SECTION: D

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	TITLE	SPECIFICATION NO. PE-TS-400 & 402-554-A001
BHEL	**AIR WASHER** **DATA SHEET - A**	VOLUME II-B SECTION D REV 00 | DATE AUG 2014 SHEET 1 OF 2

S.No.	DESCRIPTION	DETAILS
	GENERAL	
1.	Designation	Air washers for power house building.
2.	Nos. required	Refer Section-C of Specific Technical Requirement
3.	Service	Evaporative Cooling of TG Hall & electrical bay
4.	Location	As per section-C/ Tender Layout Drg.
DESIGN DATA		
5.	Type	Sheet metal type, as per schedule of Ventilation system.
6.	Capacity M3/hr	Refer Section-C of Specific Technical Requirement
7.	Inlet air temperature	(Refer design data.)
8.	Saturation Efficiency	To achieve saturation efficiency of 90% (min).
9.	Allowable Pressure drop through Spray nozzle	2.4 Kg/cm2 (g) max.
9.	Pressure drop across Spray chamber	15 to 20 mm WG.
MATERIALS		
11.	Moisture Eliminators plates	24 SWG Galvanized Sheet (Vertical and brake type)./ 100% Virgin PVC of minimum finished thickness of 2 mm.
12.	Moisture Eliminators Frame	22 SWG G.I. Sheets.
13.	Distribution plates	18 G GSS to have 50% free area.
14.	Tank	MS
15.	Casing	Black M.S. (10 SWG min.)
16.	Louvers	20 G GSS sheet & frame of 18 G galvanized steel angle. Louvers with Bird screen of galvanized wire mesh of 10 mm square.
17.	Piping	MS Heavy Class Galvanized to IS: 1239 Part I, OR IS –3589 depending upon size.
18.	Suction Screen Water	Brass (40 mesh size 2 nos for each air washer)
19.	Spray nozzles	Brass/Bronze with chrome plating or suitable plastic material (Nylon/Polymer) and shall be self cleaning type.
20.	Flooding Nozzles	Nylon/Polymer.

21.	Banks	Two spray banks each connected to individual header

EQUIPMENT SELECTION CRITERIA

22.	Face Velocity through louver.	Not to exceed 2.5 m/s
23.	Max. Pressure drop	Not to exceed 6.5 mm Wg when clean
24.	Saturation efficiency	Not less than 90%.
25.	Face velocity of air through spray chamber.	Not to exceed 2.5 m/s.
26.	Allowable pressure drop for washing chamber.	15 to 20 mm Wg.

NOTE:

1) All parts coming in contact with moisture for air washer shall be spray galvanized/epoxy painted (2 coat of rust preventing epoxy primer & 2 coat of finished paint from both sides.)
2) Moisture eliminator shall have bends at 30 Degree with the direction of air flow & shall have effectively hooked edges for traping the water.

SECTION-D

AIR WASHER

1. GENERAL

1.1.1 This specification covers the design, manufacture, construction features, installation, commissioning and conducting performance test at site.

2. CODES AND STANDARDS

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

2.1.1 IS:277: Galvanised steel sheets

2.1.2 IS:1239: Mild steel tubes

2.1.3 IS: 2062:

3. DESIGN/CONSTRUCTION FEATURES

3.1 GENERAL

3.1.1 The air washer shall be designed for max. air velocity of 2.8M/sec. Circulating water quantity shall be 1.0 CMH for every 1000 CMH of air flow, unless otherwise stated in data sheet A. The minimum saturating efficiency of air washer shall not be less than 90% Minimum length of air washer shall be 2500 mm.

3.2 TANK (SUMP)

3.2.1 The air washer tank shall either be masonry or metallic construction as specified in data sheet A. Masonry tank shall be provided by purchaser whereas metallic tank shall be of welded construction, fabricated from not less than 6mm thick MS plates, and inside, outside surfaces shall be provided with anti corrosive paint (Zinc sprayed to coating thickness of 75 micron min.).

3.2.2 The air washer tank shall have a minimum depth of 600mm and tank construction shall be such that the suction screen can be replaced while the air washer is under operation. The inlet and outlet ends of tank shall be suitably constructed to accommodate distribution plates and eliminator plates.

3.3 DISTRIBUTION PLATE

3.3.1 The distribution plate shall be fabricated from minimum 18 gauge thick GSS and shall have minimum 50% free area. The angles used for supports shall be galvanised.

3.3.2 The distribution plate shall be built up of number of sections for easy handling.

3.4 HEADERS AND STAND PIPE

3.4.1 The air washer shall be of two bank construction (one cross flow and other unit flow). The piping up to and including 100mm dia meter shall be of galvanised steel and above 100mm dia shall be black steel (subsequently spray galvanized to coating thickness as per approved TDS). All piping shall be adequately supported.

3.5 SPRAY NOZZLES

3.5.1 Spray nozzles shall be made of HDP (High density polyethylene) and shall be self cleaning type. The nozzles shall be designed to produce fine atomised spray and shall be spaced to give, uniform coverage of the air washer section. The pressure drop through the nozzle shall be in the range of 1.4 kg/cm2 g to 2.4 Kg/cm2g

3.6 ELIMINATOR PLATE

3.6.1 Eliminator plate shall be fabricated from 22 gauge thick GSS (Zinc coating thickness as per approved TDS).The eliminator section shall have minimum 6 bends. Spacer bars, tie rods and supports shall be of galvanised steel construction. Eliminator box shall be complete with suitable drop tray and drain pipe.

3.7 SUCTION SCREENS

3.7.1 Suitable no. of suction screens shall be provided by vendor and one set of spare screens shall be furnished along with each air washer.

3.8 INSPECTION DOOR AND MARINE LIGHT

3.8.1 Air tight inspection door of 600x700mm, metallic construction shall be provided. The air washer shall be equipped with marine light as required.

3.9 MAKE UP, DRAIN AND QUICK FILL CONNECTION

3.9.1 The air washer shall be provided with quick fill and make up connection. The quick fill valve shall be a globe valve. Float valve for making connection shall be backed up by a gate valve. Drain connections complete with isolating valves shall be provided for both suction and main tank. Over-flow pipe shall be provided for main tank and shall be connected to drain pipe, before the isolating valve or drain. In case of masonry tanks suitable pipe pieces with stiffener plates shall be provided by Vendor for use during casting of masonry tank.

4. DATA TO BE FURNISHED BY VENDOR AFTER AWARD OF CONTRACT

4.1.1 Performance curve for air washer

4.1.2 GA drg.

4.1.3 Foundation drag. weight, dynamic loading etc.

4.1.4 O&M manual

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	TITLE	SPECIFICATION NO. PE-TS-400 & 402-554-A002
BHEL	**LOW PRESSURE AIR DISTRIBUTION SYSTEM**	VOLUME II-B
		SECTION D
	DATA SHEET - A	REV 00 / DATE AUG 2014
		SHEET 1 OF 1

1)	General (List of areas)	As per schedule/tender drgs of Ventilation system.
2)	i) GSS Duct Work	
	a) Type	Zinc coating (Refer Section-C of Specific Technical Requirement)
	b) 1.25 mm thk ducting	Bidder to estimate as per Drawings/sketch
	c) 1.0 mm thk ducting	Separately for Ventilation system.
	d) Any other size	(area wise)
	e) Battery Room ducting.	MS with epoxy painting on both sides.
3)	Special painting	MS Ducts in Battery Room to be epoxy painted. Both interior & exterior)
4)	Thermal Insulation	Required in duct for vent. System exposed to Sun only (furnished by Cement sand plaster)
5)	SA grilles (for each size) (SQ.M)	To suit airflow as per schedule/tender drgs.
6)	Exhaust Gravity/Manual relief dampers (for each size & to maintain a slight positive pressure inside.)	-do-
	a) Frame	1.6mm M.S.
	b) Louver	0.8mm Al.

NOTE:

1) Ducting shall be as per IS-655 standard.

2) Opposed blade type volume control damper (gang operated) shall be provided at each supply air grilles.

3) Bidder to provide suitable gasketing at each duct flange.(Asbestos shall not be used).

4) Supply Air Grills shall have 2 (two) set of adjustable louvres.

5) Bidder to indicate unit rates for variable items like ducting, grilles with & without volume control damper, gravity damper, thermal insulation, etc.

6) Grilles, frames & louvres shall be of at least 18 SWG sheet and 20 SWG MS respectively.

6) Fire damper shall be solenoid operated in accordance with NFPA. The solenoid shall be charged during open condition and shall be de-energising to close.

7) Access door in ducting system shall be provided as required.

8) MS Angle (painted) shall be used only as duct supports.

9) Velocity thru duct shall not exceed 12 M/sec for Ventilation system.

10) All exhaust/return air grilles shall have one set of louvres in the front or thick rat-proof wire net guards.

SECTION-D

LOW PRESSURE AIR DISTRIBUTION SYSTEM

1. GENERAL

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

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

2.1.2 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

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

3.1.2 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 IS 277 Gr. 275 / as specified in Data Sheet A.

3.1.3 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

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.

4.1 RECTANGULAR DUCTS

4.1.1

S.No.	Max Side	Sheet Thickness		Type of transverse Joint connections	Bracings
		(mm) GI	(mm) Al		
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 to1500	0.80 (22G)	1.00	40x40x3mm MS angle, flanged connections or 40mm pocket or40mm bar slips with 35x3mm bar reinforcing on 2.5m centres	40x40x3 mm MS angles, 1.2m from joints
e)	1501 to2250	1.00 (20G)	1.50	40x40x3mm MS angle, flanged connections or 40mm pocket or40mm 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				

4.1.2 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.

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

4.1.4 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

4.1.5 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.

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

4.2 ROUND DUCTS

4.2.1

S.No.	Duct dia-mm	Sheet Thickness		Reinforcing
		(mm) GI	(mm) 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 to1250	1.00	1.50	40x40x3mm girth MS angles at 2.0 meter centres

		(20G)		
e)	1251 & above	1.25 (18G)	1.80	40x40x3mm girth MS angles at 1.2m centres

4.2.2 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.

4.2.3 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.

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

4.4 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 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.

4.5 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.

4.6 CAULKING

Wherever duct passes through wall, the opening between masonary 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.

4.7 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.

4.8 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.

4.9 DAMPERS AND SPLITTERS

4.9.1 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.

4.9.2 Fire Dampers

Fire dampers/fire doors 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 sensor or fusible link type.

