



**CENTRIFUGAL FAN**  
**DATA SHEET - A**

**VOLUME II-B**

**SECTION D**

**REV 00**

**DATE NOV 2012**

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- |      |                                                                                             |                                                       |
|------|---------------------------------------------------------------------------------------------|-------------------------------------------------------|
| 3.6  | a) Shaft<br>b) Shaft sleeve                                                                 | EN-8 or eqv.<br>-do-                                  |
| 3.7  | Support frame and structure.                                                                | Mild Steel to IS: 2062                                |
| 3.8  | Flexible connection at outlet<br>impregnated canvas with MS Flanges and cleats (3mm thick). | Fire resistant type plastic                           |
| 3.9  | V Belt                                                                                      | ISI marked (Reinforced rubber section to<br>IS: 4776) |
| 3.10 | V Pulley<br>per                                                                             | Cast Iron multi groove to grade FG 20 as              |
| 3.11 | Slide rails                                                                                 | IS: 210. Having taper lock type<br>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<br>if any.                                     | Hard synthetic rubber                                 |
| 4.0  | <b><u>ACCESSORIES</u></b>                                                                   |                                                       |
| 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<br>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  | <b><u>Motor</u></b>                                                                         |                                                       |
| 5.1  | Motor by                                                                                    | Bidder                                                |



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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).



**VENTILATION FAN (R.E.UNIT)**  
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**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 system. | as per schedule of ventilation                     |
| 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 617                        | Cast Aluminium alloy to A-6M IS-Grade LM6 |
| 14) | Support frame and structure. 2062). | M.S. of adequate thickness (IS-           |

**ACCESSORIES**

- |     |                          |      |
|-----|--------------------------|------|
| 15) | Vibration isolating pads | Yes. |
| 16) | Base frame for mounting  | Yes. |
| 17) | Wire Guard at inlet.     | Yes. |
| 18) | Disconnect switch        | Yes. |



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19) Gravity damper at outlet

Yes

**Motor**

20) Motor by

Bidder

21) Starter by

Bidder

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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## Ventilation Fan (Axial Flow Type)

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#### No. Particulars

#### Data

#### General Information

- |    |                  |                                                                                      |
|----|------------------|--------------------------------------------------------------------------------------|
| 1) | Designation      | Supply/Exhaust Fans.                                                                 |
| 2) | Nos. required in | Refer schedule of Ventilation system section-C under specific technical requirement. |
| 3) | Service air.     | To exhaust warm air/to supply fresh                                                  |
| 4) | Location         | Wall mounted.                                                                        |
| 5) | Area             | Same as above in 2.                                                                  |

#### Design Data

- |     |                               |                                                    |
|-----|-------------------------------|----------------------------------------------------|
| 6)  | Type supply                   | Axial fans suitable for 415V/3 phase for Motor.    |
| 7)  | Air delivery capacity system. | As per schedule of ventilation                     |
| 8)  | Fluid                         | Atmospheric Air.                                   |
| 9)  | Temperature                   | Refer Section of specific technical requirement    |
| 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                                    | M.S. (IS-2062)                               |
| 13) | Impeller 617)                             | Cast Aluminium. (Alloy A-6M, IS-             |
| 14) | Hub                                       | Al Alloy.                                    |
| 15) | Support frame and structure. (Galvanized/ | M.S. of adequate thickness Painted) IS-2062. |
| 16) | Neoprene rubber pads                      | As required.                                 |



## Ventilation Fan (Axial Flow Type)

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- |     |                                             |                                                            |
|-----|---------------------------------------------|------------------------------------------------------------|
| 17) | Coned inlet for wall exhausters/supply fans | MS (IS-2062)                                               |
| 18) | Supporting frame for mounting.              | Required.                                                  |
| 19) | Protective screen at inlet.                 | Yes (Min 14 SWG Galvanized wire knitted in 1" square mesh. |
| 20) | Rain Protection Cowl                        | Aluminum or hot dip Galvanized after fabrication from M.S. |

#### Motor

- |     |            |        |
|-----|------------|--------|
| 21) | Motor by   | Bidder |
| 22) | Starter by | BHEL   |

#### NOTE:

- 1) For Battery Room, motor for fan shall be of flame proof type & fan of spark proof construction with Epoxy painting.
- 2) Gravity type damper shall be provided at the outlet of axial fan for exhaust application.
- 3) Motor shall have 15% margin over Duty Point.



**Ventilation Fan (Axial Flow Type)**

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

**SPECIFICATION NO.PES-554-02**

**VOLUME II B**

**SECTION D**

**REV. 02**

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



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

**SPECIFICATION NO.PES-554-02**

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**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 airconditioning 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 statutes, 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)<br>GI      | (mm)<br>Al |                                                                |               |
| a)    | Up to 600  | 0.63<br>(24G)   | 0.80       | S-drive, pocket or bar slips or flanged joints on 2.5m centres | None          |
| b)    | 601 to 750 | 0.63            | 0.80       | S-drive, 25mm pocket or                                        | 25x25x3 mm MS |



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|    |                                                                                                                          |               |      |                                                                                                                           |                                                                   |
|----|--------------------------------------------------------------------------------------------------------------------------|---------------|------|---------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|
|    |                                                                                                                          | (24G)         |      | 25mm bar slips or flanged joints on 2.5m centres                                                                          | angles, 1.2m from joints                                          |
| c) | 751 to 1000                                                                                                              | 0.80<br>(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<br>(22G) | 1.00 | 40x40x3mm MS angle, flanged connections or 40mm pocket or 40mm bar slips with 35x3mm bar reinforcing on 2.5m centres      | 40x40x3 mm MS angles, 1.2m from joints                            |
| e) | 1501 to2250                                                                                                              | 1.00<br>(20G) | 1.50 | 40x40x3mm MS angle, flanged connections or 40mm pocket or 40mm bar slips, 1M maximum centres, with 35x3mm bar reinforcing | 40x40x3 mm diagonal angles or 40x40x3mm angles, 600mm from joints |
| f) | 2251 & above                                                                                                             | 1.25<br>(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.



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**4.2 ROUND DUCTS**

**4.2.1**

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

|                                                                                   |                                                                                   |                                    |                       |
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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 masonry and duct work shall be neatly caulked or sealed to prevent movement of air from one space to adjoin by space with a rated fire resistant material.

4.7

**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

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                   |                                    |                       |
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|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                   | <b>REV. 02</b>                     | <b>DATE: NOV 2012</b> |
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| <p>For the ducts penetrating roofs or outside walls, provision of flashing shall be made by the ducting vendor.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                   |                                    |                       |
| <b>4.10</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>DIFFUSERS AND GRILLS</b>                                                       |                                    |                       |
| <p>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.</p> <p>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.</p> <p>Suitable vanes shall be provided in duct collars to have uniform air distribution. Blank-off baffles wherever required, shall also be provided.</p> |                                                                                   |                                    |                       |
| <b>4.11</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>PLENUMS AND RA BOXING</b>                                                      |                                    |                       |
| <p>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 masonry construction to which angles are fastened.</p> <p>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.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                   |                                    |                       |
| <b>4.12</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>ACCOUSTIC LINING</b>                                                           |                                    |                       |
| <p>The ducts shall be lined acoustically from inside as given in data- sheet A and/or section C of the specification.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                   |                                    |                       |
| <b>4.13</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>PAINTING</b>                                                                   |                                    |                       |
| <p>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.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                   |                                    |                       |
| <b>4.14</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>THERMAL INSULATION</b>                                                         |                                    |                       |
| <p>Thermal insulation shall be as per data sheet - A and the insulation shall conform to enclosed spec. no. PES-553-08.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                   |                                    |                       |

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|            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>5.</b>  | <b>INSPECTION AND TESTING</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>5.1</b> | <b>INSPECTION &amp; TESTING DURING FABRICATION–BY MAIN VENDOR</b>                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 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.                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>5.2</b> | <b>INSPECTION &amp; TESTING AT SITE.</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 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.                                                                                                                                                                                                                                                                                                                                            |
| <b>6.</b>  | <b>BALANCING</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 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.                                                                                                                                                                                                                                                                                                                                                                         |
| <b>7.</b>  | <b>DATA TO BE FURNISHED BY VENDOR AFTER THE AWARD OF CONTRACT</b>                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 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.                                                                                                                                                                                                                                                                                                         |



**LOW PRESSURE  
AIR DISTRIBUTION SYSTEM  
DATA SHEET - A**

**VOLUME II-B**

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- |                                                                                                           |                                                                                          |
|-----------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|
| 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. sides.                                                                           | MS with epoxy painting on both sides.                                                    |
| 3) Special painting epoxy                                                                                 | MS Ducts in Battery Room to be 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) schedule/tender                                                      | To suit airflow as per 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.



**LOW PRESSURE  
AIR DISTRIBUTION SYSTEM  
DATA SHEET - A**

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- 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.



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**STANDARD TECHNICAL SPECIFICATION  
FOR  
CENTRIFUGAL PUMPS**



## STANDARD TECHNICAL SPECIFICATION FOR CENTRIFUGAL PUMPS

SPECIFICATION NO. PES-554-05

VOLUME II-B

SECTION D

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### 1.0 GENERAL

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

### 2.0 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.



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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 runaway 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**



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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.



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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 heat treatment charts (as applicable)

Note: Casting defects shall not be filled by any method until and 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 heat 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



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**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



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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 dirt, 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).



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- 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.



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11.8 Installation , operation and maintenance manual.

