.08 All pressure parts connected to pumping main shall be subjected to hydraulic testing at a pressure of 150% of shut-off head for a period not less than one hour. Other parts shall be tested for one and half times the maximum operating pressure, for a period not less than one hour.

1.01.09 All necessary non-destructive examinations shall be performed to meet the applicable code requirements.

1.01.10 All welding procedures adopted for performing welding work shall be qualified in accordance with the requirements of Section-IX of ASME code or IBR as applicable. All welded joints for pressure parts shall be tested by liquid penetrant examination according to the method outlined in ASME Boiler and Pressure Vessel code. Radiography, magnetic particle examination magnaflex and ultrasonic testing shall be employed wherever necessary/ recommended by the applicable code. At least 10% of all major but welding joints shall be radiographed unless otherwise stipulated.

Statutory payments in respect of IBR approvals including inspection shall be made by the bidder. Bidder's scope shall include to preparation of all necessary documents, co-ordination and follow-up for above approval. Owner shall only forward assistance/endorsement of documents /design /drawings /reports/records to be submitted for approval as stipulated/ required by Statutory Authorities till registration of the unit and clearance for commercial operation.

1.02.00 Performance Tests at Site

1.02.01 The full requirements for testing the system shall be agreed between the Owner and the Bidder prior to Award of Contract. The completely erected System shall be tested by the Bidder on site under normal operating conditions. The Bidder shall also ensure the correct performance of the System under abnormal conditions, i.e. the correct working of the various emergency and safety devices, interlocks, etc.

1.02.02 The Bidder shall provide complete details of his normal procedures for testing, for the quality of erection and for the performance of the erected plant. These tests shall include site pressure test on all erected pipe work to demonstrate the quality of the piping and the adequacy of joints made at site.

1.02.03 The Bidder shall furnish the quality procedures to be adopted for assuring quality from the receipt of material at site, during storage, erection, pre-commissioning to tests on completion and commissioning of the complete system/equipment.

1.03.00 For details of specific tests required on individual equipment refer to respective section of this specification.

All Statutory testing / clearance is in Bidder's scope including payment of all fees, etc. as required





**1x370MW YELAHANKA CCPP  
AIR CONDITIONING SYSTEM**

**MASTER DRAWING LIST WITH SCHEDULE  
OF SUBMISSION**

**SPECIFICATION No: PE-TS-409-553-A001**

**VOLUME : II B**

**SECTION : E**

**REV 00**

**DATE: MARCH 2016**

**SHEET 1 OF 4**

## **ANNEXURE-VIII**

# **MASTER DRAWING LIST WITH SCHEDULE OF SUBMISSION**



**1x370MW YELAHANKA CAPP  
AIR CONDITIONING SYSTEM**

**MASTER DRAWING LIST WITH SCHEDULE  
OF SUBMISSION**

**SPECIFICATION No: PE-TS-409-553-A001**

**VOLUME : II B**

**SECTION : E**

**REV 00**

**DATE: MARCH 2016**

**SHEET 2 OF 4**

<b>S. NO.</b>	<b>DRAWING NO</b>	<b>DRG./ DOC. TITLE</b>	<b>SCH. WEEK (FROM DATE OF LOI)</b>
1	PE-V0-409-553-A001	INSPECTION CATEGORISATION PLAN	4
2	PE-V0-409-553-A002	QAP OF SCREW CHILLER PACKAGE	14
3	PE-V0-409-553-A003	QAP OF AIR HANDLING UNIT	14
4	PE-V0-409-553-A004	QAP OF PUMPS	15
5	PE-V0-409-553-A005	QAP OF COOLING TOWER	15
6	PE-V0-409-553-A006	QAP OF MOTORS	15
7	PE-V0-409-553-A007	QAP OF PLC BASED PANEL	20
8	PE-V0-409-553-A101	HEAT LOAD CALCULATION FOR MAIN PLANT AND SERVICE BUILDING ETC	4
9	PE-V0-409-553-A102	OPERATION & CONTROL PHILOSOPHY FOR AIR CONDITIONING SYSTEM	12
10	PE-V0-409-553-A103	PRESSURE DROP CALCULATIONS FOR CHILLED AND CONDENSER WATER PIPING	10
11	PE-V0-409-553-A201	TDS AND GA OF SCREW CHILLER ALONG WITH FOUNDATION DETAILS	16
12	PE-V0-409-553-A202	TDS AND GA OF COOLING TOWER ALONG WITH FOUNDATION DETAILS	15
13	PE-V0-409-553-A203	TDS AND GA OF AIR HANDLING UNITS ALONG WITH FOUNDATION DETAILS	14
14	PE-V0-409-553-A204	TDS AND GA OF CONDENSER AND CHILLED WATER PUMPS ALONG WITH FOUNDATION DETAILS	15
15	PE-V0-409-553-A205	TDS AND GA OF PAC / SPLIT AIR CONDITIONER	12
16	PE-V0-409-553-A206	TDS AND GA OF MOTOR (PUMP, COOLING TOWER, AHU)	15
17	PE-V0-409-553-A207	TDS OF INSULATION MATERIAL (DUCT INSULATION, DUCT LINING, PIPE INSULATION)	12
18	PE-V0-409-553-A208	TDS AND GA OF FRESH AIR FANS	12
19	PE-V0-409-553-A209	TDS AND GA OF DESUPERHEATING STATION	14
20	PE-V0-409-553-A210	TDS AND GA OF ONLINE NON CHEMICAL SCALE PREVENTER	16
21	PE-V0-409-553-A211	TDS AND GA OF AIR COOLED PRECISION AC UNITS ALONG WITH FOUNDATION DETAILS	12
22	PE-V0-409-553-A212	TDS AND GA OF HEATERS AND HUMIDIFIER	7
23	PE-V0-409-553-A213	TDS AND GA OF FIRE DAMPER WITH ACTUATOR	10
24	PE-V0-409-553-A214	TDS AND GA OF FOR 3-WAY MIXING VALVE	8
25	PE-V0-409-553-A215	TDS AND GA OF VALVEES (BALANCING VALVE, GATE VALVE, CHECK VALVE, Y ATRAINER)	9
26	PE-V0-409-553-A216	TDS AND GA OF SUPPLY / RETURN AIR DIFFUSER/GRILL	8
27	PE-V0-409-553-A217	TDS OF GI SHEET	5
28	PE-V0-409-553-A218	TDS OF PIPES	5
29	PE-V0-409-553-A219	TDS AND GA OF EXPANSION TANK, MAKEUP WATER AND SOFT WATER TANK	5