4.9.3 Gravity operated back draft dampers shall be provided to ensure pressurisation of rooms as specified. These dampers shall be designed such as not to allow infiltration of outside air while forced exit of air shall be achieved through this damper. The louvres shall be freely mounted on spindles to allow the dampers to open with the pressure developed by the fan. The dampers shall be provided with flange at inlet.

4.9.4 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.

4.9.5 Flashing

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

4.10 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 land 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.

4.11 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 appox. 125mm. centres to the casing. Suitable caulking compound (Pecora or equivalent) shall be inserted between the base of the angle and all masonary 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.

4.12 ACCOUSTIC LINING

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

4.13 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.

4.14 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–BY MAIN VENDOR

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.- visual inspection by Main Vendor.

5.1.2 Galvanised sheets - Test certificate shall be furnished for visual check, coating thickness, adhesion test, sheet thickness, uniformity of coating –review of TC by BHEL/Customer

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.

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.

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	TITLE	SPECIFICATION NO. PE-TS-400 & 402-554-A003A
BHEL	**CENTRIFUGAL FAN**	VOLUME II-B
	DATA SHEET - A	SECTION D
		REV 00 / DATE AUG 2014
		SHEET 1 OF 2

No.	Particulars	Data
1	**General Information**	
1.1	Fan Designation/application.	Refer schedule of Ventilation system/ Air washers & UAF Units.
1.2	Nos. required/capacity	Refer Section-C of Specific Technical Requirement
1.3	Location	Refer layout drg. Attached.
2.0	**Design Data**	
2.1	Type	DIDW for Air Washer and SISW for UAF
2.2	Type of blades	backward curved
2.3	Arrangement	To suit application as per layout.
2.4	Discharge direction	To suit application as per layout.
2.5	Duty	Continuous
2.6	Capacity at site (Cubic Meter/hr) & static pressure.	Refer Section-C of Specific Technical Requirement
2.7	Suction pressure (mm Wg)	As per system requirement.
2.8	Fluid	Atmospheric Air.
2.9	Suction Temperature	Refer weather data attached.
2.10	Suction humidity	Refer weather data attached.
3.0	**Materials**	
3.1	Fan Scroll	Heavy Gauge Mild Steet to IS: 2062 with galvanised
3.2	Fan Casing (side plates & stiffeners)	Heavy Gauge Mild Steet to IS: 2062 / IS: 1079 / Eq. Minimum 3 mm thick casing.
3.3	Impeller	Mild Steel/plate to IS: 2062
3.4	Impeller hub	Mild Steet/plate to IS: 2062
3.5	Impeller back plate blade & shroud	Mild Steet to IS: 2062 / IS: 1079 / Eq.
3.6	a) Shaft b) Shaft sleeve	EN-8 or eqv. -do-
3.7	Support frame and structure.	Mild Steet to IS: 2062
3.8	Flexible connection at outlet canvas with MS Flanges and cleats (3mm thick).	Fire resistant type plastic impregnated

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3.9	V Belt	ISI marked (Reinforced rubber section to IS: 4776)
3.10	V Pulley	Cast Iron multi groove to grade FG 20 as per IS: 210. Having taper lock type
3.11	Slide rails	M.S./C.I.
3.12	Connection pieces	G.I. according to supplier's design
3.13	Bolts & nuts	M.S. Galvanized / Epoxy painted.
3.14	Vibration isolating pads, washers and spring if any.	Hard synthetic rubber

4.0 **ACCESSORIES**

4.1	Common base plate	Required.
4.2	Anchor bolts	-do-
4.3	Vibration Isolators	Hard synthetic rubber
4.4	V-belt pulleys	-do-
4.5	V-belts	Reinforced rubber of appropriate section
4.6	Belt guard	Required.
4.7	Outlet damper	Required(M.S. Heavy Gauge)
4.8	Inlet guard	Required.
4.9	Inlet Vane (variable)	Not required.
4.10	Drain valve	Required.
4.11	Acoustic silencers	Not required.

5.0 **Motor**

5.1	Motor by	Bidder
5.2	Starter by	BHEL
6.0	Painting of fans including base frame	Galvanized / epoxy painting (as per Section-C & painting specifications)

NOTE:

1) Motors shall have 15 % margin on duty power point.

2) Fan shall be designed to operate with in 9% and 25% of system throttling line.

3) Opposed Multiple louvers damper shall be provided at fan outlet.Louvres shall be of 2 mm thick MS (galvanized). Casing shall be of 3.15 mm thick MS (galvanized).

	TITLE	SPECIFICATION NO. PE-TS-400 & 402-554-A003B
BHEL	**VENTILATION FAN (R.E.UNIT)**	VOLUME II-B
	DATA SHEET - A	SECTION D
		REV 00 / DATE : AUG 2014
		SHEET 1 OF 2

General Information

1)	Designation	Roof extractor Units for areas as per schedule of ventilation system.
2)	Nos. required	As per schedule.
3)	Service	Continuous
4)	Location	Roof of respective areas.
5)	Area	As per schedule

Design Data

6)	Type	axial flow type.
7)	Air delivery capacity	as per schedule of ventilation system.
8)	Fluid	Atmospheric Air.
9)	Temperature	50 Deg. C
10)	Static Pressure required	As per Section'C' schedule of ventilation system.
11)	Outlet air velocity	Not more than 12 m/sec.

Materials

12)	Casing/cowl/hood	M.S. Sheet to IS: 2062 /IS: 1079/Eq.
13)	Impeller	Cast A1uminium alloy to A-6M IS-617 Grade LM6
14)	Support frame and structure.	M.S. of adequate thickness (IS-2062).

ACCESSORIES

15)	Vibration isolating pads	Yes.
16)	Base frame for mounting	Yes.
17)	Wire Guard at inlet.	Yes.
18)	Disconnect switch	Yes.
19)	Gravity damper at outlet	Yes

Motor

20)	Motor by	Bidder
21)	Starter by	Bidder

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22)	Type of motor	Conforming to IS: 325 latest/as per specification.
23)	Free delivery test	Yes.
24)	Performance test at specified duty point.	Yes
25)	Speed	Not more than 1500 RPM

NOTE:

1. Motors shall have 15% on duty power Point.

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SECTION-D

VENTILATION FANS

1. GENERAL

This specification covers the design, manufacture, testing of performance at manufacturer's/sub-contractors works, delivery at site, handling at site, erection and commissioning of ventilation fans.

2. CODE AND STANDARDS

The design, manufacture and performance of equipment shall comply with all currently applicable statutes, regulations and safety codes in the locality where it is to be installed. The equipment shall conform to latest edition of applicable Indian Standards or their equivalent standards. Nothing in this specification shall be construed to relieve the vendor of this responsibility. In particular the equipment shall conform to the latest editions of the Following standards.

2.1.1 IS:4894 -Centrifugal fans

2.1.2 IS:3588 -Electric Axial Flow fans

2.1.3 IS:2312 -Propeller type A.C. ventilation fans

2.1.4 IS-3963 -Roof extractor units

2.1.5 BS:848 -Method of performance test for fans.

2.1.6 AMCA publication 99 standards handbook

2.1.7 AMCA standard 210, Test code for air moving devices.

3. DESIGN AND CONSTRUCTION

3.1 THE ENCLOSED DATA SHEET A GIVES THE NECESSARY DETAILS FOR CENTRIFUGAL/AXIAL/ROOF EXTRACTOR UNITS ETC.

3.2 WELDING PROCESS AND WELDERS EMPLOYED FOR FABRICATION SHALL BE QUALIFIED AS PER ASME SEC. IX

3.3 CASING

3.3.1 The centrifugal fans casing shall be of welded construction fabricated with heavy gauge material (min 3 mm) with flanges (min. 5 mm) on inlet and out let side for direct connection and shall be rigidly reinforced and supported by structural angles. The seams shall be permanently sealed airtight. Horizontal Split casings shall be provided on large size fans. Casing drain (at bottom) with threaded plug/ with valve shall be provided, as required. All mounting/ connecting holes shall be drilled off centre.

3.3.2 The axial flow casing for supply fans/roof extractors shall be of heavy gauge construction (min 3 mm) properly reinforced for rigidity and shall be complete with suitable supports. Access doors with suitable locking arrangement shall be provided in the casing for easy access to the motor and impeller. External junction box/ Terminal box on casing with IP-55 protection shall be provided, if required. Wiring for motor from external junction box/ Terminal box shall be through flexible conduit.

3.3.3 Suitable motor brackets designed for rigid mounting of motors, shall be provided for roof extractors and wall mounted exhaust/ supply fans.

3.4 IMPELLER

3.4.1 Centrifugal fan impeller shall have die formed, aerofoil or laminar blades welded to the rim and back plate and shall have non-overloading, self cleaning characteristics. Rim shall be spun to have smooth contour. If required, intermediate stiffening rings

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shall be provided. Shaft sleeves shall be furnished, if specified. The impeller, pulley and shaft sleeve shall be secured to the shaft by key and/or nuts (threaded opposite to direction of rotation of impeller). The impeller shall be statically and dynamically balanced.

~~3.4.2~~ The axial fan impeller shall be of high efficiency aerofoil design. The blades shall be mounted on a streamlined hub and the impeller shall be mounted directly on the motor shaft. Impeller shall be in one piece however; fabricated blades will be acceptable up to 450 mm impeller diameter.

3.4.3 Roof ventilator impeller may either be centrifugal or axial type. Backward inclined blades shall be provided for centrifugal impellers. Blades may be die-formed or cast. Axial flow impeller shall be directly mounted to motor shaft whereas centrifugal impeller may either be direct-driven or belt-driven. The shaft of belt-driven centrifugal fan shall be solid cold rolled carbon steel, ground and polished. However, direct mounted impellers are preferred.

3.5 BEARINGS:

3.5.1 The centrifugal fan bearing may be ball, roller or sleeve bearings of self-aligning heavy duty type with adequate capacity and life. Make of Bearings to be specified. Bearings shall be oil/grease lubricated and provided with fittings for lubrication from outside and shall be located in easily accessible position to facilitate maintenance.

3.6 INLET CONES AND GUARDS

3.6.1 Centrifugal fans inlet shall be spun to have a smooth contour. Inlet screen, if provided, shall be galvanised wire mesh of 25 mm square with wire thickness of min. 1.5 mm.