11.9 Other drawings and data, if necessary.



**CENTRIFUGAL PUMPS  
DATA SHEET - A**

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| <u>S.No.</u> | <u>DESCRIPTION</u>     | <u>DETAILS</u>                                                          |
|--------------|------------------------|-------------------------------------------------------------------------|
| 1)           | Designation            | Air washer Pumps.                                                       |
| 2)           | Type                   | Horizontal Centrifugal Type.                                            |
| 3)           | Quantity               | As per section-C                                                        |
| 4)           | Installation Washer    | On floating type foundation inside Air 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**

| <u>S.No.</u> | <u>DESCRIPTION</u> | <u>DETAILS</u>                                         |
|--------------|--------------------|--------------------------------------------------------|
| 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 |



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- |           |                     |                                                    |
|-----------|---------------------|----------------------------------------------------|
| g)        | Counter Flanges     | Mild Steel                                         |
| h)        | Stuffing box bush   | Deep Bronze packing to be renewable with Case.     |
| i)<br>not | Stuffing box gland  | Flexible graphite or PTFE (Asbestos shall be used) |
| j)        | Pump Motor Coupling | Pin & Bush type (Flexible)                         |
| k)        | Bolt and Nuts       | MS                                                 |

**15) ACCESSORIES REQUIRED**

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

- |    |                                          |     |
|----|------------------------------------------|-----|
| a) | Priming funnel                           | Yes |
| b) | Drain piping upto<br>Common drain point. | Yes |
| c) | Vent                                     | Yes |
| d) | Suction & Discharge<br>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 |



**STANDARD TECHNICAL  
SPECIFICATION  
FOR  
AIR FILTER**

**SPECIFICATION NO.PES-554-04**

**VOLUME II B**

**SECTION D**

**REV. 02**

**DATE: NOV 2012**

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**STANDARD TECHNICAL SPECIFICATION  
FOR  
AIR FILTER**

|                                                                                   |                                                                    |                                    |                       |
|-----------------------------------------------------------------------------------|--------------------------------------------------------------------|------------------------------------|-----------------------|
|  | <b>STANDARD TECHNICAL<br/>SPECIFICATION<br/>FOR<br/>AIR FILTER</b> | <b>SPECIFICATION NO.PES-554-04</b> |                       |
|                                                                                   |                                                                    | <b>VOLUME II B</b>                 |                       |
|                                                                                   |                                                                    | <b>SECTION D</b>                   |                       |
|                                                                                   |                                                                    | <b>REV. 02</b>                     | <b>DATE: NOV 2012</b> |
|                                                                                   |                                                                    | <b>SHEET 2 OF 3</b>                |                       |

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.

|                                                                                   |                                                                    |                                    |                       |
|-----------------------------------------------------------------------------------|--------------------------------------------------------------------|------------------------------------|-----------------------|
|  | <b>STANDARD TECHNICAL<br/>SPECIFICATION<br/>FOR<br/>AIR FILTER</b> | <b>SPECIFICATION NO.PES-554-04</b> |                       |
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|                                                                                   |                                                                    | <b>REV. 02</b>                     | <b>DATE: NOV 2012</b> |
|                                                                                   |                                                                    | <b>SHEET 3 OF 3</b>                |                       |

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  $\geq 90$ . However oil wetted air filters shall have Average Efficiency Em (%)  $\geq 90$  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 dioctylphthalate 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

Elect. diagrams (when automatic cleaning type)



**AIR FILTER  
DATA SHEET - A**

**VOLUME II-B**

**SECTION D**

**REV 00**

**DATE NOV 2012**

**SHEET 1 OF 1**

**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 <b>dry panel filters</b> (pre filters).<br>12 mm in clean condition for fine filters. |
| 1.11 Frame Work              | 18 G, GSS.                                                                                                                                          |
| 1.12 Mounting                | Ladder Type M.S Angles (galvanised)                                                                                                                 |
| 1.13 Size                    | 600 x 600 mm                                                                                                                                        |

**Note:-**

- 1) Face velocity of air across the filters shall not exceed 2.5 m/sec.



**STANDARD TECHNICAL  
SPECIFICATION  
FOR  
THERMAL INSULATION FOR COLD  
SURFACES**

**SPECIFICATION NO.PES-554-06**

**VOLUME II B**

**SECTION D**

**REV. 01**

**DATE: NOV 2012**

**SHEET 1 OF 5**

**STANDARD TECHNICAL SPECIFICATION  
FOR  
THERMAL INSULATION FOR COLD SURFACES**

|                                                                                   |                                                                                   |                                    |                       |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------|-----------------------|
|  | <b>TECHNICAL SPECIFICATION</b><br><br><b>THERMAL INSULATION FOR COLD SURFACES</b> | <b>SPECIFICATION NO.PES-554-06</b> |                       |
|                                                                                   |                                                                                   | <b>VOLUME II B</b>                 |                       |
|                                                                                   |                                                                                   | <b>SECTION D</b>                   |                       |
|                                                                                   |                                                                                   | <b>REV. 01</b>                     | <b>DATE: NOV 2012</b> |
|                                                                                   |                                                                                   | <b>SHEET 2 OF 5</b>                |                       |

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.

|                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                   |                                    |                       |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|-----------------------|
|  | <b>TECHNICAL SPECIFICATION</b><br><br><b>THERMAL INSULATION FOR COLD SURFACES</b>                                                                                                                                                                                                                                                                                                 | <b>SPECIFICATION NO.PES-554-06</b> |                       |
|                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                   | <b>VOLUME II B</b>                 |                       |
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|                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                   | <b>SHEET 3 OF 5</b>                |                       |
| 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.                                                                                | <b>VAPOR SEALING &amp; INSULATION FINISH</b>                                                                                                                                                                                                                                                                                                                                      |                                    |                       |
|                                                                                   | 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                                                                               | <b>FINISHING SYSTEM I: EXTERNAL INSULATION WITH PLASTER FINISH</b>                                                                                                                                                                                                                                                                                                                |                                    |                       |
| 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                                                                               | <b>FINISH SYSTEM II: EXTERNAL INSULATION WITH PLASTER FINISH OVER POLYTHENE.</b>                                                                                                                                                                                                                                                                                                  |                                    |                       |
| 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                                                                               | <b>FINISH III:EXTERNAL INSULATION WITH SHEET METAL FINISH</b>                                                                                                                                                                                                                                                                                                                     |                                    |                       |
| 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                                                                               | <b>FINISH IV: EXTERNAL INSULATION WITH PLASTER &amp; WATER PROOFING COMPOUND</b>                                                                                                                                                                                                                                                                                                  |                                    |                       |
|                                                                                   | For ducts & piping exposed to atmosphere, the finish shall be as follows:                                                                                                                                                                                                                                                                                                         |                                    |                       |

|                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |  |                                    |                       |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|------------------------------------|-----------------------|
|  | <b>TECHNICAL SPECIFICATION</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  | <b>SPECIFICATION NO.PES-554-06</b> |                       |
|                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |  | <b>VOLUME II B</b>                 |                       |
|                                                                                   | <b>THERMAL INSULATION FOR COLD SURFACES</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |  | <b>SECTION D</b>                   |                       |
|                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |  | <b>REV. 01</b>                     | <b>DATE: NOV 2012</b> |
|                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |  | <b>SHEET 4 OF 5</b>                |                       |
| 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.                                                                                | <b>INSULATION OF PUMPS &amp; VALVES</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |  |                                    |                       |
|                                                                                   | 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.                                                                                | <b>INSPECTION &amp; TESTING (REFER SPEC. NO - PES-553.00)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |  |                                    |                       |
|                                                                                   | 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.                                                                                | <b>PAINTING</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |  |                                    |                       |
| 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.                                                                                | <b>DATA TO BE FURNISHED AFTER AWARD OF CONTRACT</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |  |                                    |                       |
| 9.1.1                                                                             | Final version of data sheet ‘B’ incorporating changes if any along with design data.                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |                                    |                       |

|                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                              |                                    |                       |
|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|-----------------------|
|  | <b>TECHNICAL SPECIFICATION</b><br><br><b>THERMAL INSULATION FOR COLD SURFACES</b>                                                                                                                                                                                                                                                                                                                            | <b>SPECIFICATION NO.PES-554-06</b> |                       |
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|                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                              | <b>REV. 01</b>                     | <b>DATE: NOV 2012</b> |
|                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                              | <b>SHEET 5 OF 5</b>                |                       |
| 9.1.2                                                                             | Test certificates/reports giving result of insulation to ensure conformance to applicable codes & standards & in particular the following :-<br><br>i) Thermal conductivity test<br><br>ii) Sound absorption coefficient test<br><br>iii) Corrosion test<br><br>iv) Sulphur content, moisture content, shot content, moisture absorption etc.<br><br>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.                                                                                                                                                                                                                                                                                                                                                              |                                    |                       |