**1x370MW YELAHANKA CCPP  
AIR CONDITIONING SYSTEM**

**MASTER DRAWING LIST WITH SCHEDULE  
OF SUBMISSION**

**SPECIFICATION No: PE-TS-409-553-A001**

**VOLUME : II B**

**SECTION : E**

**REV 00**

**DATE: MARCH 2016**

**SHEET 3 OF 4**

<b>S. NO.</b>	<b>DRAWING NO</b>	<b>DRG./ DOC. TITLE</b>	<b>SCH. WEEK (FROM DATE OF LOI)</b>
30	PE-V0-409-553-A220	TDS AND GA OF FILTERS	10
31	PE-V0-409-553-A221	TDS FOR INSTRUMENTS ( PRESSURE GAUGE, TEMPERATURE GAUGE, LEVEL GAUGE, PRESSURE SWITCH, TEMPERATURE SWITCH, LEVEL SWITCH, DP SWITCH, TEMPERATURE AND HUMIDITY SENSORS ETC)	12
32	PE-V0-409-553-A501	PID FOR MAIN PLANT, SERVICE BUILDING ETC	8
33	PE-V0-409-553-A502	TYPICAL Details DUCT FABRICATION DRAWING / SUPPORT / ERECTION. INSULATION OF DUCTING / PIPING & EQUIPMENTS CHILLED AND CONDENSER WATER PIPE ERECTION	7
34	PE-V0-409-553-A503	AC DUCT LAYOUT DRAWING FOR CONTROL ROOM ARES AT 11.5 M ALONG WITH AHU ROOM LAYOUT WITH FOUNDATION DETAILS	16
35	PE-V0-409-553-A506	AC DUCT LAYOUT DRAWING FOR SERVICE BUILDING WITH AHU ROOM LAYOUT AND FOUNDATION DETAILS	18
36	PE-V0-409-553-A507	AC PLANT ROOM LAYOUT & COOLING TOWER AREA LAYOUT WITH COMPLETE FOUNDATION DETAIL OF ALL EQUIPMENT	15
37	PE-V0-409-553-A508	CHILLED & CONDENSER WATER PIPING LAYOUT WITHIN PLANT ROOM & UPTO VARIOUS AHU ROOMS, & COOLING TOWER AREA.	20
38	PE-V0-409-553-A509	SPLIT AC SCHEDULE ALONGWITH HEAT LOAD CALCULATION FOR AUXILIARY BUILDING	22
39	PE-V0-409-553-A701	TDS OF PLC WITH CONFIGURATION DIAGRAM, BILL OF MATERIAL, GA &INTERNAL WIRING DIAGRAM, LOGIC FLOW DIAGRAM, IO WIRING DIAGRAM , PLC ROOM LAYOUT	20
40	PE-V0-409-553-A702	I/O LIST FOR AC SYSTEM	20
41	PE-V0-409-553-A751	ELECTRICAL FEEDER LIST	18
42	PE-V0-409-553-A752	CABLE SCHEDULE	22
43	PE-V0-409-553-A901	PG TEST PROCEDURE	12
44	PE-V0-409-553-A902	O&M MANUAL	25

Note:

The above is not the complete list and may change during detail engineering



**1x370MW YELAHANKA CCPP  
AIR CONDITIONING SYSTEM**

**FORMAT FOR OPERATION AND  
MAINTENANCE MANUAL**

**SPECIFICATION No: PE-TS-409-553-A001**

**VOLUME : II B**

**SECTION : E**

**REV 00**

**DATE: MARCH 2016**

**SHEET 1 OF 4**

**ANNEXURE-IX**

**FORMAT FOR OPERATION AND MAINTENANCE  
MANUAL**



**1x370MW YELAHANKA CAPP  
AIR CONDITIONING SYSTEM**

**FORMAT FOR OPERATION AND  
MAINTENANCE MANUAL**

**SPECIFICATION No: PE-TS-409-553-A001**

**VOLUME : II B**

**SECTION : E**

**REV 00**

**DATE: MARCH 2016**

**SHEET 2 OF 4**

Project name :  
Project number :  
Package Name :  
PO reference :  
Document number :  
Revision number :

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



**1x370MW YELAHANKA CCPP  
AIR CONDITIONING SYSTEM**

**FORMAT FOR OPERATION AND  
MAINTENANCE MANUAL**

**SPECIFICATION No: PE-TS-409-553-A001**

**VOLUME : II B**

**SECTION : E**

**REV 00**

**DATE: MARCH 2016**

**SHEET 3 OF 4**

Sl.no. & Sections	Description	Tick ( √ )if included in Manual			Remarks
		Yes	No	Not Applicable	
<b>4.0</b>	<b>COMMISSIONING ACTIVITIES (IF NOT COVERED IN SEPARATE DOCUMENT I.E. ERECTION MANUAL, COMMISSIONING MANUAL)</b>				
<b>4.1</b>	Pre-Commissioning Checks				
<b>4.2</b>	handling of items at site				
<b>4.3</b>	Storage at site				
<b>4.4</b>	Unpacking & Installation procedure				
<b>5.0</b>	<b>OPERATION GUIDELINES FOR PLANT PERSONAL/USER/OPERATOR</b>				
<b>5.1</b>	Interlock & Protection logic along with the limiting values of protection settings for the equipment along with brief philosophy behind the logic, drawings etc. to be provided.				
<b>5.2</b>	Start up, normal operation and shut down procedure for equipments along with the associated systems in step by step mode. Valve sequence chart, step list, interlocks etc. with Equipment isolating procedures to be mentioned.				
<b>5.3</b>	Do's & Don't of the equipments.				
<b>5.4</b>	Safety precautions to be taken during normal operation. Safety symbols, Emergency instructions on total power failure condition/lubrication failure/any other condition				
<b>5.5</b>	Parameters to be monitored with normal values and limiting values				
<b>5.6</b>	Trouble shooting with causes and remedial measures				
<b>5.7</b>	Routine operational checks, recommended logs & records				
<b>5.8</b>	Changeover schedule if more than one auxiliary for the same purpose is given				
<b>5.9</b>	Painting requirement and schedule				
<b>5.10</b>	Inspection, repair , Testing and calibration procedures				
<b>6.0</b>	<b>MAINTENANCE GUIDELINES FOR PLANT PERSONAL</b>				



**1x370MW YELAHANKA CCPP  
AIR CONDITIONING SYSTEM**

**FORMAT FOR OPERATION AND  
MAINTENANCE MANUAL**

**SPECIFICATION No: PE-TS-409-553-A001**

**VOLUME : II B**

**SECTION : E**

**REV 00**

**DATE: MARCH 2016**

**SHEET 4 OF 4**

Sl.no. & Sections	Description	Tick ( ✓ )if included in Manual			Remarks
		Yes	No	Not Applicable	
6.1	List of Special Tools and Tackles required for Overhaul/Trouble shooting including special testing equipment required for calibration etc.				
6.2	Stepwise dismantling and re-assembly procedure clearly specifying the tools to be used, checks to be made, records to be maintained, clearances etc. to be mentioned. Tolerances for fitment of various components to be given.				
6.3	Preventive Maintenance & Overhauling schedules linked with running hours/calendar period along with checks to be given				
6.4	Long term maintenance schedules especially for structural, foundations etc.				
6.5	Consumable list along with the estimated quantity required during commissioning, normal running and during maintenance like Preventive Maintenances and Overhaul. Storage/handling requirement of consumables/self-life.				
6.6	List of lubricants with their Indian equivalent, Lubrication Schedule, Quantity required for each equipment for complete replacement is to be given				
6.7	List of vendors & Sub-vendors with their latest addresses, service centres ,Telephone Nos., Fax Nos., Mobile Nos., e-mail IDs etc.				
6.8	List of mandatory and recommended spare parts list				
6.9	Tentative Lead time required for ordering of spares from the equipment supplier				
6.10	Guarantee and warranty clauses				
7.0	<b>Statutory and other specific requirements considerations.</b>				
8.0	<b>List of reference documents</b>				
9.0	<b>Binding as per requirement</b>				



**1x370MW YELAHANKA CCPP  
AIR CONDITIONING SYSTEM**

**SITE STORAGE AND PRESERVATION**

**SPECIFICATION No: PE-TS-409-553-A001**

**VOLUME : II B**

**SECTION : E**

**REV 00**

**DATE: MARCH 2016**

**SHEET 1 OF 16**

**ANNEXURE-X**

**SITE STORAGE AND PRESERVATION**

# SITE STORAGE AND PRESERVATION GUIDELINES FOR MECHANICAL BOPs

(Doc No: PE-DC-SSG-A001 REV.00)



PROJECT ENGINEERING MANAGEMENT, POWER SECTOR  
BHARAT HEAVY ELECTRICALS LIMITED-NOIDA

## CONTENT

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

## 1. SCOPE OF THE DOCUMENT

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

## 2. PURPOSE OF STORAGE & PRESERVATION

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

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

### a) GENERAL STORAGE REQUIREMENTS

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

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

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

**b) GENERAL PRESERVATION REQUIREMENTS**

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

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

**c) GENERAL INSPECTION REQUIREMENTS**

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

#### 4. TYPE OF STORAGE FOR VARIOUS EQUIPMENT

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

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

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



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

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





iii Open storage (O )