3.6.2 Inlet cone, outlet bell and suitably designed guards shall be provided.

3.7 GUIDE VANES:

3.7.1 In case of vane axial fans guide vanes shall be provided on discharge side.

3.8 BASE PLATE AND VIBRATION ISOLATORS

3.8.1 Base plate and vibration isolators, which may be double deflection rubber in shear or rubber in compression type or spring type shall be provided. With each fan rubber bushes, washers wherever needed for vibration isolator in sufficient nos. shall be included, as required, to ensure isolation of foundation from vibration of equipment. For roof ventilators suitable mounting arrangement shall be provided such that there is no ingress of rain water into the building.

3.9 HOOD AND COWL

3.9.1 Roof exhaustors shall be provided with hinge type hood providing easy access to motor and impeller. Weather proof lockable type disconnect switch shall be provided such that hood can open only when the disconnect switch is in'off' position. On larger size of roof ventilators hoods may be of split construction. 15 mm mesh galvanised bird screen shall be provided.

3.9.2 Rain protection cowls shall be designed to suit wall exhausters/supply fans for protecting fans from rain. The cowls shall be provided with bird screen of heavy gauge expanded metal netting.

3.10 SPEED

3.10.1 The speed of axial flow fans/roof ventilators shall not exceed 960 RPM for impeller dia exceeding 450 mm and shall not be greater than 1440 with impeller dia less than 450 mm.

4. MOTORS

Drive motors shall be of totally enclosed type, suitable for horizontal/vertical mounting as applicable and shall comply with the requirments of the specifications furnished elsewhere for motors.

5. ACCESSORIES

Accessories as specified in Data sheet-A and as required for satisfactory trouble free & safe operation of fans shall be provided.

TESTING AND INSPECTION

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

- Visual inspection of sheets/plates, angles, channels etc. – Pitting, lamination in sheets/ plates, angles and channels shall be avoided.- visual inspection by main contractor of BHEL.
- Sheets/ Plates - Test certificate shall be furnished for physical and chemical properties for sheets / plates- for review by BHEL
- Shaft: Mechanical and chemical-– review by BHEL
- Motors (of approved make): Routine TC ,FLP TC if applicable
- Workmanship and dimensional check as per manufacturing drg. and approved Drgs.- by main contractor of BHEL.- Shall be checked by BHEL/ Customer during final inspection.
- Balancing of impellers- Dynamic balancing certificates shall be furnished –grade 6.3 or better to ISO-1940. Balancing weights shall be positively locked/ welded to avoid loosening. - witness by manufacturer - TC to be furnished for review by BHEL(consisting of weight of impeller, radius of correction and balancing rpm). For spare impellers Dynamic Balancing shall be witnessed by BHEL.
- Performance test of one Centrifugal fan or Axial Fan /per type/per size as per applicable standard – by BHEL.
- Centrifugal/ Axial fans 100% run tested by main contractor of BHEL. Run test by BHEL/Customer may be at random or 100%- Vibration shall be within satisfactory zone of VDI 2056 (group- G) machines when measured on bearing housing and noise level <85 dbA at 1 metre distance. Max. Temp. on bearing housing- 40 degrees Centigrade + ambient

Description		**Data**
1)	**General**	
1.1	Service	Ventilation system .
1.2	Location	Main power house bldg. & Blower room of both the unit.
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** (pre filters). 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.

SECTION-D

AIR FILTER

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 Em (%) shall be >/= 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 Em (%) of >/= 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 Am (%) shall be >/= 90. However oil wetted air filters shall have Average Efficiency Em (%) >/= 90 as per BS EN - 779..

3.4 ABSOLUTE FILTERS (HEPA)

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 dioctyphalate 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.

3.5 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:

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

4.1.1 Dimensional inspection of frame & filter media – TC from Manufacturer- review by BHEL/Customer.

4.1.2 Witnessing by BHEL/Customer 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.

4.1.3 Verification of type test certificates for similar type & size of filters for sodium flame test as per BS-3928 (if applicable- refer data sheet) - by BHEL/Customer

5. DATA TO BE FURNISHED BY VENDOR AFTER AWARD OF CONTRACT

5.1.1 GA Drawing

5.1.2 Drawing showing material/construction detail

5.1.3 Installation and\service manual

5.1.4 Rating curves/charts

5.1.5 Test certificates

5.1.6 Elect. diagrams (when automatic cleaning type)

	TITLE	SPECIFICATION NO. PE-TS-400 & 402-554-A005
BHEL	**CENTRIFUGAL PUMPS**	VOLUME II-B
	DATA SHEET - A	SECTION D
		REV 00 / DATE AUG 2014
		SHEET 1 OF 2

S.No.	DESCRIPTION	DETAILS
1)	Designation	Air washer Pumps.
2)	Type	Horizontal Centrifugal Type.
3)	Quantity	As per section-C
4)	Installation	On floating type foundation inside Air Washer Room
5)	Fluid to be handled	Filtered Water.
6)	Temperature of Fluid	To suit.
7)	Capacity Cum/Hr TDH at	To suit system requirements however head shall Not be less than 35 MWC.
8)	Duty	————Continuous (24Hr./day)————
9)	Suction condition	————Flooded————
10)	Type of drive	Direct (flexible coupling)
11)	Type of prime mover	LV Ac Motor.
12)	Maximum speed	Not more than 1500 RPM
13)	Type of lubrication	Grease Lubrication

MATERIALS OF CONSTRUCTION

S.No.	DESCRIPTION	DETAILS
a)	Impeller	Bronze
b)	Pump Shaft	Carbon Steel C-45, IS-1570 or class-IV, IS-1875
c)	Casing	Cast Iron, grade-20, IS- 210
d)	Wearing ring	Bronze
e)	Shaft Sleeve	Bronze
f)	Base Plate/frame	Cast Iron to Grade FG-200 IS-210/fabricated Mild steel
g)	Counter Flanges	Mild Steel
h)	Stuffing box bush	Deep Bronze packing to be renewable with Case.
i)	Stuffing box gland	Flexible graphite or PTFE (Asbestos shall not be used)
j)	Pump Motor Coupling	Pin & Bush type (Flexible)
k)	Bolt and Nuts	MS

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15) **ACCESSORIES REQUIRED**

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

a)	Priming funnel	Yes
b)	Drain piping upto Common drain point.	Yes
c)	Vent	Yes
d)	Suction & Discharge Pressure gauges	Yes
e)	Companion flanges	Yes
f)	Common base plate	Yes
g)	Suction strainer.	Yes
h)	Isolating valve.	Yes
i)	NRV at pump outlet at inlet/outlet	Yes
j)	Any special requirements	Yes
k)	Inspection & Testing	Yes

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1.0 GENERAL

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

2.0 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):

a) IS-1520 :Horizontal centrifugal pumps for clear, cold and fresh water
b) IS-5120 :Technical requirements - Rotodynamic special purpose pump
c) IS-1710 :Vertical turbine pumps for clear, cold and fresh water
d) Hydraulic Institute Standards of USA
e) BS - 599 :Method of testing Pumps
f) PTC - '6' :Centrifugal Pumps Power test code
g) API - 610

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 engineer shall be final and binding.

3.0 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

4.0 CONSTRUCTIONAL 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 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.

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**

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 statically and dynamically balanced individually. The assembled rotor shall be dynamically balanced and checked for eccentricity.

4.3 **Wearing Ring**

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 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**

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 runway speed.

4.5 **Bearings**

Bearings and hydraulic devices (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 Boxes**

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.

4.7 **Shaft Couplings**

The pumps shall be directly coupled to their drives through heavy duty flexible coupling. Suitable coupling guards 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**

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.

If required in the data specification sheet, steel sole plates shall be provided, below the base plate.

4.9 **Prime Mover**

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

4.10 **Lifting arrangement**

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

5.0 **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.

6.0 **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.

7.0 **SCOPE OF INSPECTION AND TESTING**

7.1 **Castings**

7.1.1 Witnessing pouring and thereafter physical testing of castings of 'Critical' nature such as casings, impellers, diffusers.

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 neat treatment charts (as applicable)

Note: Casting effects shall not be filled by any method until an unless approved by BHEL/their customer

7.2 **Forgings and**

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 neat treatment charts (time temperature) (as applicable).

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.

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 Hydro test as per para 7.5.1 below.

Note: For para 7.1.2, 7.2.1 and 7.3.1 above; in case correlating test certificates are not available, material shall be identified by BHEL and physical tests conducted by the supplier in the presence of BHEL

7.4 **In process Inspection and Testing**

7.4.1 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. No defect shall be permitted on moving parts. 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) as per applicable code, in absence of which as per ASTM E388 and acceptance norms as stipulated hereunder.

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:

Capacity V/s Head

Capacity V/s Power absorbed by pump

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 and noise level measurement. Acceptance norms shall be as per manufacturers standards.

7.5.4 Overall dimensions as per GA drawings

7.5.5 Examination after selective opening up after running for pumps operating at speed over 1800 rpm and capacity exceeding 68M3/hr.

7.5.6 Painting and packing as per technical specification.

7.6 **Test at site**

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**

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.

8.0 **CLEANING, PROTECTION & PAINTING**

Before shipment of the equipment to be supplied under this specification the necessary cleaning, flushing etc., as per manufacturers standard shall be done to remove all dirts, scales etc. Shop coats of rust inhibiting paints, lacquers etc., shall be applied to various parts as necessary. Flanges, inlet and outlet pipe, etc shall be protected.

9.0 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:-

i) Foundation base plate and sole plate details as applicable

ii) Civil foundation and anchor bolts details and loading data

iii) 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 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.

10.0 DRAWINGS AND DATA AFTER AWARD OF CONTRACT

The vendor shall furnish the drawings and other technical documents as required in Data Sheet-C enclosed with this specification

10.1 MANUFACTURERS NAME AND TAG. PLATES

Each pump shall have a permanently attached brass/metal tag on the body indicating the following information both in Hindi and English.

a) Manufacturer's name and trade mark
b) Design Capacity and Head
c) Design
d) 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.