**INSULATION**  
**DATA SHEET - A**

**VOLUME II-B**

**SECTION D**

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**SHEET 1 OF 2**

**INSULATION MATERIAL :**

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



**INSULATION**  
**DATA SHEET - A**

**VOLUME II-B**

**SECTION D**

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**DATE : NOV 2012**

**SHEET 2 OF 2**

ix) Acoustic insulation of Duct

Glass Wool

Slab

25



**1 X 660 MW SAGARDIGHI TPS UNIT NO. 5  
PHASE III  
VENTILATION SYSTEM  
TECHNICAL SPECIFICATION**

**SPECIFICATION No: PE-TS-445-554-A001**

**SECTION : I**

**SUB-SECTION : E**

**REV. 00**

**DATE: AUGUST 2021**

**SECTION: I**

**SUB-SECTION: E**

**LIST OF ANNEXURES**



**1 X 660 MW SAGARDIGHI TPS UNIT NO. 5  
PHASE III  
VENTILATION SYSTEM  
LIST OF MAKES OF SUB-VENDOR ITEMS**

**SPECIFICATION No: PE-TS-445-554-A001**

**SECTION : I**

**Sub Section : E**

**REV. 00**

**DATE: AUGUST 2021**

**SECTION: I**

**SUB-SECTION: E**

**ANNEXURE: I**

**LIST OF MAKES OF SUB-VENDOR ITEMS**



**1 X 660 MW SAGARDIGHI TPS UNIT NO. 5  
PHASE III  
VENTILATION SYSTEM  
LIST OF MAKES OF SUB-VENDOR ITEMS**

**SPECIFICATION No: PE-TS-445-554-A001**

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**SHEET 1 OF 2**

| S.No. | Description                     | Makes                                                                                                                                                                                                                          |
|-------|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1.    | <b>AIR WASHER &amp; UAF*</b>    | HYDERABAD POLLUTION CONTROL / SK SYSTEM / ADVANCE VENTILATION / DRAFT AIR / BLUE STAR / VOLTAS / STERLING WILSON & ROOTS COOLING SYSTEM / C.DOCTOR                                                                             |
| 2.    | <b>CENTRIFUGAL FAN</b>          | FLAKT / KRUGGER / DRAFT AIR / HYDERABAD POLLUTION CONTROL / ADVANCE VENTILATION / PATEL AIR / NICOTRA/ SK SYSTEM / MARATHON / CB DOCTOR / SARLA                                                                                |
| 3.    | <b>AXIAL FLOW FANS/RE UNITS</b> | HYDERABAD POLLUTION/ SK SYSTEM / ADVANCE VENTILATION / KRUGER / NICOTRA / MARATHON / FLAKT / CB DOCTOR/ PATEL AIR /SITAL                                                                                                       |
| 4.    | <b>CENTRIFUGAL WATER PUMP</b>   | BEST & CROMPTON / JYOTI / SAM TURBO / KBL / KSB / M&P / VOLTAS / BEACON-WEIR / WORTHINGTON / FLOWMORE / SULZER / BHARAT PUMPS & COMPRESSORS LTD / FLOWSERVE INDIA CONTROL PVT LTD / V-FLOW PUMPS & SYSTEMS CO                  |
| 5.    | <b>INDUCTION MOTORS (LT)</b>    | SIEMENS / ABB / CGL / MARATHON / KEC / BHARAT BIJLEE / NGEF /JYOTI / LHP                                                                                                                                                       |
| 6.    | <b>AIR FILTER</b>               | PUROLATOR / FMI / ANFILCO / TENACITY / JOHN FOWLER /SPECTRUM / AIR TECH / PUROMATIC                                                                                                                                            |
| 7.    | <b>INSULTATION MATERIAL</b>     | BEARDSHELL / K-FLEX / PARAMONT/ ARMAFLEX / SUPREME / LLOYDS / UP TWIGA /AEROCELL                                                                                                                                               |
| 8.    | <b>FIRE DAMPER</b>              | TSC / CARRYAIRE / RAVISTAR (SYSTEM AIR )                                                                                                                                                                                       |
| 9.    | <b>BUTTERFLY VALVE</b>          | AUDCO / FOURESS / INTER VALVE / BDK / WEIR BDK / TYCO / CRANE PROCESS / KEYSTONE                                                                                                                                               |
| 10.   | <b>NON RETURN VALVE</b>         | LEADER / H.SARKAR / FLUID LINE / HI -TECH / CRESENT / A V VALVES / BANKIM & COMPANY / SHIVADURGA                                                                                                                               |
| 11.   | <b>GATE/GLOBE VALVES</b>        | CRESENT / BDK / AUDCO / FOURESS / KIRLOSKAR / SANT / BOMBAY METAL & ALLOYS / BANKIM / LEADER / H SARKAR / AV VALVES / VENUS PUMPS AND ENGG                                                                                     |
| 12.   | <b>PIPING – ERW</b>             | SURYA ROSHNI / TISCO / DADU PIPES / INDUS TUBE / WELSPUN / TATA / BST / JINDAL / SAIL                                                                                                                                          |
| 13.   | <b>GI SHEETS FOR DUCTING</b>    | TISCO / INDIAN IRON & STEEL CO LTD. / RASHITRYA ISPAT NIGAM LTD. / ESSAR/ ISPAT INDUSTRIES / JSW STEEL / LLOYDS STEEL / BHUSHAN / TATA / SAIL / JINDAL                                                                         |
| 14.   | <b>HUMID STAT</b>               | JHONSON CONTROL / HONEYWELL / PENN                                                                                                                                                                                             |
| 15.   | <b>PRESSURE GAUGE</b>           | GENERAL INST CONSORTIUM / BELL / H.GURU INST / WAAREE INSTRUMENTS / H. GURU IND / FORBES MARSHALL / MANOMETER / A.N. INST / GAUGES BOURDON / GLUCK / WIKA / ASHCROFT / BAUMER TECHNOLOGIES/PRECISION MASS PRODUCTS/ BOSE PANDA |



**1 X 660 MW SAGARDIGHI TPS UNIT NO. 5  
PHASE III  
VENTILATION SYSTEM  
LIST OF MAKES OF SUB-VENDOR ITEMS**

**SPECIFICATION No: PE-TS-445-554-A001**

**SECTION : I**

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**SHEET 1 OF 2**

|                                          |                                                                                                                                                                                                                                                                                     |
|------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>16. TEMPERATURE GAUGE</b>             | H. GURU IND/ H.GURU INST/ FORBES MARSHALL/DETRIVE INST & ELECTRONICS / PYRO ELECTRIC /TOSHNIWAL BROSS / WAREE INSTRUMENTS / A.N.INST / GOA INSTRUMENTS / WIKA/ ASHCROFT / H GURU (SI)/ BAUMER TECHNOLOGIES/ GAUGE BOURDON/ GOA THERMOSTAT/ BUDENBERG GAUGE/ PRECISION MASS PRODUCTS |
| <b>17. LEVEL GAUGE</b>                   | GENERAL INSTRUMENTS / CHEMTROLS / SBEM, PUNE/ AUTOMAT MUMBAI /SIGMA / TOSHNIWAL / TECHNOMATIC / TELACO /LEVCON / D K INSTRUMENTS / PUNE TECHTROL / FLOW STAR/ BLISS ANAND                                                                                                           |
| <b>18. PRESSURE SWITCH / DP SWITCHES</b> | BELLS / DANFOSS / DK INSTRUMENTS/ DRESSER / SOR INC / VASU / SWITZER / INDFOSS / TRAFAG / GIC / ASHCROFT/ KASTURBA UDYOG/ BARKSDALE/ PRECISION MASS/ MITTAL REFRIGERATION                                                                                                           |
| <b>19. LEVEL SWITCH</b>                  | SBEM / BLISS ANAND / HI TECH / RAMAN INST / SIGMA / SOR INC / WAREE INST / LEVCON / DK INSTURMENT / V AUTOMAT /CHEMTROLS / SIMENS / FLOW STAR / TRAC/ NIVO CONTROLS/ PUNE TECHTROLS/ SAPCON INSTRUMENTS/ BAUMER TECHNOLOGIES/ GIC                                                   |
| <b>20. Y / POT STRAINER</b>              | MULTITEX / GREAVES COTTON / JAYPEE / SANT / OTOKLIN / GRAND PRIX / GUJARAT OTOLIFT / DS ENGG / SARAJINI ENTERPRISE / BHATIA ENGINEERING / FILTERATION ENGINEERS INDIA PVT LTD / SUNGOV ENGINEERING                                                                                  |
| <b>21. CONTROL PANEL</b>                 | INDUSTRIAL CONTROL & APPLIANCE/ PYROTECH /POSITRONICS / CONTROL & SWITCHGEAR /SIEMENS / L&T /GE POWER /RITTAL / HOFFMAN                                                                                                                                                             |
| <b>NOTE</b>                              |                                                                                                                                                                                                                                                                                     |
|                                          | * Designed by C. Doctor / Blue Star / Voltas / Hyderabad Pollution Controls / SK System /Advance Ventilation / Draft Air / Sterling & Wilson / Roots cooling and fabricated by their approved fabricators.                                                                          |
|                                          | Above sub-vendor are also subjected to Customer approval during detailed engineering.                                                                                                                                                                                               |

|                                                                                   |                                                                                                           |                                      |                   |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|--------------------------------------|-------------------|
|  | <b>1 X 660 MW SAGARDIGHI TPS UNIT NO. 5<br/>PHASE III<br/>VENTILATION SYSTEM<br/>MANDATORY SPARE LIST</b> | SPECIFICATION NO. PE-TS-445-554-A001 |                   |
|                                                                                   |                                                                                                           | SECTION : I                          |                   |
|                                                                                   |                                                                                                           | SUB-SECTION : E                      |                   |
|                                                                                   |                                                                                                           | REV 00                               | DATE: AUGUST 2021 |
|                                                                                   |                                                                                                           | SHEET 1 OF 1                         |                   |

## SECTION-I

### SUB SECTION –E

## ANNEXURE-II

### MANDATORY SPARE LIST (COVERED UNDER SUB-SECTION C2-B, C-3, C-4, C-5)

|                                                                                   |                                                                                                                                                           |  |                                      |                   |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|--|--------------------------------------|-------------------|
|  | <b>1 X 660 MW SAGARDIGHI TPS UNIT NO. 5<br/>PHASE III<br/>VENTILATION SYSTEM<br/>LIST OF TOOLS &amp; TACKLES<br/>AND<br/>LIST OF COMMISSIONING SPARES</b> |  | SPECIFICATION No: PE-TS-445-554-A001 |                   |
|                                                                                   |                                                                                                                                                           |  | SECTION: I                           |                   |
|                                                                                   |                                                                                                                                                           |  | SUB-SECTION : E                      |                   |
|                                                                                   |                                                                                                                                                           |  | REV 00                               | DATE: AUGUST 2021 |
|                                                                                   |                                                                                                                                                           |  | SHEET 1 OF 2                         |                   |

## SECTION-I

## SUB-SECTION-E

## ANNEXURE-III

## LIST OF TOOLS & TACKLES AND LIST OF COMMISSIONING SPARES

|                                                                                   |                                                                                                                                                                                         |                                      |                   |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|-------------------|
|  | <b>1 X 660 MW SAGARDIGHI TPS UNIT NO. 5</b><br><b>PHASE III</b><br><b>VENTILATION SYSTEM</b><br><b>LIST OF TOOLS &amp; TACKLES</b><br><b>AND</b><br><b>LIST OF COMMISSIONING SPARES</b> | SPECIFICATION No: PE-TS-445-554-A001 |                   |
|                                                                                   |                                                                                                                                                                                         | SECTION: I                           |                   |
|                                                                                   |                                                                                                                                                                                         | SUB-SECTION : E                      |                   |
|                                                                                   |                                                                                                                                                                                         | REV 00                               | DATE: AUGUST 2021 |
|                                                                                   |                                                                                                                                                                                         | SHEET 2 OF 2                         |                   |

#### **LIST OF TOOLS & TACKLES**

| SL NO | ITEM DESCRIPTION                 | UNIT | QTY |
|-------|----------------------------------|------|-----|
| 1     | MEASURING TAPE                   | NO.  | 1   |
| 2     | TECHOMETER                       | NO.  | 1   |
| 3     | DOUBLE ENDED SPANNER             | SET  | 1   |
| 4     | RING SPANNERS                    | SET  | 1   |
| 5     | GASKET PUNCH                     | NO.  | 1   |
| 6     | CENTRE PUNCH                     | NO.  | 1   |
| 7     | HAMMER WITH WOODEN HANDLES       | NO.  | 1   |
| 8     | SCISSORS FOR SHEET METAL CUTTING | NO.  | 1   |
| 9     | TORCH WITH 2 DRY CELLS           | NO.  | 1   |
| 10    | MULTIMETER                       | NO.  | 1   |
| 11    | ANIMOMETER                       | NO.  | 1   |
| 12    | COMPOUND PRESSURE GAUGE          | NO.  | 1   |
| 13    | SLIDE WRENCH 6"                  | NO.  | 1   |
| 14    | SLIDE WRENCH 8"                  | NO.  | 1   |
| 15    | SLIDE WRENCH 10"                 | NO.  | 1   |
| 16    | BOX SPANNER SET                  | SET  | 1   |
| 17    | SCREW DRIVER SET                 | SET  | 1   |
| 18    | ALIGN KEY SET                    | SET  | 1   |
| 19    | MS TOOL BOX                      | NO.  | 1   |

**NOTE:-** Above is the minimum list. Any other Tools and tackles required for AC system w.r.t. Mechanical, Electrical and C&I part shall also be provided by the Bidder as per system / customer requirement without any commercial & Delivery implication to BHEL.