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

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

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



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

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

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

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

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

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

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

## 5. CONCLUSION

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

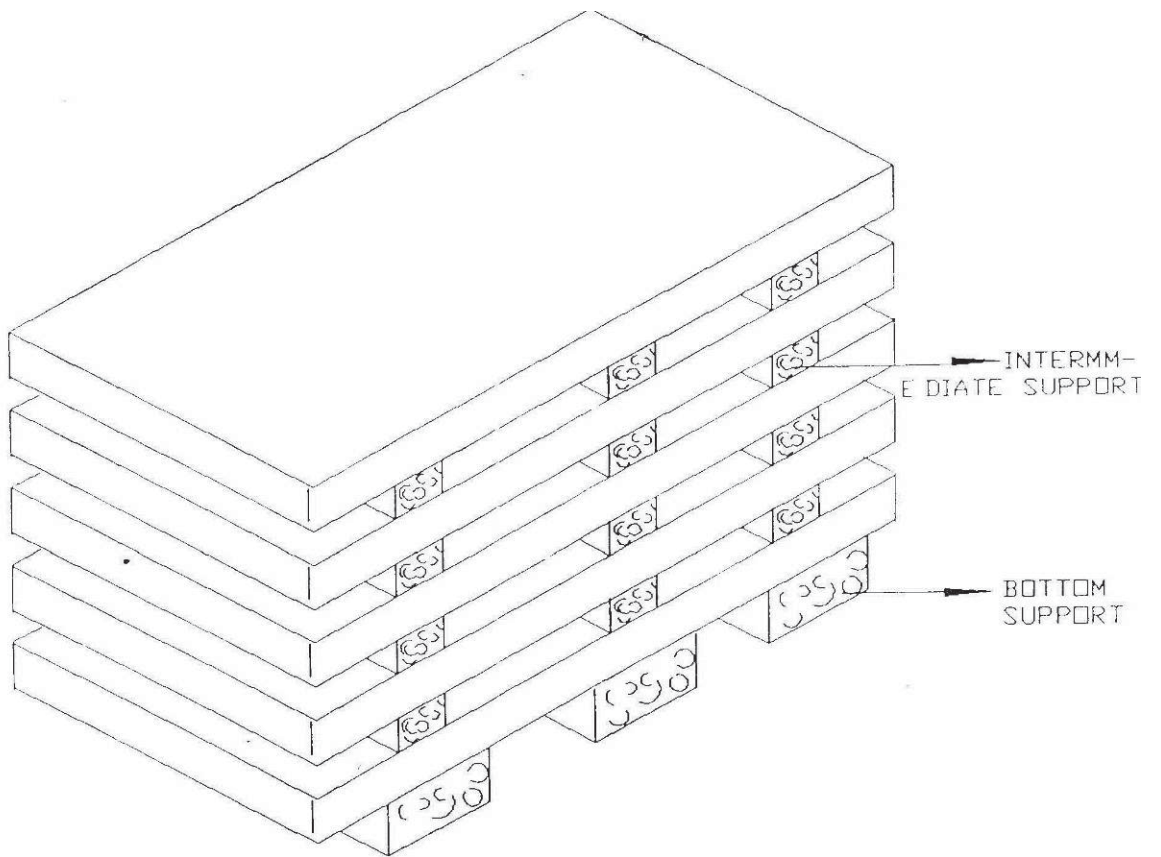


Figure – 1 – PLATE STACKING ARRANGEMENT

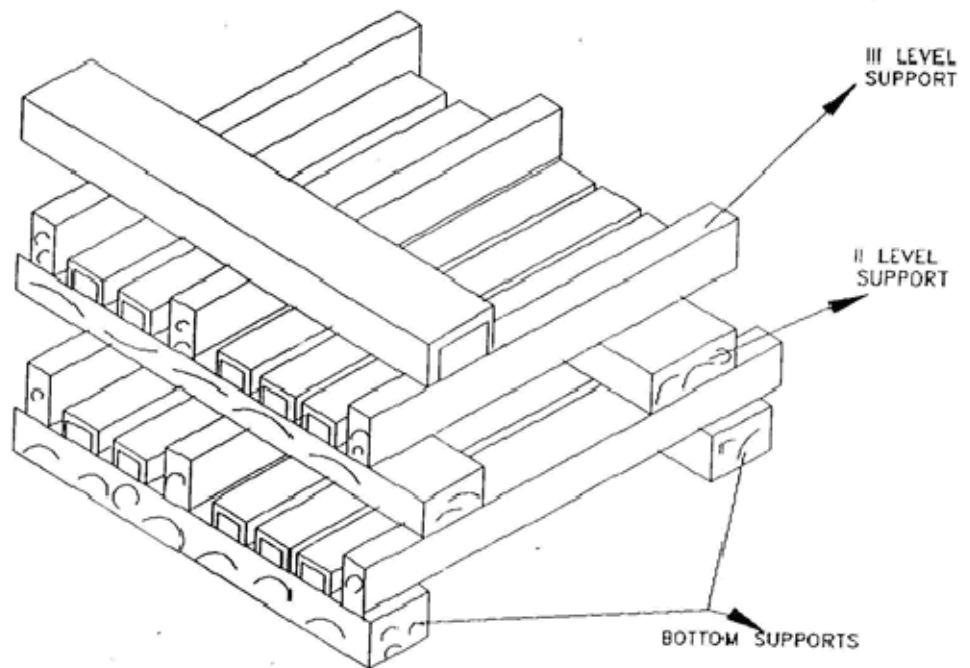


Figure – 2 – STRUCTURAL STEEL STACKING ARRANGEMENT



**1x370MW YELAHANKA CCPP  
AIR CONDITIONING SYSTEM**

**SPECIFICATION No: PE-TS-409-553-A001**

**VOLUME: III**

**REV. 00**

**DATE: MARCH 2016**

**VOLUME III**



**1x370MW YELAHANKA CCPP  
AIR CONDITIONING SYSTEM**

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

**SPECIFICATION No: PE-TS-409-553-A001**

**VOLUME : III**

**SECTION : 1**

**REV: 00**

**DATE: MARCH 2016**

**SHEET 1 OF 1**

**BIDDER SHOULD SUBMIT THE SIGNED AND STAMPED COPY OF THE  
FOLLOWING DOCUMENTS:**

1. Compliance cum confirmation certificate
2. Guaranteed power consumption
3. Un priced format for main package
4. Un priced format for mandatory spare
5. Complete set of technical specification
6. No deviation certificate
7. Pre bid clarification schedule



1x370MW YELAHANKA CCPP  
AIR CONDITIONING SYSTEM

SPECIFICATION No: PE-TS-409-553-A001

COMPLIANCE CUM CONFIRMATION  
CERTIFICATE

VOLUME: III

SECTION: 2

REV. NO. 00

DATE: MARCH 2016

SHEET: 1 OF 2

**COMPLIANCE CUM CONFIRMATION CERTIFICATE**

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

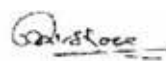
- a) The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusions, other than those mentioned under "exclusion and those resolved as per 'Schedule of Deviations', with regard to same.
- b) There are no other deviations w.r.t. specifications other than those furnished in the 'Schedule of Deviations'. Any other deviation, stated or implied, taken elsewhere in the offer stands withdrawn unless specifically brought out in the 'Schedule of Deviations'
- c) Bidder shall submit QP in the event of order based on the guidelines given in the specification & QP enclosed therein. QP will be subject to BHEL / CUSTOMER approval & customer hold points for inspection / testing shall be marked in the QP at the contract stage. Inspection / testing shall be witnessed as per same apart from review of various test certificates/ Inspection records etc. This is within the contracted price without any extra implications to BHEL after award of the contract.
- d) All drawings/ data-sheets / calculations etc. submitted along with the offer shall not be taken cognizance off.
- e) The offered materials shall be either equivalent or superior to those specified in the specification & shall meet the specified / intended duty requirements. In case the material specified in the specifications is not compatible for intended duty requirements then same shall be resolved by the bidder with BHEL during the pre-bid discussions, otherwise BHEL / Customer's decision shall be binding on the bidder whenever the deficiency is pointed out.