11.0 DRAWINGS/DOCUMENTS TO BE FURNISHED BY VENDOR AFTER THE 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.

INSULATION MATERIAL :

Insulation	Code	Thermal Conductivity MW/cm ^{0}C	Density Kg/m^3
Resin bonded mineral wool / glass wool	IS:8183	0.49 at 50 ^{0}C	At least 24 (For Thermal Insulation) 48 for Acoustic insulation
Mineral Wool Pipe Section (min. Gr.2)	IS:9842	0.43 at 50 ^{0}C	At least 81
Expanded Polystyrene	IS:4671	0.37 at 50^{0}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 Glass Wool (IS:8183)	Roll / Slab	50
ii)	Refrigerant Piping	a) Expanded Polystyrene	Pipe Section	75
		or		
		b) Mineral Wool	Pipe Section	75
iii)	AHU drain pipe (Suction & Liquid line)	a) Expanded Polystyrene	Pipe Section	25
		or		
		b) Mineral Wool	Pipe Section	25
iv)	AHU casing and condensate pan	a) Expanded Polystyrene	Slabs	25
		or		
		b) Mineral Wool	Slabs	25
v)	Chilled water piping, valves & specialties	a) Expanded Polystyrene	Pipe Section	75
		or		
		b) Mineral Wool	Pipe Section	75
vi)	Chiller	a) Expanded Polystyrene	Slabs	100
		or		
		b) Mineral Wool	Slabs	100
vii)	Chilled Water Pumps	a) Expanded Polystyrene	Slabs	50
		or		
		b) Mineral Wool	Slabs	50
viii)	Expansion tank with pipe	a) Expanded Polystyrene	Slabs/Pipe Section	50
		or		
		b) Mineral Wool	Slabs/Pipe Section	50
ix)	Acoustic insulation of Duct	Glass Wool	Slab	25

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SECTION-D

THERMAL INSULATION FOR COLD SURFACES

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 :-

2.1.1 IS:3069 : Glossary of terms & symbols & units relating to thermal insulation materials.

2.1.2 IS:4671 : Expanded polystyrene for thermal insulation purposes.

2.1.3 IS:3677 : Mineral wool for thermal insulation

2.1.4 IS:8183 : Resin bonded mineral wool

2.1.5 IS:702

3. DESIGN REQUIREMENTS

3.1.1 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.

3.1.2 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.

3.1.3 The insulation material, density and thickness etc. Shall be as specified in DATA SHEET A.

4. APPLICATION DETAILS

4.1.1 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.

4.1.2 A layer of solvent free, anticorrosive paint shall be applied & allowed to dry.

4.1.3 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.

4.1.4 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 bitumen/equivalent adhesive. Voids if any shall be packed with suitably cut pieces of insulation material.

4.1.5 In case of double layer application both circumferential & longitudinal joints shall be suitably staggered.

5. VAPOR SEALING & INSULATION FINISH

The insulation shall be treated for vapor sealing & weather proofing & finished as specified in DATA SHEET A The acceptable types of finishes are outlined below:-

5.1 FINISHING SYSTEM I: EXTERNAL INSULATION WITH PLASTER FINISH

5.1.1 A thick vapor seal of hot bitumen @ 2.5 kg/Sqm shall be applied on the outer surface of insulation & allowed to dry.

5.1.2 The surface shall then be wrapped with 20mm (3/4"_ hexagonal mesh of 24 SWG GI wire, butting all the joints & laced down with 22 SWG GI lacing wire.

5.1.3 12.5mm (1/2 inch) thick sand cement plaster in the ratio of (1:1) shall be applied in two layers, the second layer being brought to a smooth finish. A water proofing compound shall be added to the cement before its application.

5.2 FINISH SYSTEM II: EXTERNAL INSULATION WITH PLASTER FINISH OVER POLYTHENE.

5.2.1 The insulation shall be covered with 500 g polythene/polythene bonded Hessians (PBH) with 50mm overlap on longitudinal & circumferential joints. Overlaps shall be sealed with synthetic adhesive in case o-f polythene & liberal coat of bitumen in case of PBH:

5.2.2 The surface shall then be wrapped with 20mm (3/4") mesh of 24 SWG GI wire butting all the joints & laced down with 22 SWG GI lacing wire.

5.2.3 12.5mm thick (1/2 inch) sand cement plaster in ratio of(4:1) shall be applied in two layers, the second layer being brought to a smooth & even finish similarly as described above.

5.3 FINISH III:EXTERNAL INSULATION WITH SHEET METAL FINISH

5.3.1 The insulation shall be covered with 500g polythene with 50mm overlaps at joints which shall be sealed with synthetic adhesive or equivalent compound.

5.3.2 The polythene shall be covered with 24 gauge GI/aluminum sheet

5.3.3 25mm wide x 22 SWG GI/aluminum peripheral straps shall be fixed over the GI/aluminum sheet at 300mm centres to secure.

5.4 FINISH IV: EXTERNAL INSULATION WITH PLASTER & WATER PROOFING COMPOUND

For ducts & piping exposed to atmosphere, the finish shall be as follows:

5.4.1 A thick vapor seal of hot bitumen at 2.05 kg/sq.m shall be applied on the outer surface of insulation & allowed to dry.

5.4.2 The surface shall then be wrapped with 20mm (32/4") hexagonal mesh of 24 SWG GI Wire butting all the joints & laced down with 223 SWG GI lacing wire.

5.4.3 12.5mm thick (1/*2 inch) sand cement plaster in ratio of (4:1) shall be applied in two layers, the second layer being brought to a smooth finish with water proofing compound added to the cement.

5.4.4 3mm (1/8") thick coat of water proofing compound shall be applied & wrapped with fibre glass RP tissue. A final coat of 3mm thick water 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.

6. INSULATION OF PUMPS & VALVES

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.

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)

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 purchasers approval.

8. PAINTING

8.1.1 Pipe work having insulation & cladding shall be provided with color identification for the fluids handled and for indicating direction of flow.

8.1.2 Equipment surfaces having insulation and cladding shall also have identification numbers and any other relevant data provided on the insulated surface.

8.1.3 All painting for insulated surfaces shall conform to the requirement specified elsewhere.

9. DATA TO BE FURNISHED AFTER AWARD OF CONTRACT

9.1.1 Final version of data sheet 'B' incorporating changes if any along with design data.

9.1.2 Test certificates/reports giving result of insulation to ensure conformance to applicable codes & standards & in particular the following :-

i) Thermal conductivity test

ii) Sound absorption coefficient test

iii) Corrosion test

iv) Sulphur content, moisture content, shot content, moisture absorption etc.

v) Compressive strength & cross breaking strength test.

9.1.3 Sketches/technical literature/sectional drgs. indicating insulation materials finish and method of application etc.

9.1.4 Manual dealing with safety aspects & instructions for combating fire arising out of insulation work

9.1.5 Instructions on maintenance of insulation work.

SECTION: E

INSPECTION AND TESTING

1.00.00 INSPECTION AND TESTING

1.01.00 Inspection and Tests during Manufacture.

1.01.01 The method and techniques to be used by the Bidder for the control of quality during manufacture of all plant and equipment shall be agreed with the Owner.

1.01.02 The Owner's general requirements with respect to quality control and the required shop tests are set out elsewhere in this specification.

1.01.03 Before any item of plant or equipment leaves its place of manufacture the Owner shall be given the option of witnessing inspections and tests for compliance with the specification and related standards.

1.01.04 Advance notice shall be given to the Owner as agreed in the Contract, prior to the stage of manufacture being reached, and the piece of plant must be held at this stage until the Owner has inspected the piece, or has advised in writing that inspection is waived. If having consulted the Owner and given reasonable notice in writing of the date on which the piece of plant will be available for inspection, the Owner does not attend the Bidder may proceed with manufacture having forwarded to the Owner duly certified copies of his own inspection and test results.

The owner's representative shall have at all reasonable times access to bidder's or his sub-vendor's premises and shall have power to inspect/ examine materials and workmanship or equipment under manufacture.

The Bidder shall forthwith forward to the engineer duly certified copies of the Test Certificates in six copies (one to the Purchaser and five to the Consulting Engineer) for approval. Further nine (9) copies of Shop Test Certificates shall be bound with Instruction Manuals referred to elsewhere.

For electrical equipment, routine tests as per relevant IS spec are to be carried out on all equipment. Type tests are also to be carried out on selected equipment as detailed in the specs of concerned electrical equipment.

1.01.05 Under no circumstances any repair or welding of castings be carried out without the consent of the Engineer. Proof of the effectiveness of each repair by radiographic and/or other non-destructive testing technique, shall be provided to the Engineer.

1.01.06 All the individual and assembled rotating parts shall be statically and dynamically balanced in the works.
Where accurate alignment is necessary for component parts of machinery normally assembled on site, the Bidder shall allow for trial assembly prior to despatch from place of manufacture.

1.01.07 All materials used for the manufacture of equipment covered under this specification shall be of tested quality. Relevant test certificates shall be made available to the Purchaser. The certificates shall include tests for mechanical properties and chemical analysis of representative material. Equipment or parts coming under any statutory 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 magnuflux 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

BHARAT HEAVY ELECTRICALS LIMITED

CORPORATE QUALITY ASSURANCE

PROJECT: **SYSTEM :**

VENDOR : **ITEM :**

SL NO	COMPONENT /OPERATION OPERATIONS	CHARACTERISTICS CHECKED	CATEGORY	TYPE /METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11

Legend: **1. BHEL** **2. Vendor** **3. Sub-Vendor**

QP No	**CQS/SQP/31**	**Signature**	**Date**			
	Rev		**Name**			
Page No	**1 of 1**		**Party**	**Customer/Consultant**	**Bhel**	**Vendor**

Praveen Kishore

S A Khan

Varun Jain

VOLUME III

BIDDER SHOULD SUBMIT THE SIGNED AND STAMPED COPY OF THE FOLLOWING DOCUMENTS ALONG WITH THE BID:

1. Compliance cum confirmation certificate
2. Guaranteed power consumption
3. Schedule of technical deviation, if any (Deviation sheet part B)
4. Un priced format for main package
5. Un priced format for mandatory spare
6. Complete set of technical specification
7. No deviation deviation certificate
8. List of tools and tackles
9. List of commissioning spares
10. Filled electrical load data sheet (Page 95 of 279)

Note: - Bidder to submit all the above mentioned document in .pdf file only, hard copies are not required.