#### **LIST OF COMMISSIONING SPARES**

| SL NO | ITEM DESCRIPTION                            | UNIT | QTY |
|-------|---------------------------------------------|------|-----|
| 1     | FAN BELTS (FOR EACH TYPE & SIZE)            | SET  | 1   |
| 2     | PRESSURE GAUGE (FOR EACH TYPE AND RANGE)    | NO.  | 1   |
| 3     | TEMPERATURE GAUGE (FOR EACH TYPE AND RANGE) | NO.  | 1   |
| 4     | FILTER FOR AXIAL FAN (FOR EACH SIZE)        | SET  | 1   |

**NOTE:-** Above is the minimum list. Any other commissioning spare required for AC system w.r.t. Mechanical, Electrical and C&I part shall also be provided by the Bidder as per system / customer requirement without any commercial & Delivery implication to BHEL.

Supply of special tools and tackle including toolbox required for operation, maintenance and overhauling of the system is in the scope of the bidder.

|                                                                                   |                                                                                                                                    |                                             |                          |
|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|--------------------------|
|  | <b>1 X 660 MW SAGARDIGHI TPS UNIT NO. 5<br/>PHASE III<br/>VENTILATION SYSTEM<br/>DRAWINGS / DOCUMENTS SUBMISSION<br/>PROCEDURE</b> | <b>SPECIFICATION No: PE-TS-445-554-A001</b> |                          |
|                                                                                   |                                                                                                                                    | <b>SECTION : I</b>                          |                          |
|                                                                                   |                                                                                                                                    | <b>SUB-SECTION : E</b>                      |                          |
|                                                                                   |                                                                                                                                    | <b>REV 00</b>                               | <b>DATE: AUGUST 2021</b> |
|                                                                                   |                                                                                                                                    | <b>SHEET 1 OF 2</b>                         |                          |

**SECTION-I**  
**SUB-SECTION-E**  
**ANNEXURE-IV**  
**DRAWINGS / DOCUMENTS SUBMISSION PROCEDURE**

|                                                                                   |                                                                                                                                    |                                             |                          |
|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|--------------------------|
|  | <b>1 X 660 MW SAGARDIGHI TPS UNIT NO. 5<br/>PHASE III<br/>VENTILATION SYSTEM<br/>DRAWINGS / DOCUMENTS SUBMISSION<br/>PROCEDURE</b> | <b>SPECIFICATION No: PE-TS-445-554-A001</b> |                          |
|                                                                                   |                                                                                                                                    | <b>SECTION : I</b>                          |                          |
|                                                                                   |                                                                                                                                    | <b>SUB-SECTION : E</b>                      |                          |
|                                                                                   |                                                                                                                                    | <b>REV 00</b>                               | <b>DATE: AUGUST 2021</b> |
|                                                                                   |                                                                                                                                    | <b>SHEET 2 OF 2</b>                         |                          |

1. Bidder shall submit soft copy / hard copy / CD ROMs of all the finally approved drawings and O&M Manuals as required by Customer/ Customer’s consultant/ BHEL-site/ BHEL-PEM. The exact number of hard copies/ CD ROMs of these documents to be submitted shall be notified to the bidder during detailed engineering and bidder shall submit the same without any commercial/ delivery implications to BHEL/ Customer.

2. All the drawing documents along with the O&M manual (of all the revisions) are necessarily to be submitted in soft copies in addition to hard copies.

3. Bidder to submit soft copies of all the drawing and document along with quality plans for BHEL review and approval.

4. Editable copy of all the drawings and documents shall be provided.

5. The date of submission of drawing documents shall be considered as the date of submission of hard and soft copies whichever is later.

6. All the drawings shall be prepared on computer auto cad and other documents (like datasheet etc.) on MS office software. Bidder not complying to the requirement shall not be considered. For the execution of the contract regular meeting (generally once in 15 days or as per project requirement) is required.

7. Vendor to come for meeting with the concerned dealing persons as per BHEL or customer requirement in a short notice.

8. Bidder to also furnish the auto cad copy/ MS-Excel/ MS-word (as applicable) of the following documents after award of contract. However, any other auto cad copy/ MS-Excel/ MS-word of any other document as per the insistence of BHEL and customer will also be submitted by the bidder without any delivery and commercial implication to BHEL and customer.

a. P&IDs.

b. Equipment layout of Air washer and UAF along-with pumps, Ventilation duct layout etc.

c. Piping layout drawing.

d. Valve schedule, Instrument schedule, Cable Schedule etc,

e. I/O list and drive list.

f. Any other document/ drawing as required by BHEL/ customer

Other requirements

1. Successful bidder shall furnish detailed erection manual for each of the equipment as well as complete system supplied under this contract at least 3 months before the scheduled erection of the concerned equipment / component or along with supply of concerned equipment / component whichever is earlier.

2. Document approval by customer under Approval category or information category shall not absolve the vendor of their contractual obligations of completing the work as per specification requirement. Any deviation from specified requirement shall be reported by the vendor in writing and require written approval. Unless any change in specified requirement has been brought out by the vendor during detail engineering in writing while submitting the document to customer for approval, approved document (with implicit deviation) will not be cited as a reason for not following the specification requirement.

3. In case vendor submits revised drawing after approval of the corresponding drawing, any delay in approval of revised drawing shall be to vendor’s account and shall not be used as a reason for extension in contract completion. However, in case changes are necessitated due to any constraints at customer end, delay in review/ approval of such revised drawing beyond one month will be to customer’s account.

|                                                                                                                                                   |                                                                                                                                                                  |                                             |                          |
|---------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|--------------------------|
|                                                                  | <b>1 X 660 MW SAGARDIGHI TPS UNIT NO. 5</b><br><b>PHASE III</b><br><b>VENTILATION SYSTEM</b><br><b>MASTER DRAWING LIST WITH SCHEDULE OF</b><br><b>SUBMISSION</b> | <b>SPECIFICATION No: PE-TS-445-554-A001</b> |                          |
|                                                                                                                                                   |                                                                                                                                                                  | <b>SECTION : I</b>                          |                          |
|                                                                                                                                                   |                                                                                                                                                                  | <b>SUB-SECTION : E</b>                      |                          |
|                                                                                                                                                   |                                                                                                                                                                  | <b>REV 00</b>                               | <b>DATE: AUGUST 2021</b> |
|                                                                                                                                                   |                                                                                                                                                                  | <b>SHEET 1 OF 5</b>                         |                          |
| <div><div><div>SECTION-I</div><div>SUB-SECTION-E</div><div>ANNEXURE-V</div><div>MASTER DRAWING LIST WITH SCHEDULE OF SUBMISSION</div></div></div> |                                                                                                                                                                  |                                             |                          |

|  | <b>1 X 660 MW SAGARDIGHI TPS UNIT NO. 5<br/>PHASE III<br/>VENTILATION SYSTEM<br/>MASTER DRAWING LIST WITH SCHEDULE OF<br/>SUBMISSION</b> |                                                                                                                             | <b>SPECIFICATION No: PE-TS-445-554-A001</b> |                          |
|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|--------------------------|
|                                                                                   |                                                                                                                                          |                                                                                                                             | <b>SECTION : I</b>                          |                          |
|                                                                                   |                                                                                                                                          |                                                                                                                             | <b>SUB-SECTION : E</b>                      |                          |
|                                                                                   |                                                                                                                                          |                                                                                                                             | <b>REV 00</b>                               | <b>DATE: AUGUST 2021</b> |
|                                                                                   |                                                                                                                                          |                                                                                                                             | <b>SHEET 2 OF 5</b>                         |                          |
| <b>Sr. No.</b>                                                                    | <b>BHEL Drawing No</b>                                                                                                                   | <b>Drawing Title</b>                                                                                                        | <b>SCH. WEEK (FROM DATE OF LOI)</b>         |                          |
| 1.                                                                                | PE-V0-445-554-A001**                                                                                                                     | INSPECTION CATEGORISATION PLAN CUM SUB VENDOR LIST FOR VENTILATION SYSTEM                                                   | 4                                           |                          |
| 2.                                                                                | PE-V0-445-554-A002                                                                                                                       | QUALITY PLAN OF AIR WASHER & UAF FOR VENTILLATION SYSTEM                                                                    | 12                                          |                          |
| 3.                                                                                | PE-V0-445-554-A003                                                                                                                       | QUALITY PLAN OF CENTRIFUGAL PUMPS FOR VENTILLATION SYSTEM                                                                   | 12                                          |                          |
| 4.                                                                                | PE-V0-445-554-A004                                                                                                                       | QUALITY PLAN OF CENTRIFUGAL FANS FOR VENTILLATION SYSTEM                                                                    | 13                                          |                          |
| 5.                                                                                | PE-V0-445-554-A005                                                                                                                       | QUALITY PLAN OF AXIAL FLOW FANS & RE UNITS FOR VENTILLATION SYSTEM                                                          | 14                                          |                          |
| 6.                                                                                | PE-V0-445-554-A006                                                                                                                       | QUALITY PLAN OF MOTOR FOR VENTILLATION SYSTEM                                                                               | 15                                          |                          |
| 7.                                                                                | PE-V0-445-554-A007**                                                                                                                     | OPERATION & CONTROL PHILOSOPHY FOR VENTILATION SYSTEM                                                                       | 8                                           |                          |
| 8.                                                                                | PE-V0-445-554-A008                                                                                                                       | VENTILATION FAN SCHEDULE.                                                                                                   | 17                                          |                          |
| 9.                                                                                | PE-V0-445-554-A009                                                                                                                       | DATA SHEET & GA FOR AIR WASHER WITH FOUNDATION DETAILS FOR VENTILLATION SYSTEM                                              | 12                                          |                          |
| 10.                                                                               | PE-V0-445-554-A010                                                                                                                       | DATA SHEET & GA FOR ROOF EXTRACTOR, AXIAL EXHAUST AND SUPPLY AIR FANS WITH FIXING ARRANGEMENT FOR VENTILLATION SYSTEM       | 12                                          |                          |
| 11.                                                                               | PE-V0-445-554-A011                                                                                                                       | DATA SHEET & GA FOR VALVES & STRAINERS FOR VENTILLATION SYSTEM                                                              | 8                                           |                          |
| 12.                                                                               | PE-V0-445-554-A012                                                                                                                       | DATA SHEET FOR INSULATION FOR VENTILLATION SYSTEM                                                                           | 7                                           |                          |
| 13.                                                                               | PE-V0-445-554-A013                                                                                                                       | DATA SHEET & GA FIRE DAMPER FOR VENTILLATION SYSTEM                                                                         | 8                                           |                          |
| 14.                                                                               | PE-V0-445-554-A014                                                                                                                       | DATA SHEET FOR INSTRUMENTS (PRESSURE GAUGE, TEMP GAUGE, LEVEL GAUGE, PRESSURE SWITCH, LEVEL SWITCH) FOR VENTILLATION SYSTEM | 14                                          |                          |
| 15.                                                                               | PE-V0-445-554-A015                                                                                                                       | DATA SHEET OF PIPE FOR VENTILLATION SYSTEM                                                                                  | 5                                           |                          |
| 16.                                                                               | PE-V0-445-554-A016                                                                                                                       | DATA SHEET OF GI AND MS SHEET FOR VENTILLATION SYSTEM                                                                       | 5                                           |                          |
| 17.                                                                               | PE-V0-445-554-A017                                                                                                                       | DATA SHEET & GA FOR PRE AND FINE FILTERS FOR VENTILLATION SYSTEM                                                            | 10                                          |                          |
| 18.                                                                               | PE-V0-445-554-A018                                                                                                                       | DATA SHEET FOR MOTORS (A/W Fan, A/W pumps, UAF Fan, UAF Pump) FOR VENTILLATION SYSTEM                                       | 15                                          |                          |
| 19.                                                                               | PE-V0-445-554-A019                                                                                                                       | TYPICAL Details DUCT FABRC DRG / SUPPORT / EREC.FOR VENTILLATION SYSTEM INSUL OF DUCT / PIPING & EQUIPMENTS PIPE ERECTION   | 7                                           |                          |