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

- f) The commissioning spares shall be supplied on 'As Required Basis' & prices for same included in the base price itself.
- g) All sub vendors shall be subject to BHEL / CUSTOMER approval in the event of order.
- h) Guarantee for plant/equipment shall be as per relevant clause of GCC / SCC / Other Commercial Terms & Conditions
- i) In the event of order, all the material required for completing the job at site shall be supplied by the bidder within the ordered price even if the same are additional to approved billing break up, approved drawing or approved Bill of quantities within the scope of work as tender specification. This clause will apply in case during site

  
Anshu

  
S. S. Srinivas

  
Prasenjit



1x370MW YELAHANKA CCPP  
AIR CONDITIONING SYSTEM

SPECIFICATION No: PE-TS-409-553-A001

**COMPLIANCE CUM CONFIRMATION  
CERTIFICATE**

VOLUME: III

SECTION: 2

REV. NO. 00

DATE: MARCH 2016

SHEET: 2 OF 2

commissioning, additional requirements emerges due to customer and / or consultant's comments. No extra claims shall be put on this account

- j) Schedule of drawings submissions, comment incorporations & approval shall be as stipulated in the specifications. The successful bidder shall depute his design personnel to BHEL's / Customer's / Consultant's office for across the table resolution of issues and to get documents approved in the stipulated time.
- k) As built drawings shall be submitted as and when required during the project execution.
- l) The bidder has not tempered with this compliance cum confirmation certificate and if at any stage any tempering in the signed copy of this document is noticed then same shall be treated as breach of contract and suitable actions shall be taken against the bidder.
- m) Successful bidder shall furnish detailed erection manual for each of the equipment supplied under this contract at least 3 months before the scheduled erection of the concerned equipment / component or along with supply of concerned equipment / component whichever is earlier.
- n) Document approval by customer under Approval category or information category shall not absolve the vendor of their contractual obligations of completing the work as per specification requirement. Any deviation from specified requirement shall be reported by the vendor in writing and require written approval. Unless any change in specified requirement has been brought out by the vendor during detail engineering in writing while submitting the document to customer for approval, approved document (with implicit deviation) will not be cited as a reason for not following the specification requirement.
- o) In case vendor submits revised drawing after approval of the corresponding drawing, any delay in approval of revised drawing shall be to vendor's account and shall not be used as a reason for extension in contract completion.



1x370MW YELAHANKA CCPP  
AIR CONDITIONING SYSTEM

**PRE-BID CLARIFICATION SCHEDULE**

SPECIFICATION No: : PE-TS-409-553-A001

VOLUME: III

SECTION: 3

REV. NO. 00

DATE: March 2016

SHEET: 1 OF 1

**PRE-BID CLARIFICATION SCHEDULE**

S. NO.	SECTION/CLAUSE/PAGE NO.	STATEMENT OF THE REFERRED CLAUSE	CLARIFICATION REQUIRED

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

Signature: \_\_\_\_\_

Name: \_\_\_\_\_

Designation: \_\_\_\_\_

Company: \_\_\_\_\_

Date: \_\_\_\_\_

Company Seal



**1x370MW YELAHANKA CCPP  
AIR CONDITIONING SYSTEM**

**NO DEVIATION CERTIFICATE**

**SPECIFICATION No: PE-TS-409-553-A001**

**VOLUME : III**

**SECTION : 4**

**REV: 00**

**DATE: MARCH 2016**

**SHEET 1 OF 2**

**NO DEVIATION CERTIFICATE**



**1x370MW YELAHANKA CCPP  
AIR CONDITIONING SYSTEM**

**NO DEVIATION CERTIFICATE**

**SPECIFICATION No: PE-TS-409-553-A001**

**VOLUME : III**

**SECTION : 4**

**REV: 00**

**DATE: MARCH 2016**

**SHEET 2 OF 2**

SL NO	VOULME / SECTION	PAGE NO.	CLAUSE NO.	TECHNICAL SPECIFICATIO N/ TENDER DOCUMENT	COMPLETE DESCRIPTION OF DEVIATION	COST OF DEVIATION	PORTION OF PRICE SCHEDULE ON WHICH COST OF DEVIATION IS APPLICABLE	NATURE OF COST OF DEVIATION (POSITIVE/ NEGATIVE)	WHETHER COST OF DEVIATION INCLUDED/ EXCLUDED IN PRICE BID	REMARKS
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**TECHNICAL DEVIATIONS**


**PARTICULARS OF BIDDERS/ AUTHORISED REPRESENTATIVE**

NAME	DESIGNATIONS	SIGN & DATE	COMPANY SEAL

**NOTES:**

1. Cost of deviation will be applicable on the basic price (i.e. excluding taxes, duties & freight) only.
2. All the bidders have to list out all of their Technical Deviations in detail in the above format on cost basis (if any).
3. Any deviation not mentioned above and shown separately will not be taken cognizance of and the offer shall be liable for rejection.
4. Bidder shall indicate "quoted" in cost of deviation column of the schedule above along with their Technical offer.
5. Bidder shall furnish priced schedule of technical deviation along with price bid in sealed envelop.
6. The final decision of acceptance/ rejection of the deviations quoted by the bidder along with its cost shall be at discretion of the Purchaser.
7. Bidders to note that any deviation not listed above and asked after Part I Bid opening shall not be considered.
8. Bidders to note that no Price Impact will be acceptable after Part I Bid opening subject to if there is any change in Technical Specification/NIT terms from BHEL side.
9. Deviation listed above without any cost of deviation, if found acceptable to BHEL, will be considered without any price implication.



**1x370MW YELAHANKA CCPP  
AIR CONDITIONING SYSTEM**

**GAURANTEE POWER CONSUMPTION**

**SPECIFICATION No: PE-TS-409-553-A001**

**VOLUME: III**

**SECTION: 5**

**REV. NO. 00**

**DATE: MARCH 2016**

**SHEET: 1 OF 1**

S.NO.	DESCRIPTION OF EQUIPMENT	NO OF EQUIPMENT		TOTAL POWER CONSUMPTION FOR EACH EQUIPMENT AT MOTOR INPUT TERMINAL AND CONTROL PANEL (IN KW)	GUARANTEED CONSUMPTION	DUTY FACTOR	TOTAL KW
		WORKING	STANDBY				
		3A	3B	4		5	6=3Ax4x5
<b>1</b>	<b>AC-Plant-1: (CENTRAL CHILLED WATER SYSTEM FOR MAIN CCR AREAS,CER,UPS ETC AC areas of Power house building)</b>						
<b>1.1</b>	Water chilling machine -Screw chiller	1	1			1	0
<b>1.2</b>	AHUs for Common control room areas, CER, computer room etc.	1	1			1	0
<b>1.3</b>	Cooling tower fans for AC plant	1	1			1	0
<b>1.4</b>	Condenser water pumps for AC plant	1	1			1	0
<b>1.5</b>	Chilled water pumps for AC plant	1	1			1	0
<b>1.6</b>	Fresh air fans for above AHU room	1	0			1	0
				<b>TOTAL (KW)</b>			<b>260</b>

**NOTES:**

- Estimated power consumption (EPC) figure for the system (for working drives only) has been considered as **260 KW**. So long bidder's quoted guaranteed power consumption (GPC) above remains within this EPC, there will be no technical loading of bid on power consumption for evaluation. However, if bidder's quoted GPC exceeds EPC, there shall be technical loading of bid for evaluation @ **Rs 136000/-per KW** of additional power over EPC.
- Bidder's guaranteed power consumption at motor input terminals (not shaft power) as furnished in relevant schedule shall be demonstrated by the successful bidder during performance testing at works/site. In case power consumption is noted higher than EPC / bidder's quoted GPC whichever is higher, during inspection/ PG test, penalty @ **Rs 136000/-per KW** shall be levied on vendor.