Praveen Kishore
S A Khan
Varun Jain

DRAWING/DOCUMENT DISTRIBUTION LIST

All documents & drawings shall be in English and in metric units

SI		LII	NLC (HQ)	NLC-SITE	BHEL SITE	PMG BHEL	PEM/ UNITS/ PSSR	REMARKS
1	Master list of drawings / document (duly indicating schedule of submission)	Soft copy	Soft copy	Soft copy		Soft copy	Soft copy (S)	
2	Drawings / document for Approval/Information (First Submission)	Soft copy + 2 prints	Soft copy + 3 prints	Soft copy + 1 print		Soft copy	Soft copy (S)	
3	Return with comments/approval	Soft copy (S)	Soft copy	Soft copy		Soft copy	Soft copy	
4	Drawings / Documents for approval (second & subsequent submissions till approval)	Soft copy	Soft copy	Soft copy		Soft copy	Soft copy (S)	
5	Drawings / documents for distribution (Approved by NLC, in cat. 1 or Received for Information)	Soft copy + 2 print (HQ+ Site)	Soft copy + 3 prints	Soft copy + 3 prints	Soft copy + 5 prints	Soft copy	Soft copy (S)	
6	Erection Drawings / documents	-	Soft copy + 1 print	Soft copy + 3 prints	Soft copy + 5 prints	Soft copy	Soft copy (S)	
7	As built Drawings / documents	Soft copy + 1 print	Soft copy + 1 print	Soft copy + 3 prints	Soft copy + 5 prints	Soft copy	Soft copy (S)	
8	Operation & Maintenance Manual	-	Soft copy + 1 print	Soft copy + 10 prints	Soft copy + 5 prints	Soft copy	Soft copy (S)	
9	Type Test Certificate	Soft copy	Soft copy + 1 print	Soft copy + 3 prints	Soft copy + 5 prints	Soft copy	Soft copy (S)	

NOTES:

1. The above schedule of submission does not include Docs/Drgs. of quality assurance/inspection and delivery/dispatches. QAP documents to be submitted as per distribution schedule.
2. Date of submitting soft copy is to be taken as date of submission.
3. S – Source for generation of document.

Praveen Kishore
S A Khan
Varun Jain

DATA SHEET-B

SL.NO.	ITEM	UNIT	PARTICULARS
1.	Manufacturer	--	
2.	Model No.	--	
3.	Nos. offered	--	
4.	Area	--	
5.	Specific weight of air at temp.	Kg/M^3	
6.	Static pressure at rated speed	MMWG	
7.	Total pressure at rated speed	MMWG	
8.	Outlet velocity of air	M/sec	
9.	Rated speed	RPM	
10.	Critical speed of fan shaft & impeller assembly	RPM	
11.	Tip speed	M/sec	
12.	Impeller dia	MM	
13.	No. of blades	--	
14.	Pitch angle	Degree	
15.	Efficiency at rated speed	%	
16.	Fan power at rated speed	KW	
17.	Recommended/selected motor	KW	
18.	Material of impeller & thickness and code conference	MM	
19.	Material of casing & thickness and code conference	MM	
20.	Material of casing & shaft and diameter code conference	MM	
21.	Type of bearing & material		
22.	Type of drive & manufacturer		
23.	Percentage reduction in capacity of fan when any of the following are added a) Inlet cone or bell b) Outlet cone c) Louver shutter d) Wall cowl e) Wire mesh guard	 % % % % %	

24.	Motor data a) Voltage, phase, frequency b) Rated KW c) Type of enclosure d) Type of insulation e) Motor design ambient of temp.	 V/ph/HZ KW -- -- °C	
25.	Motor data sheet B as per spec. PES-5-6-02 furnished	Yes / No	
26.	Fan statically & dynamically balanced	Yes / No	
27.	Weight of fan/motor/base drive	Kg	
28.	Fan sound pressure level at 3 impeller dia from center of fan inlet/outlet (with ref. To $10^5 N/M^2$)	Db (A)	
29.	Performance curves enclosed	Yes / No	

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S.NO	ITEM	UNIT	PARTICULARS
1.0	Material & code conformance of duct sheets	--	
2.0	Zinc coating/class as per IS-277	gms/m^2	
3.0	Any deviation from specification requirements for construction & fabrication	Yes/No	
4.0	Following accessories included	Yes/No	
4.1	Branch dampers	Yes/No	
4.2	Fire dampers	Yes/No	
4.3	Guide vanes	Yes/No	
4.4	Duct supports	Yes/No	
5.0	Qty. of duct sheets included 18G sheet 20G sheet Any other size	 M^2 M^2 M^2	
6.0	Qty. of supply air grilles & diffusers included	M^2	
7.0	Qty. of return air duct work, if any	M^2	
8.0	Thermal insulation		
8.1	Type/make/thickness	mm	
8.2	Qty.included		
9.0	Acoustics insulation	M^2	
9.1	Type/make/thickness	MM	
9.2	Qty.included	M^2	
10.0	Any deviation from inspection & testing requirements	Yes/No	
11.0	Pressure drop across i. Supply air diffusers ii. Supply air grilles	 Mm WG Mm WG	
12.0	Velocity at outlet i. Grilles ii. Diffusers	 M / sec M / sec	
13.0	Throw of i. Grilles ii. Diffusers	 M M	

	Title- 2X600 MW SCCL TPP	Spec. No.: PE-TS-400 & 402-554-A003
	AIR FILTER	Volume III
	DATA SHEET 'B'	Sheet 1 of 1

S.NO	ITEM	UNIT	PARTICULARS
1.	Manufacture	--	
2.	Model No.	--	
3.	Type	--	
4.	Size	mmxmm xmm	
5.	Rating	M^3/hr	
6.	Nos.	--	
7.	Efficiency	Microns	
8.	Test method	--	
9.	Press drop at clean conditions	Mm wg	
10.	Press drop at dirty conditions	Mm wg	
11.	Filter media	--	
12.	Whether cleanable	--	
13.	Material of frame	--	
14.	Weight of filter	Kg	
15.	Mounting frame work	--	

SL.NO.	ITEM	UNIT	PARTICULARS
1.	Manufacturer's name		
2.	Designation of pump		
3.	Model No.		
4.	Type of pump		
5.	Nos. provided		
6.	Capacity	M^3/hr	
7.	TDH at rated capacity	MWC	
8.	No. of stages	--	
9.	Shut off head with discharge valve fully closed	MWC	
10.	Pump rated speed	RPM	
11.	NBSH required	MWC	
12.	Pump efficiency at duty point	%	
13.	Power required at pump Shaft at duty point	KW	
14.	Maximum power required at any operating point	KW	
15.	Motor rated capacity	KW	
16.	Material of construction & code conformance		
	i. Casing		
	ii. Shaft		
	iii. Impeller		
	iv. Bearings		
	v. Wearing ring		
	vi. Shaft sleeve		
	vii. Stuffing box packing		
	viii. Base plate	--	
	ix. Pump motor coupling	--	
	x. Counter flanges	--	
	xi. Bolts &nuts	--	
	xii. Stuffing box bush	--	
	xiii. Stuffing box gland		
17.	Drilling standard for flanges/ counter flanges	--	
18.	Bearing (type & nos. provided per set)	--	
19.	Method of lubrication of bearings	--	
20.	Type of shaft sealing arrangement	--	
21.	Coupling (type)		

22.	Coupling guard provided?	Yes/No	
23.	Method of fastening impeller to shaft		
24.	Base plates, foundation bolts and hardwares Provided?	Yes/No	
25.	Lifting lugs, eye bolts etc. provided for each pump drive set.	Yes/No	
26.	Counter flanges with nuts, bolts and gaskets provided?	Yes/No	
27.	Direction of rotation	--	
28.	Maximum allowable particle size	--	
29.	Dimension		
29.1	Pump/motor Length Width Height	 mm mm mm	
29.2	Length and width of base plate	mmxmm	
29.3	Suction dia	mm	
29.4	Discharge dia	mm	
30.	Weights		
30.1.	Completely assembled pump and drive motor	Kg	
30.2	Weight of pump only	Kg	
30.3	Weight of motor	Kg	
30.4	Maximum weight to be handled during erection and maintenance	Kg	
30.5	Total shipping weight	Kg	
31.	Testing		
31.1	Hydrostatic test pressure	Kg/cm^2 (g)	
31.2	Duration of test	Hr	
31.3	Testing and inspection provided as per purchaser's requirement	Yes/no	
32.	Painting details Painting details would be furnished to the successful bidder during contract stage.		

COMPLIANCE CUM CONFIRMATION CERTIFICATE

The bidder shall confirm compliance with following by signing/ stamping this compliance certificates (every sheet) and furnishes 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 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 be considered for reference only, same shall be subject to BHEL/ CUSTOMER approval in the event of order.

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. Prices for special tools & tackles, if any, shall also be included in the base price.

g) All sub vendors shall be subject to BHEL/ CUSTOMER approval in the event of order.

h) The performance guarantees shall stand valid till at least eighteen (18) months after commissioning of AC system or as per commercial terms and conditions whichever is more.

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. This clause will apply in case during site 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) That 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) Any commercial documents / deviations shall not be considered during technical evaluation. Moreover any technical deviations included in commercial deviation either explicit or implicit shall be considered null and void even if agreed by BHEL during commercial evaluation stage