|                                                                                   |                                                                                                                                          |                                             |                          |
|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|--------------------------|
|  | <b>1 X 660 MW SAGARDIGHI TPS UNIT NO. 5<br/>PHASE III<br/>VENTILATION SYSTEM<br/>MASTER DRAWING LIST WITH SCHEDULE OF<br/>SUBMISSION</b> | <b>SPECIFICATION No: PE-TS-445-554-A001</b> |                          |
|                                                                                   |                                                                                                                                          | <b>SECTION : I</b>                          |                          |
|                                                                                   |                                                                                                                                          | <b>SUB-SECTION : E</b>                      |                          |
|                                                                                   |                                                                                                                                          | <b>REV 00</b>                               | <b>DATE: AUGUST 2021</b> |
|                                                                                   |                                                                                                                                          | <b>SHEET 3 OF 5</b>                         |                          |

| Sr. No. | BHEL Drawing No      | Drawing Title                                                                                  | SCH. WEEK (FROM DATE OF LOI) |
|---------|----------------------|------------------------------------------------------------------------------------------------|------------------------------|
| 20.     | PE-V0-445-554-A020   | GA OF PROPELLER FAN FOR VENTILLATION SYSTEM                                                    | 9                            |
| 21.     | PE-V0-445-554-A021** | PID FOR AIRWASHER AND UAF UNIT FOR VENTILLATION SYSTEM                                         | 8                            |
| 22.     | PE-V0-445-554-A022** | AIR WASHER LAYOUT OUTSIDE "A ROW" SIDEALONGWITH FOUNDATION DETAILS - TG BUILDING               | 12                           |
| 23.     | PE-V0-445-554-A023** | AIR WASHER LAYOUT FOR"B-C BAY" SIDEALONGWITH FOUNDATION DETAILS - TG BUILDING                  | 12                           |
| 24.     | PE-V0-445-554-A024** | UAF LAYOUT ALONGWITH FOUNDATION DETAILS - ESP CUM FGD BUILDING.                                | 12                           |
| 25.     | PE-V0-445-554-A025   | VENTILATION DUCT LAYOUT FOR TG BUILDING - 'A' ROW SIDE                                         | 12                           |
| 26.     | PE-V0-445-554-A026   | VENTILATION DUCT LAYOUT FOR TG BUILDING - 'BC BAY' SIDE                                        | 12                           |
| 27.     | PE-V0-445-554-A027   | VENTILATION DUCT LAYOUT FOR ESP CUM FGD BUILDINGS                                              | 12                           |
| 28.     | PE-V0-445-554-A028** | LOCATION OF ROOF EXTRACTOR UNIT IN TG BUILDING ALONGWITH FIXING DETAILSFOR VENTILLATION SYSTEM | 12                           |
| 29.     | PE-V0-445-554-A029   | VENT. ARRANGEMENT FOR BATTERY ROOM.                                                            | 12                           |
| 30.     | PE-V0-445-554-A030   | VENT. ARRANGEMENT FOR VARIOUS AUXILIARY BUILDING.                                              | 18                           |
| 31.     | PE-V0-445-554-A031   | ELECTRICAL FEEDER LIST FOR VENTILLATION SYSTEM                                                 | 18                           |
| 32.     | PE-V0-445-554-A032   | VENTILATION CABLE SCHEDULE                                                                     | 16                           |
| 33.     | PE-V0-445-554-A033   | P.G/ DEMONSTRATION TEST PROCEDUREFOR VENTILLATION SYSTEM                                       | 12                           |
| 34.     | PE-V0-445-554-A034   | O & M MANUAL FOR VENTILLATION SYSTEM                                                           | 25                           |
| 35.     | PE-V0-445-554-A035** | VENTILATION AIR CALCULATION FOR TG AND ESP CUM FGD BUILDING                                    | 5                            |
| 36.     | PE-V0-445-554-A036** | SCHEME FOR AIR DISTRIBUTION IN TG BUILDING ESP CUM FGD BUILDING.                               | 6                            |
| 37.     | PE-V0-445-554-A037   | DATA SHEET & GA FOR UAF WITH FOUNDATION DETAILS FOR VENTILLATION SYSTEM                        | 6                            |

|                                                                                   |                                                                                                                                          |                                      |                   |
|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|-------------------|
|  | <b>1 X 660 MW SAGARDIGHI TPS UNIT NO. 5<br/>PHASE III<br/>VENTILATION SYSTEM<br/>MASTER DRAWING LIST WITH SCHEDULE OF<br/>SUBMISSION</b> | SPECIFICATION No: PE-TS-445-554-A001 |                   |
|                                                                                   |                                                                                                                                          | SECTION : I                          |                   |
|                                                                                   |                                                                                                                                          | SUB-SECTION : E                      |                   |
|                                                                                   |                                                                                                                                          | REV 00                               | DATE: AUGUST 2021 |
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| Sr. No. | BHEL Drawing No    | Drawing Title                                                                                            | SCH. WEEK (FROM DATE OF LOI) |
|---------|--------------------|----------------------------------------------------------------------------------------------------------|------------------------------|
| 38.     | PE-V0-445-554-A038 | DATA SHEET & GA FOR AIR WASHER FAN WITH FOUNDATION DETAILS FOR VENTILLATION SYSTEM                       | 10                           |
| 39.     | PE-V0-445-554-A039 | DATA SHEET & GA FOR UAF FAN WITH FOUNDATION DETAILS FOR VENTILLATION SYSTEM                              | 10                           |
| 40.     | PE-V0-445-554-A040 | DATA SHEET & GA FOR AIR WASHER PUMP WITH FOUNDATION DETAILS FOR VENTILLATION SYSTEM                      | 10                           |
| 41.     | PE-V0-445-554-A041 | DATA SHEET & GA FOR UAF PUMP WITH FOUNDATION DETAILS FOR VENTILLATION SYSTEM                             | 10                           |
| 42.     | PE-V0-445-554-A042 | DATA SHEET & GA FOR STRAINER FOR VENTILLATION SYSTEM                                                     | 8                            |
| 43.     | PE-V0-445-554-A043 | DATA SHEET FOR MOTORS (RE unit, Supply and Exhaust axial fan) FOR VENTILLATION SYSTEM                    | 14                           |
| 44.     | PE-V0-445-554-A044 | TDS AND GA OF GRILL/ NRD / VCD / GRAVITY DAMPER / INTAKE LOUVER ETC FOR VENTILLATION SYSTEM              | 12                           |
| 45.     | PE-V0-445-554-A045 | GA FOR MANUAL TROLLEY (MANUALLY OPERATED, PLATFORM TROLLEY OF 1.5 TON CAPACITY WITH BASE AREA 2M X 1.5M) | 10                           |
| 46.     | PE-V0-445-554-A046 | AIR WASHER / UAF LAYOUT ALONGWITH FOUNDATION DETAILS -FGD BUILDING.                                      | 12                           |
| 47.     | PE-V0-445-554-A047 | VENTILATION DUCT LAYOUT FOR FGD BUILDINGS                                                                | 12                           |
| 48.     | PE-V0-445-554-A048 | SCHEDULE OF INSTRUMENTS FOR VENTILLATION SYSTEM                                                          | 16                           |
| 49.     | PE-V0-445-554-A049 | I/O List FOR VENTILATION SYSTEM                                                                          | 16                           |
| 50.     | PE-V0-445-554-A050 | PLANT SCHEMATIC / MIMIC FOR VENTILATION SYSTEM                                                           | 8                            |
| 51.     | PE-V0-445-554-A051 | UAF LAYOUT FOR AUXILIARY BUILDINGS                                                                       | 12                           |
| 52.     | PE-V0-445-554-A052 | QAP FOR VALVES FOR VENTILATION SYSTEM - MANUAL VALVES                                                    | 10                           |
| 53.     | PE-V0-445-554-A053 | QAP FOR VALVES FOR VENTILATION SYSTEM - MOTORIZED VALVES                                                 | 10                           |

**BHEL Drawing / Document indicated with \*\* are basis engineering documents.**

**Notes:**

1. The above drawing list is tentative and shall be finalized with the successful bidder after placement of order. While some of the drawings indicated above may not be applicable, some additional drawings may also be required based on scope of work.

|                                                                                   |                                                                                                                                                                  |                                             |                          |
|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|--------------------------|
|  | <b>1 X 660 MW SAGARDIGHI TPS UNIT NO. 5</b><br><b>PHASE III</b><br><b>VENTILATION SYSTEM</b><br><b>MASTER DRAWING LIST WITH SCHEDULE OF</b><br><b>SUBMISSION</b> | <b>SPECIFICATION No: PE-TS-445-554-A001</b> |                          |
|                                                                                   |                                                                                                                                                                  | <b>SECTION : I</b>                          |                          |
|                                                                                   |                                                                                                                                                                  | <b>SUB-SECTION : E</b>                      |                          |
|                                                                                   |                                                                                                                                                                  | <b>REV 00</b>                               | <b>DATE: AUGUST 2021</b> |
|                                                                                   |                                                                                                                                                                  | <b>SHEET 5 OF 5</b>                         |                          |

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

3. Only manual calculation with authentic supporting literature (e.g. extracts of hand book/ standard/codes) shall be acceptable. All design calculations and drawings shall be in SI system only.