**AIR CONDITIONING SYSTEM FOR 1 x 370 MW YELAHANKA CCPP --- SUGGESTIVE PRICE FORMAT**

SL No	DESCRIPTION OF EQUIPMENT/ ITEM	QTY	UNIT	SUPPLY						ERECTION AND COMMISSIONING			TOTAL	
				Unit Price (Rs)	Total ex-works price (Rs)	ED (Inc CESS) (Rs)	CST / VAT (Rs)	Freight (Including service tax, if applicable) (Rs)	TOTAL FOR price SUPPLY (Rs)	Unit Price (Rs)	Total price (Rs)	Service Tax (Rs)		TOTAL PRICE (Erection and commissioning including Service tax)
1.0	Total lumpsum firm prices for equipment & Services as specified, Comprising Engineering, design, manufacture, inspection & Testing at manufacturer's/subvendor's works, Painting at manufactures works, duly packed for transportation, delivery to site, unloading, storage & handling at-site, fabrication, erection and commissioning, performance and guarantee testing, submission of as built drawing, O&M Manual, carrying out acceptance tests at site, and final painting of complete Air conditioning system on turnkey basis as per specification PE-TS-409-553-A001 including mandatory spares, special tool & tackle for maintenance, commissioning spares, all taxes, duties etc.													
<b>A</b>	<b>AC-Plant-1: CENTRAL CHILLED WATER SYSTEM COMMON FOR MAIN CR AREAS, CER &amp; UPS CHARGER ROOM OF TG BUILDING AND AC AREAS OF SERVICE BUILDING</b>													
1	Microprocessor controlled, water cooled chiller package each of minimum capacity 200TR consisting of Hermetic/ semi - Hermetically sealed Screw type refrigerant compressor operating on R134a/R407C/R410A refrigerant complete with motor, unit mounted starter, complete with suction and discharge shut off valves, HP / LP cutouts, oil pressure failure switch, gauge panel, automatic capacity control; Condenser, relief valve, chiller, controls such as thermostatic/electronic expansion valve, cooling thermostat, antifreeze thermostat, water flow switch, integral refrigerant pipes & fittings; strainer, sight glass, isolating valves, chiller drain valve, chiller insulation, refrigerant piping insulation, first charge of gas and oil, base frames, vibration isolators, integral wiring, unit mounted isolator / fuse switch and other accessories as specified.	2	NO											
2	Sheet metal cabinet type air handling units (double skin as per specification) consisting of chilled water cooling coil, centrifugal blower, TEFC sq cage induction motor, drive set, filters (pre filter), 3 way motorised mixing valve with thermostatic controls and other accessories as per specifications to meet the AC load of the main Control Room areas, CER etc. of power house building at 11.5m and kept at 17.0 M floor level as per specification. Fine filter and HEPA Filters shall be provided in Common discharge plenum.	2	NO											
3	Sheet metal cabinet type air handling units (double skin as per specification) consisting of chilled water cooling coil, centrifugal blower, TEFC sq cage induction motor, drive set, filters (pre filter), 3 way motorised mixing valve with thermostatic controls and other accessories as per specifications to meet the AC load of the different floors of Service building. Fine Filters in Common discharge plenum for AHUS shall also be included.	3	NO											
4	Fibreglass reinforced plastic (FRP) construction cooling towers complete with fan, motor, FRP basin, nozzles, make-up water & quick fill water connection, Level Switch, drains, piping, valves, strainers, ladder & all accessories as specified.	2	NO											
5	Centrifugal pump sets for condenser water recirculation complete with TEFC motor, & all accessories as specified.	2	NO											
6	Centrifugal pump sets for chilled water recirculation complete with TEFC motor, & all accessories, as specified.	2	NO											
7	Make up water FRP/G.I Storage tank to cooling towers with level switch, pr switch and other accessories as required. Capacity of each tank 8 m3.	2	NO											
8	FRP/G.I Expansion Tank (insulated) for chilled water with all accessories as required, capacity 1 m3.	1	NO											
9	Online Non chemical scale preventer, with all accessories as required to meet system requirements	1	NO											

Amshul

S.A. Yousef

Praveen Kishore

**AIR CONDITIONING SYSTEM FOR 1 x 370 MW YELAHANKA CCPP --- SUGGESTIVE PRICE FORMAT**

SL No	DESCRIPTION OF EQUIPMENT/ ITEM	QTY	UNIT	SUPPLY				ERECTION AND COMMISSIONING			TOTAL		
				Unit Price (Rs)	Total ex-works price (Rs)	ED (inc CESS) (Rs)	CST / VAT (Rs)	Freight (including service tax, if applicable) (Rs)	TOTAL FOR site (Rs)	Unit Price (Rs)		Total price (Rs)	Service Tax (Rs)
10	Condenser water piping with necessary fittings, strainers, valves including piping from soft water storage tank to humidifiers of AHU room as specified.	1	LOT										
11	Chilled water piping from AC plant to AHU rooms within power house building and in service building complete with valves supports, fittings, strainers, insulation with finish as per specification.	1	LOT										
12	Monsoon reheating/ winter heating kit comprising strip heaters, safety controls, air-stat, contactors, frame work, thermostat & humidistat/ sensors etc.	1	LOT										
13	Pan type humidifier for each AHU room.	1	LOT										
14	Fresh air fan (axial flow type), complete with motor, inlet cone, air filters (Dry panel HDPE filter), dampers etc.	1	LOT										
15	PLC control system as per technical specification for main power house and service building , AC & ventilation system.	1	LOT										
<b>B</b>	<b>ITEMS COMMON TO ALL AC PLANTS</b>												
1*	FAN COIL UNIT consisting of chilled water cooling coil, blower, motor, driveset, filters (prefilter), 3way motorised mixing valve with thermostatic controls and other accessories as per specifications												
a*	3 TR	2	NO*										
b*	2TR	1	NO*										
c*	1.5 TR	1	NO*										
2*	<b>M5 medium class drain piping upto nearest drain point with and without insulation</b>												
a*	50 mm	150	M										
b*	40 mm	100	M										
3*	<b>Fire damper.</b>												
a*	Fire damper with auto resetting, limit switches, indication lamps etc.	15	SQM*										
b*	Motorized actuator with single phase power supply for the above fire damper.	20	NO*										
4*	Finished GSS ductwing fabricated from GSS having zinc coating <b>275</b> gms/ m <sup>2</sup> ducting complete with hangers/ supports, dampers, grilles, diffusers (with & without VCD) etc.												
a*	18G.	500	SQM*										
b*	20G.	550	SQM*										
c*	22G.	600	SQM*										
d*	24G.	1500	SQM*										
e*	Supply air diffuser with VCD (Extruded Aluminium).	30	SQM*										
f*	Return air diffuser without VCD (Extruded Aluminium).	50	SQM*										
g*	G1 Volume control dampers for Duct	10	SQM*										
5	Acoustic insulation of the first 6 of ducting from AHU outlets.	1	LOT										
6*	Thermal insulation of supply air duct & return air duct with finish as specified.	3150	SQM*										
7	Field instruments like pressure gauge, temperature gauge, pressure switch, differential pressure switch, flow switch, flow meters, and other required instruments as per specifications.	1	LOT										
8*	fibres optic cable	250	Rmt*										
<b>C</b>	<b>AC System for Aux. building</b>												


  
 Anshul S.A. (Kor)