Praveen Kishore

S A Khan

Varun Jain

PROJECT: 2X500 MW NEW NEYVELI TPP PACKAGE: VENTILATION SYSTEM MASTER DRAWING LIST					
S. NO.	**DRAWING NO**	**DRG./ DOC. TITLE**	**SUBMISSION FROM THE DATE OF LOI (WEEK)**	**APPROVAL/COMMENTS BY BHEL FROM THE DATE OF RECEIVED (WEEK)**	**RESUBMISSION BY VENDOR(IF REQUIRED) (WEEK)**
*1	PE-V0-XXX-554-A001	INSPECTION CATEGORISATION PLAN	4	2	2
*2	PE-V0-XXX-554-A002	QUALITY PLAN OF AIR WASHER & UAF	12	2	2
*3	PE-V0-XXX-554-A003	QUALITY PLAN OF CENTRIFUGAL PUMPS	12	2	2
*4	PE-V0-XXX-554-A004	QUALITY PLAN OF CENTRIFUGAL FANS	13	2	2
*5	PE-V0-XXX-554-A005	QUALITY PLAN OF AXIAL FLOW FANS & RE UNITS	14	2	2
*6	PE-V0-XXX-554-A006	QUALITY PLAN OF MOTOR	15	2	2
7	PE-V0-XXX-554-A101	VENTILATION FAN SCHEDULE.	22	2	2
*8	PE-V0-XXX-554-A201	DATA SHEET & GA FOR AIR WASHER ALONGWITH FAN AND PUMP WITH FOUNDATION DETAILS.	12	2	2
*9	PE-V0-XXX-554-A202	DATA SHEET & GA FOR UAF ALONGWITH FAN AND PUMP FOUNDATION DETAILS.	10	2	2
*10	PE-V0-XXX-554-A203	DATA SHEET & GA FOR ROOF EXTRACTOR, AXIAL EXHAUST AND SUPPLY AIR FANS WITH FIXING ARRANGEMENT.	12	2	2
11	PE-V0-XXX-554-A204	DATA SHEET & GA FOR VALVES AND STRAINER.	8	2	2
12	PE-V0-XXX-554-A205	DATA SHEET FOR INSULATION.	8	2	2
13	PE-V0-XXX-554-A206	DATA SHEET & GA FIRE DAMPER.	8	2	2
14	PE-V0-XXX-554-A207	DATA SHEET FOR INSTRUMENTS (PRESSURE GAUGE, TEMP GAUGE, LEVEL GAUGE, PRESSURE SWITCH, LEVEL SWITCH).	14	2	2
15	PE-V0-XXX-554-A208	DATA SHEET OF PIPE.	5	2	2
16	PE-V0-XXX-554-A209	DATA SHEET OF GI AND MS SHEET.	5	2	2
17	PE-V0-XXX-554-A210	DATA SHEET & GA FOR PRE AND FINE FILTERS.	8	2	2
18	PE-V0-XXX-554-A211	DATA SHEET FOR MOTORS (A/W Fan, A/W pumps, UAF Fan, UAF Pump, RE units, Supply and Exhaust axial fans)	15	2	2
19	PE-V0-XXX-554-A401	TYPICAL Details DUCT FABRICATION DRAWING / SUPPORT / ERECTION. INSULATION OF DUCTING / PIPING & EQUIPMENTS PIPE ERECTION	7	2	2
*20	PE-V0-XXX-554-A403	GA OF PROPELLER FAN.	9	2	2
21	PE-V0-XXX-554-A601	SCHEME FOR AIR DISTRIBUTION IN TG BUILDING AND ESP BUILDING.	5	2	2
*22	PE-V0-XXX-554-A602	PID FOR AIRWASHER AND UAF UNIT.	8	2	2
*23	PE-V0-XXX-554-A603	AIR WASHER LAYOUT OUTSIDE "A ROW" ALONG WITH FOUNDATION DETAILS, INCLUDING SUPPORT DETAILS FOR DUCT FROM AIR WASHER ROOM TO "A ROW".	14	2	2
*24	PE-V0-XXX-554-A604	AIR WASHER LAYOUT FOR "B-C BAY" SIDE ALONGWITH FOUNDATION DETAILS - TG BUILDING	14	2	2
*25	PE-V0-XXX-554-A605	UAF LAYOUT ALONGWITH FOUNDATION DETAILS - ESP BUILDING.	11	2	2

PROJECT: 2X500 MW NEW NEYVELI TPP PACKAGE: VENTILATION SYSTEM MASTER DRAWING LIST					
S. NO.	**DRAWING NO**	**DRG./ DOC. TITLE**	**SUBMISSION FROM THE DATE OF LOI (WEEK)**	**APPROVAL/COMMENTS BY BHEL FROM THE DATE OF RECEIVED (WEEK)**	**RESUBMISSION BY VENDOR(IF REQUIRED) (WEEK)**
*26	PE-V0-XXX-554-A606	VENTILATION DUCT LAYOUT FOR TG BUILDING - 'A' ROW SIDE (UNIT I & II).	12	2	2
*27	PE-V0-XXX-554-A607	VENTILATION DUCT LAYOUT FOR TG BUILDING - 'BC BAY' SIDE (UNIT I & II).	12	2	2
*28	PE-V0-XXX-554-A608	VENTILATION DUCT LAYOUT FOR ESP BUILDINGS.(UNIT I & II).	12	2	2
*29	PE-V0-XXX-554-A609	LOCATION OF ROOF EXTRACTOR UNIT IN TG BUILDING ALONGWITH FIXING DETAILS.	12	2	2
30	PE-V0-XXX-554-A610	VENT. ARRANGEMENT FOR BATTERY ROOM.	13	2	2
31	PE-V0-XXX-554-A611	VENT. ARRANGEMENT FOR VARIOUS AUXILIARY BUILDING.	18	2	2
32	PE-V0-XXX-554-A701	ELECTRICAL FEEDER LIST.	18	2	2
33	PE-V0-XXX-554-A702	VENTILATION CABLE SCHEDULE	18	2	2
34	PE-V0-XXX-554-A901	P.G. TEST PROCEDURE.	12	2	2
35	PE-V0-XXX-554-A902	O & M MANUAL.	25	2	2

NOTE :-
1 :- (*) MARKED DRAWINGS/DOCUMENTS SHALL BE TREATED AS BASIC ENGINEERING DRAWING/DOCUMENT.
2 :- THE ABOVE DRAWING/DOCUMENT LIST IS TENTATIVE AND SHALL BE FINALISED AFTER AWARD OF WORK.

Praveen Kishore
S A Khan
Varun Jain

SCHEDULE OF TECHNICAL DEVIATION

PROJECT:-2X500 MW NEW NEYVELI TPP

PACKAGE:-VENTILATION SYSTEM

NAME OF VENDOR:-

SL NO	VOULME/ SECTION	PAGE NO.	CLAUSE NO.	TECHNICAL SPECIFICATION/ 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
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.

VENTILATION SYSTEM FOR 2x500 MW NEW NEYVELLI TPP (TG PACKAGE) --- SUGGESTIVE PRICE FORMAT

SL No	DESCRIPTION OF EQUIPMENT/ ITEM	QTY	UNIT	SUPPLY						ERECTION AND COMMISIONING				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 price SUPPLY (Rs)	Unit Price (Rs)	Total price (Rs)	Service Tax (Rs)	TOTAL PRICE (Erection and commissioning including Service tax)	Total Price Supply FOR site and E&C including service tax (Rs)
1.0	LUMPSUM PRICES													
1.1	Total lumpsum firm prices for equipment & Services as specified, Comprising Engineering, design, manufacture, inspection & Testing at manufacturers works/subvendor's work, Painting at manufactures works, duty packed for transportation, delivery to site, unloading storage & handling at site, erection & commissioning, carrying out acceptance tests at site, final painting and handing over to customer the complete ventilation system on turnkey basis for 2X500 MW NNTPP as per specification PE-TS-400 & 402-554-A001 including special tool & tackels for maintenance, commissioning spares, all taxes, duties etc.													
1.2	Break up prices for items covered in clause 1.0 above. In case, price indicated above does not match with item wise break-up given at 2.0, the highest price so calculated shall be considered for evaluation but in case of order, the same shall be placed at lowest price.													
2.0	VENTILATION SYSTEM													
2.1	Sheet metal type air washer unit with centrifugal fan with motor, pumps with motors, dry panel filters (fabric type pre-filter), complete with fixing frame, air washer internals, inlet air louvers, piping as per IS:1239 pt I (heavy class galvanised), motorised valves for auto start of standby equipment, valves, nozzles, level switch, pressure switches, temp indicators, back wash arrangement, galvanised drain piping, etc as per spec. (fan capacity 2,00,000 CMH at 75 mmwc static pressure) as specified.The air washer and fan casing shall be spray galvinised on inside and outside.	8	NO											
2.2*	Supply air ducting (finished GSS (zinc coating 275 gms/ sqm)) for above area complete with dampers, grills (with VCD & without VCD), supports (painted) and all accessories as specified.													
2.2.1*	18 G.	5000	SQM											
2.2.2*	20 G.	5000	SQM											
2.2.3*	22 G.	500	SQM											
2.2.4*	24 G.	1500	SQM											
2.2.5*	MS duct (20 G) with epoxy paint for battery room.	150	SQM											
2.2.6*	Extruded Aluminum grilles with VCD.	150	SQM											
2.2.7*	Extruded Aluminu grilles without VCD.	8	SQM											
2.2.8*	MS air-intake louvers for aux bldgs.	4	SQM											
2.2.9*	Wall mounted dampers (gravity operated) for Aux. Bldgs. only.	24	SQM											
2.3*	FIRE DAMPERS													
2.3.1*	Fire dampers (motor operated) with auto resetting, limit switch, indicating lamps etc as specified.	24	SQM											
2.3.2*	Motorized actuator with control panel with single phase power supply for the above fire damper.	35	NO											
2.4*	GI volume control dampers for ducts	12	SQM											
2.5*	INSULATION													
2.5.1*	Thermal insulation 25 mm thk mineral wool & finish as specified for supply air duct.	1600	SQM											
2.5.2*	Acoustic insulation for duct	50	SQM											
2.6*	Roof extractor units (axial flow type) with hood, disconnect switch and all accessories as specified. Following fan shall have 15 mmwc static pressure.													
2.6.1*	Capacity 50,000 CMH with Motor rating 5.5 KW	20	NO											
2.6.2*	Capacity 40,000 CMH with Motor rating 5.5 KW	2	NO											
2.6.3*	Capacity 20,000 CMH with Motor rating 2.2 KW	2	NO											
2.7*	Axial flow supply fans with pre and fine filter (wall mounted) complete with casing, TEFC sq cage induction motors & mounting frame, MS rain protection cowl, bird screen and all other accessories (suitable for 415V/3-phase supply). Following fan shall have 30 mmwc static pressure.													
2.7.1*	Capacity 10,000 CMH with Motor rating 2.2 KW	2	NO											
2.7.2*	Capacity 7,500 CMH with Motor rating 1.5 KW	2	NO											
2.7.3*	Capacity 6,000 CMH with Motor rating 1.1 KW	7	NO											
2.7.4*	Capacity 4,000 CMH with Motor rating 0.75 KW	4	NO											