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

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

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

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

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

e) Drawings/ documents to be submitted for purchasers review/ approval shall be under revision a, b, c... etc. while drawings /documents to be submitted thereafter for customer's approval after purchaser's approval shall be under r-0, 1, 2, 3 ....etc.

f) Drawings and documents not covered above but required to check safety of machines/ system, shall be submitted during detailed engineering stage without any commercial implication.

g) All drawings shall include "B.O.M" and indicate quantity, material of construction, make along with IS/BS no., technical parameters, dimensions, hardness, machining symbol and tolerance, requirement of radiography and hydraulic tests, painting details, elevation, side view, plan, skin section and blow-up view for clarity.

h) All drawings shall be prepared as per BHEL'S title block and shall bear BHEL'S drawing no.

i) 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.

j) Bidder to follow the following the drawing submission schedule:

k) 1st submission of drawings from date of LOI as per the submission schedule (week).

l) Every revised submission incorporating comments – within 7 days.

m) Bidder to submit revised drawings complete in all respects incorporating all comments. Any incomplete drawing submitted shall be treated as non-submission with delays attributable to bidder's account. For any clarification/ discussion required to complete the drawings, the bidder shall himself depute his personal to BHEL for across the table discussions/ finalizations/ submissions of drawings.

|                                                                                   |                                                                                                                                      |                                      |                   |
|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|-------------------|
|  | <b>1 X 660 MW SAGARDIGHI TPS UNIT NO. 5<br/>PHASE III<br/>VENTILATION SYSTEM<br/>FORMAT FOR OPERATION AND<br/>MAINTENANCE MANUAL</b> | SPECIFICATION No: PE-TS-445-554-A001 |                   |
|                                                                                   |                                                                                                                                      | SECTION : I                          |                   |
|                                                                                   |                                                                                                                                      | SUB SECTION E                        |                   |
|                                                                                   |                                                                                                                                      | REV 00                               | DATE: AUGUST 2021 |
|                                                                                   |                                                                                                                                      | SHEET 1 OF 4                         |                   |

**SECTION-I**  
**SUB SECTION-E**  
**ANNEXURE-VI**  
**FORMAT FOR OPERATION AND MAINTENANCE MANUAL**



**1 X 660 MW SAGARDIGHI TPS UNIT NO. 5  
PHASE III  
VENTILATION SYSTEM  
FORMAT FOR OPERATION AND  
MAINTENANCE MANUAL**

**SPECIFICATION No: PE-TS-445-554-A001**

**SECTION : I**

**SUB SECTION E**

**REV 00**

**DATE: AUGUST 2021**

**SHEET 2 OF 4**

Project name :  
Project number :  
Package Name :  
PO reference :  
Document number :  
Revision number :

| Sl.no. & Sections | Description                                                                                                                                                                                                     | Tick ( √ )if included in Manual |    |                | Remarks |
|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|----|----------------|---------|
|                   |                                                                                                                                                                                                                 | Yes                             | No | Not Applicable |         |
| <b>1.</b>         | <b>COVER PAGE</b>                                                                                                                                                                                               |                                 |    |                |         |
| <b>1.1</b>        | Project Name                                                                                                                                                                                                    |                                 |    |                |         |
| <b>1.2</b>        | Customer/consultant Name                                                                                                                                                                                        |                                 |    |                |         |
| <b>1.3</b>        | Name of Package                                                                                                                                                                                                 |                                 |    |                |         |
| <b>1.4</b>        | Supplier details with phone, FAX ,email address , Emergency Contact number                                                                                                                                      |                                 |    |                |         |
| <b>1.5</b>        | Name and sign of prepared by , checked by & approved by                                                                                                                                                         |                                 |    |                |         |
| <b>1.6</b>        | Revision history with approval Details                                                                                                                                                                          |                                 |    |                |         |
| <b>2.0</b>        | <b>INDEX</b>                                                                                                                                                                                                    |                                 |    |                |         |
| <b>2.1</b>        | showing the sections & related page nos<br>All the pages should be numbered section wise                                                                                                                        |                                 |    |                |         |
| <b>3.0</b>        | <b>DESCRIPTION OF PLANT/SYSTEM</b>                                                                                                                                                                              |                                 |    |                |         |
| <b>3.1</b>        | Description /write up of operating principle of system equipment/ associated sub-systems & accessories/controls system , operating conditions, performance parameters under normal , start up and special cases |                                 |    |                |         |
| <b>3.2</b>        | Equipment list and basic parameter with Tag numbers                                                                                                                                                             |                                 |    |                |         |
| <b>3.3</b>        | Data sheets approved by Customer/for information and catalogues provided by original manufacturer                                                                                                               |                                 |    |                |         |
| <b>3.4</b>        | Associated other packages and Interface /terminal points                                                                                                                                                        |                                 |    |                |         |
| <b>3.5</b>        | P&ID & Process Diagrams                                                                                                                                                                                         |                                 |    |                |         |
| <b>3.6</b>        | GA Layout drawings, As-built drawings , Actual photograph of items/system (Drawings of A2 & bigger sizes are to be attached in the last)                                                                        |                                 |    |                |         |
| <b>3.7</b>        | Single line/wiring diagrams                                                                                                                                                                                     |                                 |    |                |         |
| <b>3.8</b>        | Control philosophy /control write-ups                                                                                                                                                                           |                                 |    |                |         |

|                                                                                   |                                                                                                                           |                                      |                   |  |  |
|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|--------------------------------------|-------------------|--|--|
|  | 1 X 660 MW SAGARDIGHI TPS UNIT NO. 5<br>PHASE III<br>VENTILATION SYSTEM<br>FORMAT FOR OPERATION AND<br>MAINTENANCE MANUAL | SPECIFICATION No: PE-TS-445-554-A001 |                   |  |  |
|                                                                                   |                                                                                                                           | SECTION : I                          |                   |  |  |
|                                                                                   |                                                                                                                           | SUB SECTION E                        |                   |  |  |
|                                                                                   |                                                                                                                           | REV 00                               | DATE: AUGUST 2021 |  |  |
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| Sl.no. & Sections | Description                                                                                                                                                                                                                     | Tick ( √ )if included in Manual |    |                | Remarks |
|-------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|----|----------------|---------|
|                   |                                                                                                                                                                                                                                 | Yes                             | No | Not Applicable |         |
| 4.0               | COMMISSIONING ACTIVITIES (IF NOT COVERED IN SEPARATE DOCUMENT I.E. ERECTION MANUAL, COMMISSIONING MANUAL)                                                                                                                       |                                 |    |                |         |
| 4.1               | Pre-Commissioning Checks                                                                                                                                                                                                        |                                 |    |                |         |
| 4.2               | handling of items at site                                                                                                                                                                                                       |                                 |    |                |         |
| 4.3               | Storage at site                                                                                                                                                                                                                 |                                 |    |                |         |
| 4.4               | Unpacking & Installation procedure                                                                                                                                                                                              |                                 |    |                |         |
| 5.0               | OPERATION GUIDELINES FOR PLANT PERSONAL/USER/OPERATOR                                                                                                                                                                           |                                 |    |                |         |
| 5.1               | Interlock & Protection logic along with the limiting values of protection settings for the equipment along with brief philosophy behind the logic, drawings etc. to be provided.                                                |                                 |    |                |         |
| 5.2               | Start up, normal operation and shut down procedure for equipments along with the associated systems in step by step mode. Valve sequence chart, step list, interlocks etc. with Equipment isolating procedures to be mentioned. |                                 |    |                |         |
| 5.3               | Do's & Don't of the equipments.                                                                                                                                                                                                 |                                 |    |                |         |
| 5.4               | Safety precautions to be taken during normal operation. Safety symbols, Emergency instructions on total power failure condition/lubrication failure/any other condition                                                         |                                 |    |                |         |
| 5.5               | Parameters to be monitored with normal values and limiting values                                                                                                                                                               |                                 |    |                |         |
| 5.6               | Trouble shooting with causes and remedial measures                                                                                                                                                                              |                                 |    |                |         |
| 5.7               | Routine operational checks, recommended logs & records                                                                                                                                                                          |                                 |    |                |         |
| 5.8               | Changeover schedule if more than one auxiliary for the same purpose is given                                                                                                                                                    |                                 |    |                |         |
| 5.9               | Painting requirement and schedule                                                                                                                                                                                               |                                 |    |                |         |
| 5.10              | Inspection, repair , Testing and calibration procedures                                                                                                                                                                         |                                 |    |                |         |
| 6.0               | MAINTENANCE GUIDELINES FOR PLANT PERSONAL                                                                                                                                                                                       |                                 |    |                |         |

|                                                                                   |                                                                                                                                                              |                                             |                          |
|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|--------------------------|
|  | <b>1 X 660 MW SAGARDIGHI TPS UNIT NO. 5</b><br><b>PHASE III</b><br><b>VENTILATION SYSTEM</b><br><b>FORMAT FOR OPERATION AND</b><br><b>MAINTENANCE MANUAL</b> | <b>SPECIFICATION No: PE-TS-445-554-A001</b> |                          |
|                                                                                   |                                                                                                                                                              | <b>SECTION : I</b>                          |                          |
|                                                                                   |                                                                                                                                                              | <b>SUB SECTION E</b>                        |                          |
|                                                                                   |                                                                                                                                                              | <b>REV 00</b>                               | <b>DATE: AUGUST 2021</b> |
|                                                                                   |                                                                                                                                                              | <b>SHEET 4 OF 4</b>                         |                          |

| Sl.no. & Sections | Description                                                                                                                                                                                                                     | Tick ( √ )if included in Manual |    |                | Remarks |
|-------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|----|----------------|---------|
|                   |                                                                                                                                                                                                                                 | Yes                             | No | Not Applicable |         |
| 6.1               | List of Special Tools and Tackles required for Overhaul/Trouble shooting including special testing equipment required for calibration etc.                                                                                      |                                 |    |                |         |
| 6.2               | Stepwise dismantling and re-assembly procedure clearly specifying the tools to be used, checks to be made, records to be maintained, clearances etc. to be mentioned. Tolerances for fitment of various components to be given. |                                 |    |                |         |
| 6.3               | Preventive Maintenance & Overhauling schedules linked with running hours/calendar period along with checks to be given                                                                                                          |                                 |    |                |         |
| 6.4               | Long term maintenance schedules especially for structural, foundations etc.                                                                                                                                                     |                                 |    |                |         |
| 6.5               | Consumable list along with the estimated quantity required during commissioning, normal running and during maintenance like Preventive Maintenances and Overhaul. Storage/handling requirement of consumables/self-life.        |                                 |    |                |         |
| 6.6               | List of lubricants with their Indian equivalent, Lubrication Schedule, Quantity required for each equipment for complete replacement is to be given                                                                             |                                 |    |                |         |
| 6.7               | List of vendors & Sub-vendors with their latest addresses, service centres ,Telephone Nos., Fax Nos., Mobile Nos., e-mail IDs etc.                                                                                              |                                 |    |                |         |
| 6.8               | List of mandatory and recommended spare parts list                                                                                                                                                                              |                                 |    |                |         |
| 6.9               | Tentative Lead time required for ordering of spares from the equipment supplier                                                                                                                                                 |                                 |    |                |         |
| 6.10              | Guarantee and warranty clauses                                                                                                                                                                                                  |                                 |    |                |         |
| 7.0               | <b>Statutory and other specific requirements considerations.</b>                                                                                                                                                                |                                 |    |                |         |
| 8.0               | <b>List of reference documents</b>                                                                                                                                                                                              |                                 |    |                |         |
| 9.0               | <b>Binding as per requirement</b>                                                                                                                                                                                               |                                 |    |                |         |

|                                                                                   |                                                                                                                    |                                      |                   |
|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|--------------------------------------|-------------------|
|  | <b>1 X 660 MW SAGARDIGHI TPS UNIT NO. 5<br/>PHASE III<br/>VENTILATION SYSTEM<br/>SITE STORAGE AND PRESERVATION</b> | SPECIFICATION No: PE-TS-445-554-A001 |                   |
|                                                                                   |                                                                                                                    | SECTION : I                          |                   |
|                                                                                   |                                                                                                                    | SUB SECTION-E                        |                   |
|                                                                                   |                                                                                                                    | REV 00                               | DATE: AUGUST 2021 |
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## SECTION-I