  
 Pawan Kishor

**AIR CONDITIONING SYSTEM FOR 1 x 370 MW YELAHANKA CCPP --- SUGGESTIVE PRICE FORMAT**

SL No	DESCRIPTION OF EQUIPMENT/ ITEM	QTY	UNIT	SUPPLY				ERECTION AND COMMISSIONING				TOTAL		
				Unit Price (Rs)	Total ex-works price (Rs)	ED (inc CESS) (Rs)	CST / VAT (Rs)	Freight (including service tax, if applicable) (Rs)	TOTAL FOR price SUPPLY (Rs)	Unit Price (Rs)	Total price (Rs)		Service Tax (Rs)	TOTAL PRICE (Erection and commissioning including Service tax)
1*	Air Cooled PAC-Unit complete with all accessories as specified. The package unit shall be complete with all accessories like duct heaters, pan humidifier, filters, acoustic insulation of duct for 5m from PU, drain piping with insulation upto nearest drain, required instrumentation etc													
	(a)* 1.0 TR net capacity	1	No*											
	(b)* 1.5TR net capacity	1	No*											
3*	Air-cooled split type AC units consisting of outdoor unit (having compressor condenser coil with fan and motor), indoor unit (having evaporator coil,filter, fan with motor), inter connecting refrigerant piping as per site requirement & fittings with insulation, cordless remote electrical power cord upto the nearest available point along with isolator/MCB, fixing frame for indoor & out door unit, stabilizer etc. (Minimum BEE Rating 5 Star for non ductable units).													
	(a)* 5.0 TR capacity (ductable type, 415 V, 3 phase with isolation switch).	2	No*											
	(b)* 2.0 TR capacity (non-ductable type, 240 V, 1 phase isolation switch) with isolation switch , i.e MCB of suitable rating as specified.	20	No*											
	(c)* 1.5 TR capacity (non-ductable type, 240 V, 1 phase isolation switch) with isolation switch , i.e MCB of suitable rating as specified.	30	No*											
4*	Manually operated, platform trolley of 1 Ton capacity with base area 2m x 1.5m	2	No											
5	Total lumpsum price for special tools & tackles for maintenance inclusive of packing forwarding, transportation up to site, etc. (Bidder shall submit item-wise price break-up).	1	LOT											
6	Total lumpsum price for commissioning spares inclusive of packing forwarding, transportation up to site, etc. (Bidder shall submit item-wise price break-up).	1	LOT											
7	Total lumpsum price for Mandatory Spare for air conditioning inclusive of packing forwarding, transportation up to site, etc. (Bidder to submit item-wise price break-up ).	1	LOT											
8	Any other item not indicated above, but required to make the system complete in all respects.	1	LOT											

**NOTES**

- The bidder shall furnish unit rates for variable item (marked \*) for necessary adjustment (plus or minus) variation during detailed engg. stage. The unit rates quoted above shall be considered and no separate unit rates shall be quoted. Unit rates shall be valid throughout the contract.
- Bidder must submit prices in the Pro Forma duly filled in signed and stamped on every page without any ambiguity. The price shall be written against each item. Term such as "refer covering letter" etc. are not acceptable. Extra sheet may be attached if the space provided is not sufficient
- Price format shall not be changed by the bidder as the bidder may get disqualified by doing so.

 Anshul  
 Praveen Kishore  
 S.A. (Kor)

**AIR CONDITIONING SYSTEM FOR 1 x 370 MW YELAHANKA CCPP --- MANDATORY SPARES SUGGESTIVE PRICE FORMAT**

Sl. No	DESCRIPTION OF EQUIPMENT/ ITEM	QTY	UNIT	SUPPLY				ERECTION AND COMMISSIONING			TOTAL		
				Unit Price (Rs)	Total ex-works price (Rs)	ED (inc CESS) (Rs)	CST / VAT (Rs)	Freight (including service tax, if applicable) SUPPLY (Rs)	TOTAL FOR site (Rs)	Unit Price (Rs)		Total price (Rs)	Service Tax (Rs)
<b>A</b>	<b>MECHANICAL</b>												
1.0	Vapour Compression chiller												
1.1	Oil filter "O" ring	1 set											
1.2	Refrigerant filter	1 set											
1.3	Master solenoid valve	1 No											
1.4	Master solenoid valve coil	1 set											
2.0	Refrigerant condenser												
2.1	Gasket	1 set											
3.0	Refrigerant chiller												
3.1	Gasket	1 set											
4.0	Air Handling Unit												
4.1	V-Belt for AHU blower	1 set											
4.2	AHU blower bearing	1 set											
4.3	Filters	1 sq m / AHU											
4.4	Motor for each size of AHU	1 no.											
5.0	Induced draft FRP cooling tower												
5.1	Fan impeller	1 no.											
5.2	Spray Nozzles	1 set											
6.0	Horizontal centrifugal pump (for each model)												
6.1	Impeller	1 no of each type											
6.2	Shaft Sleeve	1 set											
6.3	Bearings	1 set											
6.4	Motor Bearing	1 set											
<b>B</b>	<b>ELECTRICAL SPARES</b>												
1.0	Control panel												
1.1	Air break switch	1 no of each rating											
1.2	Aux relays, contactors	2 nos of each type											
1.3	Clustered type LED's of different	20 nos											
1.4	Push buttons	6 nos											
1.5	Fuses for power & control circuit	5 sets of each type											
1.6	Control switches	1 of each type											

Anshul

S.A. (User)

Praveen Kishore

**AIR CONDITIONING SYSTEM FOR 1 x 370 MW YELAHANKA CCPP --- MANDATORY SPARES SUGGESTIVE PRICE FORMAT**

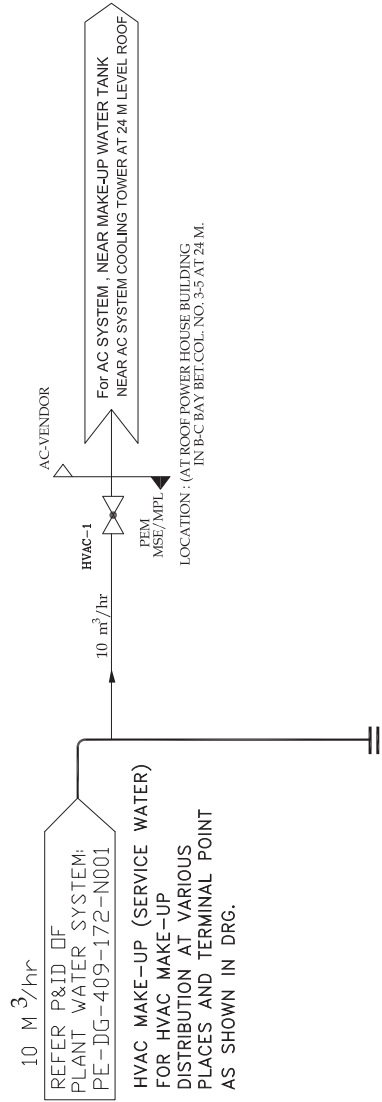
Sl. No	DESCRIPTION OF EQUIPMENT/ ITEM	QTY	UNIT	SUPPLY				ERECTION AND COMMISSIONING				TOTAL				
				Unit Price (Rs)	Total ex-works price (Rs)	ED (inc CESS) (Rs)	CST / VAT (Rs)	Freight (including service tax, if applicable) (Rs)	TOTAL FOR price SUPPLY (Rs)	Unit Price (Rs)	Total price (Rs)		Service Tax (Rs)	TOTAL PRICE (Erection and commissioning including Service tax)		
<b>C</b>	<b>C&amp;I SPARES</b>															
1.0	Control panel	1 no or 10% of the quantity of each type and range, whichever is higher.														
<b>2.0</b>	<b>Measurement and control system</b>															
2.1	Input / output module	1 no or 10% of the quantity of each type, whichever is higher.														
2.2	Each type of fuse	5 nos or 30% of each type, whichever is higher														
<b>3.0</b>	<b>CPU for man machine interface</b>															
3.1	CPU cards, memory modules, any other PCB/modules	1 no or 10% of the quantity of each type, whichever is higher.														
3.2	Power supply module	1 no or 10% of the quantity of each type, whichever is higher.														
<b>4.0</b>	<b>Panels, local panels</b>															
4.1	Fuses of each type and rating	25 nos														
4.2	Mcb of each type and rating	5 nos														
4.3	Terminal of each type	5 nos														

**NOTES**

- The bidder shall furnish unit rates for variable item (marked \*) for necessary adjustment (plus or minus) variation during detailed engg. stage. The unit rates quoted above shall be considered and no separate unit rates shall be quoted. Unit rates shall be valid throughout the contract.
- Bidder must submit prices in the Pro Forma duly filled in signed and stamped on every page without any ambiguity. The price shall be written against each item. Term such as "refer covering letter" etc. are not acceptable. Extra sheet may be attached if the space provided is not sufficient
- Price format shall not be changed by the bidder as the bidder may get disqualified by doing so.