VENTILATION SYSTEM FOR 2x500 MW NEW NEYVELLI TPP (TG PACKAGE) --- SUGGESTIVE PRICE FORMAT

SL No	DESCRIPTION OF EQUIPMENT/ ITEM	QTY	UNIT	SUPPLY						ERECTION AND COMMISIONING				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 price SUPPLY (Rs)	Unit Price (Rs)	Total price (Rs)	Service Tax (Rs)	TOTAL PRICE (Erection and commissioning including Service tax)	Total Price Supply FOR site and E&C including service tax (Rs)
2.8*	Axial flow supply fans with pre filter (wall mounted) complete with casing, TEFC sq cage induction motors & mounting frame, MS rain protection cowl, bird screen and all other accessories (suitable for 415V/3-phase supply). Following fan shall have 20 mmwc static pressure.													
2.8.1*	Capacity 10,000 CMH with Motor rating 1.5 KW	20	NO											
2.8.2*	Capacity 7,500 CMH with Motor rating 1.1 KW	6	NO											
2.8.3*	Capacity 6,000 CMH with Motor rating 1.1 KW	3	NO											
2.8.4*	Capacity 4,000 CMH with Motor rating 0.75 KW	3	NO											
2.9*	Axial flow exhaust fans (Bifurcated type, spark proof construction, wall mounted)													
2.9.1*	Capacity 15,000 CMH with Motor rating 2.2 KW	4	NO											
2.9.2*	Capacity 10,000 CMH withMotor rating 1.5 KW	2	NO											
2.9.3*	Capacity 7,500 CMH with Motor rating 1.1 KW	4	NO											
2.9.4*	Capacity 2,000 CMH with Motor rating 0.55 KW	2	NO											
2.10*	Axial flow exhaust fans (Wall mounted) complete with casing,TEFC sq cage induction													
2.10.1*	Capacity 15,000 CMH with Motor rating 1.1 KW	2	NO											
2.10.2*	Capacity 10,000 CMH with Motor rating 0.75 KW	5	NO											
2.10.3*	Capacity 7,500 CMH with Motor rating 0.55 KW	2	NO											
2.10.4*	Capacity 6,000 CMH with Motor rating 0.55 KW	30	NO											
2.10.5*	Capacity 2,000 CMH with Motor rating 0.37 KW	6	NO											
2.11*	Exhaust fan (propeller type) completes with induction motor & mounting frame MS rain protection cowl, bird screen and all other accessories as specified (suitable for 240V/ 1 phase). Following fan shall have 5 mmwc static pressure.													
2.11.1*	Capacity 1200 CMH with Motor rating 100 watts	40	NO											
2.12*	Manually operated, platform trolley of 1 Ton capacity with base area 2m x 1.5m	4	NO											
2.13	Total lumpsum price for commissioning spares inclusive of packing forwarding, transportation up to site, etc.	1	LOT											
2.14	Total lumpsum price for special tools & tackles for maintenance inclusive of packing forwarding, transportation up to site, etc.	1	LOT											
2.15	Instruments and accessories for complete hookup of ventilation system with main central control system.	1	LOT											
2.16	Total lumpsum price for Mandatory Spare for ventilation system inclusive of packing forwarding, transportation up to site, etc.	1	LOT											
2.17	Any other item not indicated above, but required to complete Ventilation package as per system requirements.													

NOTES

1 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.

2 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

4 Items like drain piping with insulation, Duct work with accessories, insulation etc are commom for all the AC plants

5 Price format shall not be changed by the bidder as the bidder may get disqualified by doing so.

6 For limitation on payment, percentages of individual items/equipments, as specified in the appendix-A1 shall be applicable

MANDATORY SPARE LIST - 2 x 500 MW NEW NWYVELI (TG PACKAGE)										
SL No	DESCRIPTION OF EQUIPMENT/ ITEM	SUPPLY								
		UNIT	QUANTITY	Unit Price (Rs)	Total ex-works price (Rs)	ED including CESS (Rs)	CST / VAT (Rs)	FREIGHT including Service Tax, If applicable (Rs)	TOTAL F.O.R. Site Price Supply (Rs)	REMARKS
1	Humidistat	No	2							Applicable items considered. Applicable items are those which are installed in the system.
2	Pr. Gauge of each type and range	%	5							
3	Temperature gauge of each type and range	%	5							
4	Level switches of each type and range	No	2							
5	Solenoid valves of each type and range	No	2							
6	Flow meter of each type and range	No	2							
7	Flow Switch of each type	No	2							
8	Thermostat of each type	No	2							

VENTILATION SYSTEM FOR 2x500 MW NEW NEYVELLI TPP (SG PACKAGE) --- SUGGESTIVE PRICE FORMAT

SL No	DESCRIPTION OF EQUIPMENT/ ITEM	QTY	UNIT	SUPPLY						ERECTION AND COMMISIONING				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 price SUPPLY (Rs)	Unit Price (Rs)	Total price (Rs)	Service Tax (Rs)	TOTAL PRICE (Erection and commissioning including Service tax)	Total Price Supply FOR site and E&C including service tax (Rs)
1.0	LUMPSUM PRICES													
1.1	Total lumpsum firm prices for equipment & Services as specified, Comprising Engineering, design, manufacture, inspection & Testing at manufacturers works/subvendor's work, Painting at manufactures works, duty packed for transportation, delivery to site, unloading storage & handling at site, erection & commissioning, carrying out acceptance tests at site, final painting and handing over to customer the complete ventilation system on turnkey basis for 2X500 MW NNTPP as per specification PE-TS-400 & 402-554-A001 including special tool & tackels for maintenance, commissioning spares, all taxes, duties etc.													
1.2	Break up prices for items covered in clause 1.0 above. In case, price indicated above does not match with item wise break-up given at 2.0, the highest price so calculated shall be considered for evaluation but in case of order, the same shall be placed at lowest price.													
2.0	VENTILATION SYSTEM													
2.1	Unitary air filtration unit with centrifugal fan with motor, pumps with motors, dry panel filters (fabric type pre-filter), UAF internals, MS structures, piping as per IS:1239 pt I (heavy class galvanised), valves including motorised valves for auto start of standby equipment, nozzles, level switch, pressure switches, temp indicators, back wash arrangement, galvanised drain piping etc as per spec (fan capacity 75,000 CMH at 50 mmwc static pressure) as specified.The UAF and fan casing shall be spray galvinised on inside and outside.	2	NO											
2.2*	Supply air ducting (finished GSS (zinc coating 275 gms/ sqm)) for above area complete with dampers, grills (with VCD & without VCD), supports (painted) and all accessories as specified.													
2.2.1*	18 G.	1000	SQM											
2.2.2*	20 G.	1000	SQM											
2.2.3*	22 G.	500	SQM											
2.2.4*	24 G.	500	SQM											
2.2.5*	MS duct (20 G) with epoxy paint for battery room.	50	SQM											
2.2.6*	Extruded Aluminum grilles with VCD.	50	SQM											
2.2.7*	Extruded Aluminu grilles without VCD.	2	SQM											
2.2.8*	MS air-intake louvers for aux bldgs.	1	SQM											
2.2.9*	Wall mounted dampers (gravity operated) for Aux. Bldgs. only.	6	SQM											
2.3*	FIRE DAMPERS													
2.3.1*	Fire dampers (motor operated) with auto resetting, limit switch, indicating lamps etc as specified.	6	SQM											
2.3.2*	Motorized actuator with control panel with single phase power supply for the above fire damper.	10	NO											
2.4*	GI volume control dampers for ducts	3	SQM											
2.5*	INSULATION													
2.5.1*	Thermal insulation 25 mm thk mineral wool & finish as specified for supply air duct.	400	SQM											
2.5.2*	Acoustic insulation for duct	50	SQM											
2.6*	Roof extractor units (axial flow type) with hood, disconnect switch and all accessories as specified. Following fan shall have 15 mmwc static pressure.													
2.6.1*	Capacity 40,000 CMH with Motor rating 5.5 KW	14	NO											
2.6.2*	Capacity 20,000 CMH with Motor rating 2.2 KW	2	NO											
2.7*	Axial flow supply fans with pre and fine filter (wall mounted) complete with casing, TEFC sq cage induction motors & mounting frame, MS rain protection cowl, bird screen and all other accessories (suitable for 415V/3-phase supply). Following fan shall have 30 mmwc static pressure.													

VENTILATION SYSTEM FOR 2x500 MW NEW NEYVELLI TPP (SG PACKAGE) --- SUGGESTIVE PRICE FORMAT

SL No	DESCRIPTION OF EQUIPMENT/ ITEM	QTY	UNIT	SUPPLY						ERECTION AND COMMISIONING				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 price SUPPLY (Rs)	Unit Price (Rs)	Total price (Rs)	Service Tax (Rs)	TOTAL PRICE (Erection and commissioning including Service tax)	Total Price Supply FOR site and E&C including service tax (Rs)
2.7.1*	Capacity 10,000 CMH with Motor rating 2.2 KW	2	NO											
2.7.2*	Capacity 7,500 CMH with Motor rating 1.5 KW	2	NO											
2.7.3*	Capacity 6,000 CMH with Motor rating 1.1 KW	5	NO											
2.7.4*	Capacity 4,000 CMH with Motor rating 0.75 KW	2	NO											
2.8*	Axial flow supply fans with pre filter (wall mounted) complete with casing, TEFC sq cage induction motors & mounting frame, MS rain protection cowl, bird screen and all other accessories (suitable for 415V/3-phase supply). Following fan shall have 20 mmwc static pressure.													
2.8.1*	Capacity 10,000 CMH with Motor rating 1.5 KW	10	NO											
2.8.2*	Capacity 7,500 CMH with Motor rating 1.1 KW	4	NO											
2.8.3*	Capacity 6,000 CMH with Motor rating 1.1 KW	2	NO											
2.8.4*	Capacity 4,000 CMH with Motor rating 0.75 KW	2	NO											
2.9*	Axial flow exhaust fans (Bifurcated type, spark proof construction, wall mounted)													
2.9.1*	Capacity 15,000 CMH with Motor rating 2.2 KW	2	NO											
2.9.2*	Capacity 10,000 CMH withMotor rating 1.5 KW	2	NO											
2.9.3*	Capacity 7,500 CMH with Motor rating 1.1 KW	3	NO											
2.9.4*	Capacity 2,000 CMH with Motor rating 0.55 KW	2	NO											
2.10*	Axial flow exhaust fans (Wall mounted) complete with casing,TEFC sq cage induction													
2.10.1*	Capacity 15,000 CMH with Motor rating 1.1 KW	2	NO											
2.10.2*	Capacity 10,000 CMH with Motor rating 0.75 KW	2	NO											
2.10.3*	Capacity 7,500 CMH with Motor rating 0.55 KW	2	NO											
2.10.4*	Capacity 6,000 CMH with Motor rating 0.55 KW	15	NO											
2.10.5*	Capacity 2,000 CMH with Motor rating 0.37 KW	4	NO											
2.11*	Exhaust fan (propeller type) completes with induction motor & mounting frame MS rain protection cowl, bird screen and all other accessories as specified (suitable for 240V/ 1 phase). Following fan shall have 5 mmwc static pressure.													
2.11.1*	Capacity 1200 CMH with Motor rating 100 watts	20	NO											
2.12*	Manually operated, platform trolley of 1 Ton capacity with base area 2m x 1.5m	2	NO											
2.13	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											
2.14	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											
2.15	Instruments and accessories for complete hookup of ventilation system with main central control system.	1	LOT											
2.16	Total lumpsum price for Mandatory Spare for ventilation system inclusive of packing forwarding, transportation up to site, etc. (Bidder to submit item-wise price break-up seperately).	1	LOT											
2.17	Any other item not indicated above, but required to complete Ventilation package as per system requirements.													