### SUB-SECTION-E

## ANNEXURE-VII

### SITE STORAGE AND PRESERVATION

# **SITE STORAGE AND PRESERVATION GUIDELINES**

## **FOR**

### **MECHNANICAL BOPs**

**(Doc No: PE-DC-SSG-A001 REV.00)**



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

## **CONTENT**

- 1 SCOPE OF THE DOCUMENT
- 2 PURPOSE OF STORAGE & PRESERVATION
- 3 MEASURES TO BE TAKEN FOR STORAGE AND PRESERVATION
  - a) GENERAL STORAGE REQUIREMENTS
  - b) GENERAL PRESERVATION REQUIREMENTS
  - c) GENERAL INSPECTION REQUIREMENTS
- 4 TYPE OF STORAGE FOR VARIOUS EQUIPMENT
5. CONCLUSION
6. STACKING ARRANGEMENT FOR PLATES AND STRUCTURAL STEEL

## **1. SCOPE OF THE DOCUMENT**

This guideline is prepared in intent to provide proper site storage and preservation of the Mechanical, Electrical and C & I items / equipment supplied under various bought out packages/items. This storage procedure shall be followed at different power plant sites by concerned agency for storage and preservation from the date of equipment received at site until the same are erected and handed over to the customer.

## **2. PURPOSE OF STORAGE & PRESERVATION**

Many of the items may be required to be kept in stores for long period. It shall therefore be essential that proper methods of storage and preservation be applied so that items do not deteriorate, loose some of their properties and become unusable due to atmospheric conditions and biological elements.

## **3. MEASURES TO BE TAKEN FOR STORAGE, HANDLING & PRESERVATION**

### **a) GENERAL STORAGE REQUIREMENTS**

1. To the extent feasible, materials should be stored near the point of erection. The storage areas should have adequate unloading and handling facilities with adequate passage space for movement of material handling equipment such as cranes, fork lift trucks, etc. The storage of materials shall be properly planned to minimise time loss during retrieval of items required for erection.
2. The outdoor storage areas as well as semi-closed stores shall be provided with adequate drainage facilities to prevent water logging. Adequacy of these facilities shall be checked prior to monsoon.
3. The storage sheds shall be built in conformity with fire safety requirements. The stores shall be provided with adequate lights and fire extinguishers. 'No smoking' signs shall be placed at strategic locations. Safety precautions shall be strictly enforced.
4. Adequate lighting facility shall be provided in storage areas and storage sheds and security personnel positioned to ensure enforcement of security measures to prevent theft and loss of materials.
5. Adequate number of competent stores personnel and security staff shall be deployed to efficiently store and maintain the equipment / material.
7. The equipment shall be stored in an orderly manner, preserving their identification slips, tags and instruction booklets, etc., required during erection. The storage of materials shall be equipment-wise. Loose parts shall be stored in sheds on racks,

preserving the identification marks and tags in good condition. The group codes shall be displayed on the racks

6. At no time shall any materials be stored directly on ground. All materials shall be stored minimum 200 mm above the ground preferably on wooden sleepers

**b) GENERAL PRESERVATION REQUIREMENTS**

1. All special measures to prevent corrosion shall be taken like keeping material in dry condition, avoiding the equipment coming in contact with corrosive fluid like water, acid etc.
2. Materials which carry protective coating shall not be wrapped in paper, cloth, etc., as these are liable to absorb and retain moisture. The material shall be inspected and in case of signs of wear or damages to protective coating, that portion shall be cleaned with approved solution and coated with an approved protective paint. Complete record of all such observations and protective measures taken shall be maintained.
3. Generally equipment supplied at site are properly greased or rust protective oil is applied on machined/ fabricated components. However periodic inspection shall be carried out to ensure that protection offered is intact.
4. While handling the equipment, no dragging on the ground is permitted. Avoid using wire rope for lifting coated components. Use polyester slings (if possible) otherwise protective material (e.g. clothes, wood block etc.) should be used while handling the components with rope / slings
5. For Equipment supplied with finished paint, touch paint shall be done in case any surface paint gets peeled off during handling. Otherwise such surfaces shall necessarily be wrapped with polythene to avoid any corrosion. Further for equipment wherein finish coat is to be applied at site, site to ensure that equipment is received with primer coat applied.
6. It shall be ensured by periodic inspection that plastic inserts are intact in tapped holes, wherever applicable.
7. Pipes shall be blown with air periodically and it shall be ensured that there is no obstruction.
8. Silica gel or approved equivalent moisture absorbing material in small cotton bags shall be placed and tied at various points on the equipment, wherever necessary.
9. Heavy rotating parts in assembled conditions shall be periodically rotated to prevent corrosion/jamming due to prolonged storage.

10. All the electrical equipment such as motors, generators, etc. shall be tested for insulation resistance at least once in three months and a record of such measured insulation values shall be maintained.
11. Following preservatives/preservation methods can be used depending upon type of equipment
  - a. Rust preventive fluid (RPF)
  - b. Rust protective paints
  - c. Tarpaulin covers, in case of outdoor storage
  - d. De-oxy aluminate for weld-ments

**c) GENERAL INSPECTION REQUIREMENTS**

1. Period inspection of materials with specific reference to –
  - Ingress of moisture and corrosion damages.
  - Damage to protective coating.
  - Open ends in pipes, vessels and equipment -
    - In case any open ends are noticed, same shall be capped.
2. Any damages to equipment / materials.
  - In case of any damages, these shall be promptly notified and in all cases, the repairs / rectification shall be carried out.
  - Any items found damaged or not suitable as per project requirements shall be removed from site. If required to store temporarily, they shall be clearly marked and stored separately to prevent any inadvertent use.

#### 4. TYPE OF STORAGE FOR VARIOUS EQUIPMENT

The types of storage are broadly classified under the following heads:

i **Closed storage with dry and dust free atmosphere. (C )**

The closed shed can be constructed by using cold-rolled / tubular components for structure and corrugated asbestos sheets / galvanised iron sheets for roofing. Brick walls / asbestos sheets can be used to cover all the sides. The floor of the shed can be finished with plain cement concrete suitably glazed. The shed shall be provided with proper ventilation and illumination.



ii **Semi-closed storage. (S)**

The semi closed shed can be constructed by using cold-rolled / tubular components for structure and corrugated / asbestos sheets for roofing. The floor shall be brick paved. If required a small portion of sides can be covered to protect components from rainwater splashing onto the components.





### iii Open storage (O )

The open yard shall be levelled, well consolidated to achieve raised ground with the provision of feeder roads for crane approach along with access roads running all sides. One part of the open yard shall be stone pitched, levelled and consolidated with raised ground suitable for storing / stacking heavier and critical components with due space to handle them by cranes etc . Adequate number of sleepers, concrete block etc. to be provided to make raised platforms to stack critical materials.

A separate yard to be identified as “scrap yard” slightly away from main open yard to store wooden/steel scraps, which are to be disposed off. This is required to avoid mix up with regular components as well as to avoid fire hazard.

Some of the components, which are having both machined & un-machined surfaces and are bulky, shall be stored in open storage area on a raised ground and suitably covered with water proof / fire retardant tarpaulin.



The equipment listed below shall be stored and inspected as per requirement mentioned in the table below.

| Sl. No.                                                                            | Description of the equipment        | Type of Storage | Check for                                        | Remarks         |
|------------------------------------------------------------------------------------|-------------------------------------|-----------------|--------------------------------------------------|-----------------|
| <b>Raw material /mechanical items like pipes, plates, structure sections etc.)</b> |                                     |                 |                                                  |                 |
| 1.                                                                                 | Steel pipes ( lined/unlined)        | S               | Damage , paint, corrosion, rubber lining peeling | Provide end cap |
| 2.                                                                                 | MS Plates                           | S               | Damage, paint, corrosion                         |                 |
| 3.                                                                                 | SS Plates                           | S               | Damage                                           |                 |
| 4.                                                                                 | Non-metallic pipes                  | S               | Damage, cracks                                   | Provide end cap |
| 5.                                                                                 | Stainless steel pipes               | S               | Damage ,                                         | Provide end cap |
| 6.                                                                                 | MS sections, beams                  | S               | Damage, paint, corrosion                         |                 |
| 7.                                                                                 | Cable trays                         | S               | Damage, condition of preservations               |                 |
| 8.                                                                                 | Insulation sheets                   | S               | Damage                                           |                 |
| 9.                                                                                 | Insulation                          | C               | Damage, packing                                  |                 |
| 10.                                                                                | Hangers Rods                        | S               | Damage, paint, packing                           |                 |
| 11.                                                                                | Tubes                               | S               | Damage, paint , packing                          | Provide end cap |
| 12.                                                                                | Hume pipes                          | O               | Damage                                           |                 |
| 13.                                                                                | Castings                            | O               | Damage, paint, corrosion                         |                 |
| <b>Fabricated mechanical items (pressure vessels, tanks etc.)</b>                  |                                     |                 |                                                  |                 |
| 14.                                                                                | Pressure vessels (unlined)          | O               | Damage, paint, corrosion,                        | Covered nozzles |
| 15.                                                                                | Atmospheric storage tanks (unlined) | O               | Damage, paint, corrosion                         | Covered nozzles |