 Anshul  
 S.A. Vohra  
 Praveen Kishore





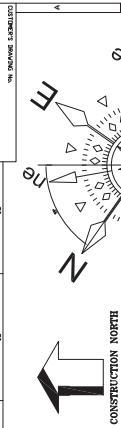
**NOTE: -**

1. MPL TO PROVIDE HVAC MAKE-UP WATER PIPING/FITTINGS UP TO THE TERMINAL POINT AS SHOWN IN DRG.
2. HVAC MAKE-UP WATER PIPING INCLUDING FITTINGS SHALL BE TERMINATED WITHIN THE RANGE OF 5 METER DISTANCE FROM MAKE-UP WATER TANK / AIR-WASHER BY MPL (UP PIPING VENDORS SCOPE) FURTHER PIPING SHALL BE DONE BY RESPECTIVE PLANT SUPPLIER AS MARKED IN THIS DRG.
3. THE HVAC MAKE-UP WATER ISOLATING VALVES AS PER VALVE SCHEDULE SHALL BE ARRANGED BY MPL (VALVE GROUP) AS PER THE SCHEME AS MARKED IN THE DRG.
4. HVAC MAKE-UP WATER PRESSURE AT EACH TERMINAL POINT SHALL BE MAINTAINED 0.5 kg/cm2.
5. A.C. SYSTEM MAKE-UP WATER PIPING FROM TERMINAL POINT TO MAKE-UP WATER TANK, COOLING TOWER, EXPANSION TANK & PAN HUMIDIFIER SHALL BE IN BIDDER'S SCOPE.
6. MAKE-UP WATER REQUIREMENT IS CONTINUOUS.

	KARNATAKA POWER CORPORATION LIMITED 1X750 MW YELAMANKA COMBINED CYCLE POWER PLANT
	FICHTNER Engineering & Construction Chennai, Bangalore PROJECT ENGINEERING MANAGEMENT INDIA
409 CONTRACT	BHARAT HEAVY ELECTRICALS LTD PROJECT ENGINEERING MANAGEMENT INDIA
TITLE: HVAC MAKE UP WATER PID	SHEET NO. 1 OF 1 DATE: 15/07/2014 SCALE: 1:1 PROJECT NO. PE-00-409-403-ADXX







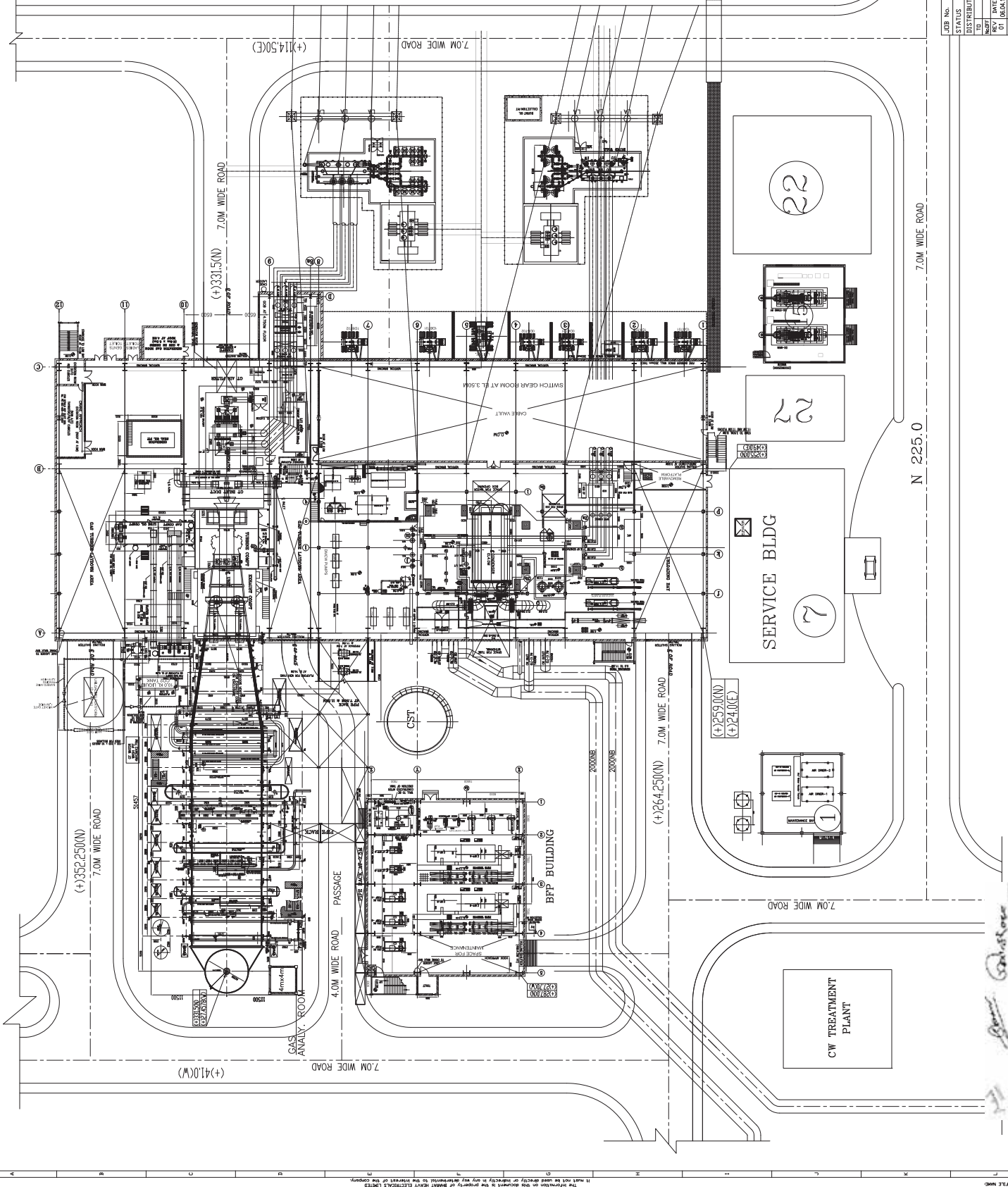
- LEGENDS:-**
- ROAD
  - PIPE/CABLE RACK
  - GRATING
  - CONCRETE PEDESTAL
  - CHEQUERED PLATE WITH FLOOR FINISH
  - OPENING
  - BRICK WALL
  - METAL CLADDING
  - CONCRETE FLOOR
  - RAIL TRACK
  - ROLLING SHUTTER

- NOTES:-**
- ALL DIMENSIONS AND CO-ORDINATES ARE IN METER UNLESS NOTED OTHERWISE.
  - FINISHED GRADED LEVEL (FGL) OF MAIN PLANT AREA (STACK TO TRANSFER YARD) SHALL BE RL 900.0M.
  - FLL(FINISHED FLOOR LEVEL) OF GT/STE BUILDING SHALL BE RL 900.5M WHICH CORRESPONDS TO EL 0.0M FOR ALL REFERENCE.
  - DETAILS/REQUIREMENT OF VARIOUS BUILDINGS/FACILITIES SHALL BE AS PER RESPECTIVE PACKAGES.