NOTES

1 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.

2 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

4 Items like drain piping with insulation, Duct work with accessories, insulation etc are commom for all the AC plants

5 Price format shall not be changed by the bidder as the bidder may get disqualified by doing so.

6 For limitation on payment, percentages of individual items/equipments, as specified in the appendix-A2 shall be applicable

MANDATORY SPARE LIST - 2 x 500 MW NEW NWYVELI (SG PACKAGE)										
SL No	DESCRIPTION OF EQUIPMENT/ ITEM	SUPPLY								
		UNIT	QUANTITY	Unit Price (Rs)	Total ex-works price (Rs)	ED including CESS (Rs)	CST / VAT (Rs)	FREIGHT including Service Tax, If applicable (Rs)	TOTAL F.O.R. Site Price Supply (Rs)	REMARKS
1	Contractor (For each type and rating)	No.	Minimum 1 no. of each type							Applicable items considered. Applicable items are those which are installed in the system.
2	Over load relay (For each type and rating)	No.	2 no. of each type							
3	Relay/Timer (For each type and rating)	No.	3 no. of each type							
4	Fan motor (For each type and rating)	No.	30% of each rating							
5	Electronics cards (For each type and rating)	No.	20% of each rating							
6	Switch fuse unit/MCCB/ELCB (For each type and rating)	No.	2 no. of each rating							
7	Blower motor (For each type and rating)	No.	30% of each rating							
8	Pumps (For each type and size)									
8.1	Impeller (For each type and size)	No.	2							
8.2	Shafts (For each type and size)	No.	1							
8.3	Shaft sleeve (For each type and size)	Set	3							
8.4	Casing wear ring (For each type and size)	Set	6							
8.5	Impeller bearing (For each type and size)	Set	2							
8.6	Motor bearing (For each type and size)	Set	2							
8.7	Thrust bearing (For each type and size)	Set	2							
8.8	Radial bearing (For each type and size)	Set	2							
8.9	Gland packing (For each type and size)	Set	2							
8.1	Fasteners (For each type and size)	Set	1							
8.11	Complete coupling (pump & motor) (For each type and size)	Set	1							
8.12	Motor (For each type and rating)	No.	1							

APPENDIX - A1
Percentage breakup for Ventilation Package
2x500 MW NEW NEYVELI TPP (TG PACKAGE)

SL NO	DESCRIPTION OF EQUIPMENT/ ITEM	Percentage of total price
1	Total lumpsum firm prices for equipment & Services as specified, Comprising Engineering, design, manufacture, inspection & Testing at manufacturers works/subvendor's work, Painting at manufactures works, duty packed for transportation, delivery to site, unloading storage & handling at site, erection & commissioning, carrying out acceptance tests at site, final painting and handing over to customer the complete ventilation system on turnkey basis for 2X500 MW NNTPP as per specification PE-TS-400 & 402-554-A001 including special tool & tackels for maintenance, commissioning spares, all taxes, duties etc.(Without mandatory spare - Sr. No. 2.16 of suggestive price format).	**100%**
2.0	**BREAK-UP OF PRICES GIVEN IN 1.0 ABOVE (To be used during contract execution for payment)**	
2.1	Total lump sum firm price for **EQUIPMENT (SUPPLY)** for Engineering, design, manufacturing, inspection & Testing at manufacturers works/subvendor's work, Painting at manufactures works, duly packed for transportation, delivery to site, unloading storage & handling at site, for the complete scope of supply of Ventilation system and as defined in the technical specification (PE-TS-400 & 402-554-A001) for 2X500 MW NNTPS including special tool & tackels for maintenance, commissioning spares, all taxes, duties etc..	**80%**
2.2	Erection & commissioning, carrying out acceptance tests at site, final painting and handing over to customer the complete ventilation system on turnkey basis as per specification PE-TS-400 & 402-554-A001 including all taxes, duties etc.	**20%**
2.3	Mandatory spares	
3.0	**Break-up (%) of prices given at Sl No-2.1 above (To be used during contract execution for payment)**	**Percentage of total price of SL No 2.1 above**
3.1	Air washer - (Item no 2.1 of Suggestive price format)	**23.00%**
3.2	GSS Duct work - (Item no 2.2.1 to 2.2.4 of Suggestive price format)	**25.00%**
3.3	MS duct and grills, louvers etc (Item no 2.2.5 to 2.2.9 of Suggestive price format)	**5.00%**
3.4	Fire damper, VCD, (Item no 2.3 to 2.4 of Suggestive price format)	**1.90%**
3.5	Thermal and Acoustic Insulation (Item no 2.5 of Suggestive price format)	**3.00%**
3.6	RE units (Item no 2.6 of Suggestive price format)	**10.00%**
3.7	Supply air fans (Item no 2.7 and 2.8 of Suggestive price format)	**15.00%**
3.8	Exhaust fans (Item no 2.9,2.10 and 2.11 of Suggestive price format)	**15.00%**
3.9	Manually operated, platform trolley (Item no 2.12 of Suggestive price format)	**0.10%**
3.10	Commissioning Spares & Tools tackles (Item no 2.13 & 2.14 of Suggestive price format)	**1.00%**
3.11	Instruments and accessories & any other item (Item no 2.15 & 2.17 of Suggestive price format)	**1.00%**

Varun Jain S A Khan Praveen Kishore

APPENDIX - A2
Percentage breakup for Ventilation Package
2x500 MW NEW NEYVELI TPP (SG PACKAGE)

SL NO	DESCRIPTION OF EQUIPMENT/ ITEM	Percentage of total price
1	Total lumpsum firm prices for equipment & Services as specified, Comprising Engineering, design, manufacture, inspection & Testing at manufacturers works/subvendor's work, Painting at manufactures works, duty packed for transportation, delivery to site, unloading storage & handling at site, erection & commissioning, carrying out acceptance tests at site, final painting and handing over to customer the complete ventilation system on turnkey basis for 2X500 MW NNTPP as per specification PE-TS-400 & 402-554-A001 including special tool & tackels for maintenance, commissioning spares, all taxes, duties etc.(Without mandatory spare - Sr. No. 2.16 of suggestive price format).	**100%**
2.0	**BREAK-UP OF PRICES GIVEN IN 1.0 ABOVE (To be used during contract execution for payment)**	
2.1	Total lump sum firm price for **EQUIPMENT (SUPPLY)** for Engineering, design, manufacturing, inspection & Testing at manufacturers works/subvendor's work, Painting at manufactures works, duly packed for transportation, delivery to site, unloading storage & handling at site, for the complete scope of supply of Ventilation system and as defined in the technical specification (PE-TS-400 & 402-554-A001) for 2X500 MW NNTPS including special tool & tackels for maintenance, commissioning spares, all taxes, duties etc..	**80%**
2.2	Erection & commissioning, carrying out acceptance tests at site, final painting and handing over to customer the complete ventilation system on turnkey basis as per specification PE-TS-400 & 402-554-A001 including all taxes, duties etc.	**20%**
3.0	**Break-up (%) of prices given at Sl No-2.1 above (To be used during contract execution for payment)**	**Percentage of total price of SL No 2.1 above**
3.1	UAF - (Item no 2.1 of Suggestive price format)	**23.00%**
3.2	GSS Duct - (Item no 2.2.1 to 2.2.4 of Suggestive price format)	**25.00%**
3.3	MS duct and grills, louvers etc (Item no 2.2.5 to 2.2.9 of Suggestive price format)	**5.00%**
3.4	Fire damper, VCD, (Item no 2.3 to 2.4 of Suggestive price format)	**1.90%**
3.5	Thermal and Acoustic Insulation (Item no 2.5 of Suggestive price format)	**3.00%**
3.6	RE units (Item no 2.6 of Suggestive price format)	**10.00%**
3.7	Supply air fans (Item no 2.7 and 2.8 of Suggestive price format)	**15.00%**
3.8	Exhaust fans (Item no 2.9,2.10 and 2.11 of Suggestive price format)	**15.00%**
3.9	Manually operated, platform trolley (Item no 2.12 of Suggestive price format)	**0.10%**
3.10	Commissioning Spares & Tools tackles (Item no 2.13 & 2.14 of Suggestive price format)	**1.00%**
3.11	Instruments and accessories & any other item (Item no 2.15 & 2.17 of Suggestive price format)	**1.00%**

Varun Jain S A Khan Praveen Kishore

2X500 MW NEW NEYVELI TPP

VENTILATION SYSTEM

GUARANTEED POWER CONSUMPTION FIGURES

S.NO.	DESCRIPTION OF EQUIPMENT	NO OF EQUIPMENT		TOTAL GUARANTEED POWER CONSUMPTION FOR EACH EQUIPMENT AT MOTOR INPUT TERMINAL AND CONTROL PANEL (IN KW)	DUTY FACTOR	TOTAL KW
		WORKING	STANDBY			
		3A	3B	**4**	**5**	**6=3Ax4x5**
1	Centrifugal fans for air-washer units, 2,00,000 CMH at 75 mmwc	8	0		**1**	
2	Pumps for above air-washer	8	0		**1**	
3	Centrifugal fans for UAF units, 75,000 CMH at 50 mmwc	2	0		**1**	
4	Pumps for above UAF	2	0		**1**	
				TOTAL (KW)		

Note:	Estimated power consumption (EPC) figure at motor input terminals (not shaft power) for the system (for working drives only) shall not be more than 966 KW.

Praveen Kishore

S A Khan

Varun Jain