- REFERENCE DRAWINGS:-**
- S.N.**      **DESCRIPTION**
1. SITE PLAN
  2. GENERAL ARRANGEMENT OF BOILER-PLAN
  3. CA OF GAS TURBINE & GENERATOR
  4. GENERAL ARRANGEMENT AND CROSS SECTION OF BPP BUILDING
  5. PE-DC-409-100-MGT2 (PEM)

- DRAWING NO.**
- PE-DC-409-100-MGT2 (PEM)  
 D-00-561-93650 (TRY)  
 1-566-09-89007 (IND)  
 1-566-09-89008 (IND)  
 PE-DC-409-100-MGT2 (PEM)

**SWITCH-YARD AREA**



KARNATAKA POWER CORPORATION LIMITED  
 137D MW YELAHANNA, COMBINED CYCLE POWER PLANT

**CLIENT**  
 Karnataka Power Corporation Limited

**DESIGNER**  
 BHARAT HEAVY ELECTRICALS LTD  
 Chennai, Bangalore

**PROJECT ENGINEERING MANAGEMENT**  
 PROJECT ENGINEERING MANAGEMENT  
 CHENNAI

**DATE**      **SCALE**      **SHEET NO. OF**      **TOTAL SHEETS**

**TITLE**  
 MAIN EQUIPMENT PLAN

**JOB No.** 409  
**STATUS** CONTRACT  
**DISTRIBUTION**

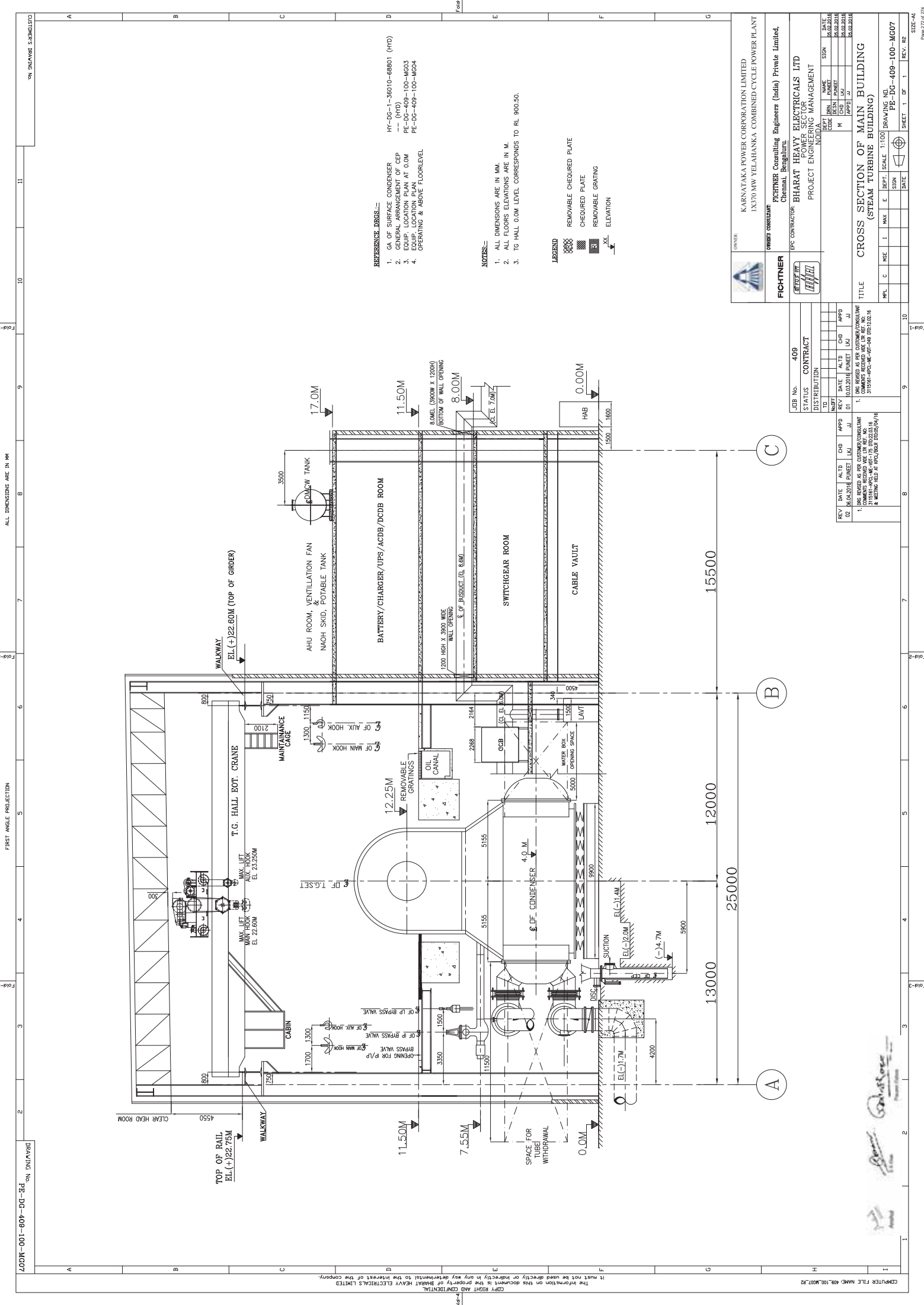
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01		06.04.18	LM	JJ	

FOR REVISION AS PER COMMENTS/REVISIONS  
 1. AS PER REVISIONS/REVISIONS  
 18. REVISIONS BY PROJECT ENGINEERING MANAGEMENT

*Handwritten signatures and initials.*

2025/01/10 09:50:24 AM SWANISH

The information on this drawing is the property of Bharat Heavy Electricals Limited. It shall not be used or copied in any form or by any means without the written consent of the company.



403KW-001-60-01-31c ON DRAWING 3.3.2016

ALL DIMENSIONS ARE IN MM

FIRST ANGLE PROJECTION

ON DRAWING 3.3.2016

- REFERENCE DRGS.:-**
- GA OF SURFACE CONDENSER
  - GENERAL ARRANGEMENT OF CEP
  - LOCATION PLAN AT 0.0M
  - EQUIP. LOCATION PLAN OPERATING & ABOVE FLOORLEVEL
- HY-06-1-36010-68801 (HYD)  
 --- (HYD)  
 PE-09-105-MG033  
 PE-06-409-100-MG04

- NOTES:-**
- ALL DIMENSIONS ARE IN MM.
  - ALL FLOORS ELEVATIONS ARE IN M.
  - TO HALL 0.0M LEVEL CORRESPONDS TO RL 900.50.

- LEGEND**
- REMOVABLE CHEQUERED PLATE
  - CHEQUERED PLATE
  - REMOVABLE GRATING
  - ELEVATION

OWNER: KARNATAKA POWER CORPORATION LIMITED  
 1X70 MW YELAHANKA COMBINED CYCLE POWER PLANT

ENGINEER CONSULTANT: FICHTNER  
 FICHTNER Consulting Engineers (India) Private Limited,  
 Chennai, Bangalore.

EPIC CONTRACTOR: BHARAT HEAVY ELECTRICALS LTD  
 POWER SECTOR  
 PROJECT ENGINEERING MANAGEMENT  
 CHENNAI, INDIA

JOB No. 409  
 STATUS: CONTRACT DISTRIBUTION

REV	DATE	ALTD	CHK	APPD	BY	REV	DATE	ALTD	CHK	APPD
01	15.08.2016					01	15.08.2016			
02	15.08.2016					02	15.08.2016			
03	15.08.2016					03	15.08.2016			
04	15.08.2016					04	15.08.2016			
05	15.08.2016					05	15.08.2016			

COMMENTS RECEIVED AND THE REF. NO.  
 1. 15.08.2016 AS PER DISTURBANCE REPORT  
 2. 15.08.2016 AS PER DISTURBANCE REPORT  
 3. 15.08.2016 AS PER DISTURBANCE REPORT  
 4. 15.08.2016 AS PER DISTURBANCE REPORT

TITLE: CROSS SECTION OF MAIN BUILDING (STEAM TURBINE BUILDING)

SCALE: 1:100 DRAWING NO: PE-DG-409-100-MG07

DATE: 15.08.2016

SHEET: 1 OF 1 REV: R2