| Sl. No.                                                                         | Description of the equipment         | Type of Storage | Check for                               | Remarks         |
|---------------------------------------------------------------------------------|--------------------------------------|-----------------|-----------------------------------------|-----------------|
| 16.                                                                             | Pressure vessels (lined)             | S               | Damage, paint, corrosion, rubber lining |                 |
| 17.                                                                             | Atmospheric storage tanks(lined)     | S               | Damage, paint, corrosion, rubber lining |                 |
| 18.                                                                             | Support structures                   | O               | Damage , paint, corrosion               |                 |
| 19.                                                                             | Flanges                              | C               | Damage , paint, corrosion               |                 |
| 20.                                                                             | Fabricated pipes                     | S               | Damage , paint, corrosion               | Provide end cap |
| 21.                                                                             | Vessels internals                    | C               | Damage , paint, corrosion ,packing      |                 |
| 22.                                                                             | Grills                               | S               | Damage , paint, corrosion               |                 |
| 23.                                                                             | Angles                               | S               | Damage , paint, corrosion               |                 |
| 24.                                                                             | Bridge mechanism/clarifier mechanism | O               | Damage , paint, corrosion               |                 |
| 25.                                                                             | Cranes, rails                        | S               | Damage , paint, corrosion               |                 |
| 26.                                                                             | Stair cases                          | O               | Damage , paint, corrosion               |                 |
| 27.                                                                             | Ladders/handrails                    | O               | Damage , paint, corrosion               |                 |
| 28.                                                                             | Fabricated ducts                     | S               | Damage , paint, corrosion               |                 |
| 29.                                                                             | Isolation Gates                      | O               | Damage , paint, corrosion               |                 |
| 30.                                                                             | Fabricated boxes/panels              | S               | Damage , paint, corrosion               |                 |
| <b>Mechanical components like valves, fittings, cables glands, spares etc.)</b> |                                      |                 |                                         |                 |
| 31.                                                                             | Valves                               | S               | Damage , packing                        |                 |

| Sl. No.                                                                       | Description of the equipment         | Type of Storage | Check for                   | Remarks         |
|-------------------------------------------------------------------------------|--------------------------------------|-----------------|-----------------------------|-----------------|
| 32.                                                                           | Fittings                             | S               | Damage , packing            | Provide end cap |
| 33.                                                                           | Cable glands                         | C               | Damage , packing            |                 |
| 34.                                                                           | Tools & tackles                      | C               | Damage , packing            |                 |
| 35.                                                                           | Nut , bolts, washers,                | C               | Damage , packing            |                 |
| 36.                                                                           | Gasket & Packings                    | C               | Damage , packing            |                 |
| 37.                                                                           | Copper tubes                         | C               | Damage , packing, corrosion | Provide end cap |
| 38.                                                                           | SS tubing                            | C               | Damage , packing            | Provide end cap |
| <b>Rotating assemblies (pumps, blowers, stirrers, fans, compressors etc.)</b> |                                      |                 |                             |                 |
| 39.                                                                           | Pumps                                | S               | Damage , packing, corrosion | Shaft rotation  |
| 40.                                                                           | Blowers/Compressors                  | S               | Damage , packing, corrosion | Shaft rotation  |
| 41.                                                                           | Agitators/stirrers/radial launders   | C               | Damage , packing, corrosion | Shaft rotation  |
| 42.                                                                           | Rollers for chlorine tonner mounting | C               | Damage , packing, corrosion |                 |
| 43.                                                                           | Centrifuge                           | S               | Damage , packing,           |                 |
| 44.                                                                           | Gear box                             | C               | Damage , packing, corrosion |                 |
| 45.                                                                           | Bearings                             | C               | Damage , packing, corrosion |                 |
| 46.                                                                           | Fans                                 | S               | Damage , packing, corrosion |                 |
| 47.                                                                           | Dosing skids                         | S               | Damage , packing, corrosion |                 |
| 48.                                                                           | Pump assemblies                      | S               | Damage , packing, corrosion |                 |
| 49.                                                                           | Air washers( INTERNALS)              | S               | Damage , packing            |                 |
| 50.                                                                           | Air conditioners ( split)            | C               | Damage , packing            |                 |

| Sl. No.                                                                                        | Description of the equipment                     | Type of Storage                              | Check for                            | Remarks            |
|------------------------------------------------------------------------------------------------|--------------------------------------------------|----------------------------------------------|--------------------------------------|--------------------|
| 51.                                                                                            | Elevators( CONTAINERIZED)                        | O                                            | Damage , packing, corrosion          |                    |
| 52.                                                                                            | Chillers/VA machines                             | S                                            | Damage , packing                     |                    |
| 53.                                                                                            | Air handling Unit/Package unit                   | S                                            | Damage , packing                     |                    |
| 54.                                                                                            | Chlorinators & Evaporators                       | C                                            | Damage , packing                     |                    |
| 55.                                                                                            | Ejectors                                         | C                                            | Damage , packing                     |                    |
| 56.                                                                                            | Electrolyser                                     | C                                            | Damage , packing                     |                    |
| <b>Miscellaneous items like chain pulley blocks, hoists etc.</b>                               |                                                  |                                              |                                      |                    |
| 57.                                                                                            | Chain pulley blocks                              | S                                            | Damage, Packing                      |                    |
| 58.                                                                                            | Electric hoists                                  | S                                            | Damage, Packing                      |                    |
| 59.                                                                                            | Fire extinguishers                               | C                                            | Damage, expiry date                  |                    |
| 60.                                                                                            | Fork Lift Truck                                  | S                                            | Damage, Packing                      |                    |
| 61.                                                                                            | Hydraulic Mobile Crane                           | O                                            | Damage, Packing                      |                    |
| 62.                                                                                            | Mobile Pick Up & Carry Crane                     | O                                            | Damage, Packing                      |                    |
| 63.                                                                                            | Motor boats                                      | O                                            | Damage, Packing                      |                    |
| 64.                                                                                            | Safety showers                                   | S                                            | Damage, Packing                      |                    |
| 65.                                                                                            | Diffusers/dampers                                | S                                            | Damage, Packing                      |                    |
| <b>Chemicals and consumables ( acid, alkali, paints, oils, reagents and special chemicals)</b> |                                                  |                                              |                                      |                    |
| 66.                                                                                            | Hydro Chloric Acid (HCl)                         | Store in canes/<br>storage tank in dyke area | Date of production/<br>leakage/fumes | hazardous chemical |
| 67.                                                                                            | Sulphuric acid (H <sub>2</sub> SO <sub>4</sub> ) | Store in canes/<br>storage tank in dyke area | Date of production/<br>leakage/fumes | hazardous chemical |

| Sl. No. | Description of the equipment  | Type of Storage                           | Check for                                    | Remarks                                                                                   |
|---------|-------------------------------|-------------------------------------------|----------------------------------------------|-------------------------------------------------------------------------------------------|
| 68.     | Sodium hydroxide (NaOH)       | Store in canes/ storage tank in dyke area | Date of production/ leakage/ fumes/ breather | hazardous chemical ,breather to be checked for air ingress                                |
| 69.     | Sodium hypo chlorite          | To be stored under shed                   | Date of production/ leakage/ fumes           | hazardous chemical ,self-life normally 15-30 days after which strength of chemical decays |
| 70.     | Ammonia                       | S                                         | Date of production/ leakage/ fumes           | Store in closed storage tanks, hazardous chemical                                         |
| 71.     | CW treatment chemicals        | S                                         | Date of production , Self-life               | Store in closed canes                                                                     |
| 72.     | RO/UF cleaning chemicals      | S                                         | Date of production , Self-life               | Store in closed canes                                                                     |
| 73.     | Lime                          | C                                         | Damage to packing , seepage                  | Prevent moisture, rain                                                                    |
| 74.     | Alum bricks                   | C                                         | Damage to packing                            | Prevent moisture, rain                                                                    |
| 75.     | Poly electrolyte              | S                                         |                                              | Store in closed storage tanks                                                             |
| 76.     | Laboratory chemicals( powder) | C                                         | Damage, Packing self-life                    |                                                                                           |
| 77.     | Laboratory chemicals( liquid) | C                                         | Damage, Packing self-life                    |                                                                                           |
| 78.     | Lubrication oils              | C                                         | Leakage                                      |                                                                                           |
| 79.     | Paints                        | S                                         | Leakage ,air tightness                       |                                                                                           |
| 80.     | Sand                          | O                                         | Damage of packing                            | No hooks                                                                                  |
| 81.     | Salt (NaCl)                   | C                                         | Damage of packing, water ingress             | Prevent moisture, rain                                                                    |
| 82.     | Anthracite                    | S                                         | Damage of packing                            |                                                                                           |
| 83.     | Activated carbon              | S                                         | Damage of packing                            |                                                                                           |

| Sl. No.                                                     | Description of the equipment         | Type of Storage                                                                                           | Check for         | Remarks                       |
|-------------------------------------------------------------|--------------------------------------|-----------------------------------------------------------------------------------------------------------|-------------------|-------------------------------|
| 84.                                                         | Thermal insulation                   | S                                                                                                         | Damage of packing |                               |
| 85.                                                         | Cement                               | C                                                                                                         | Damage of packing | Prevent moisture, rain        |
| 86.                                                         | Gravels                              | O                                                                                                         | Damage of packing |                               |
| 87.                                                         | ION exchange resins                  | C                                                                                                         | Damage , packing  | Refer manufacturer guidelines |
| 88.                                                         | RO membranes                         | C                                                                                                         | Damage , packing  | Refer manufacturer guidelines |
| 89.                                                         | UF membranes                         | C                                                                                                         | Damage , packing  | Refer manufacturer guidelines |
| 90.                                                         | Cleaning chemicals                   | C                                                                                                         | Damage , packing  | Refer manufacturer guidelines |
| 91.                                                         | Chemicals for analysers/calibration  | C                                                                                                         | Damage , packing  | Refer manufacturer guidelines |
| <b>Electrical and C &amp; I items (motors, cables etc.)</b> |                                      |                                                                                                           |                   |                               |
| 92.                                                         | Motors                               | C                                                                                                         | Damage , packing  |                               |
| 93.                                                         | Cable drums                          | O                                                                                                         | Damage            |                               |
| 94.                                                         | Control Panel /control desk, UPS ,JB | S                                                                                                         | Damage, Packing   |                               |
| 95.                                                         | Instruments( gauges/analysers)       | C                                                                                                         | Damage            |                               |
| <b>Special items</b>                                        |                                      | As per Manufacturer's item, like Hydrogen cylinders, Ozonator, Analyser, Chlorine dioxide generators etc. |                   |                               |

## **5. CONCLUSION**

Concerned storage agency at site should make sure that loss in equipment performance and wear & tear are minimised through proper storage and preservation. The above are broad guidelines and cover major equipment / materials. However specific storage practices shall be followed as per manufacturer recommendation. All the necessary measures even in addition to the ones mentioned above, if found necessary, should be taken to achieve the objective.

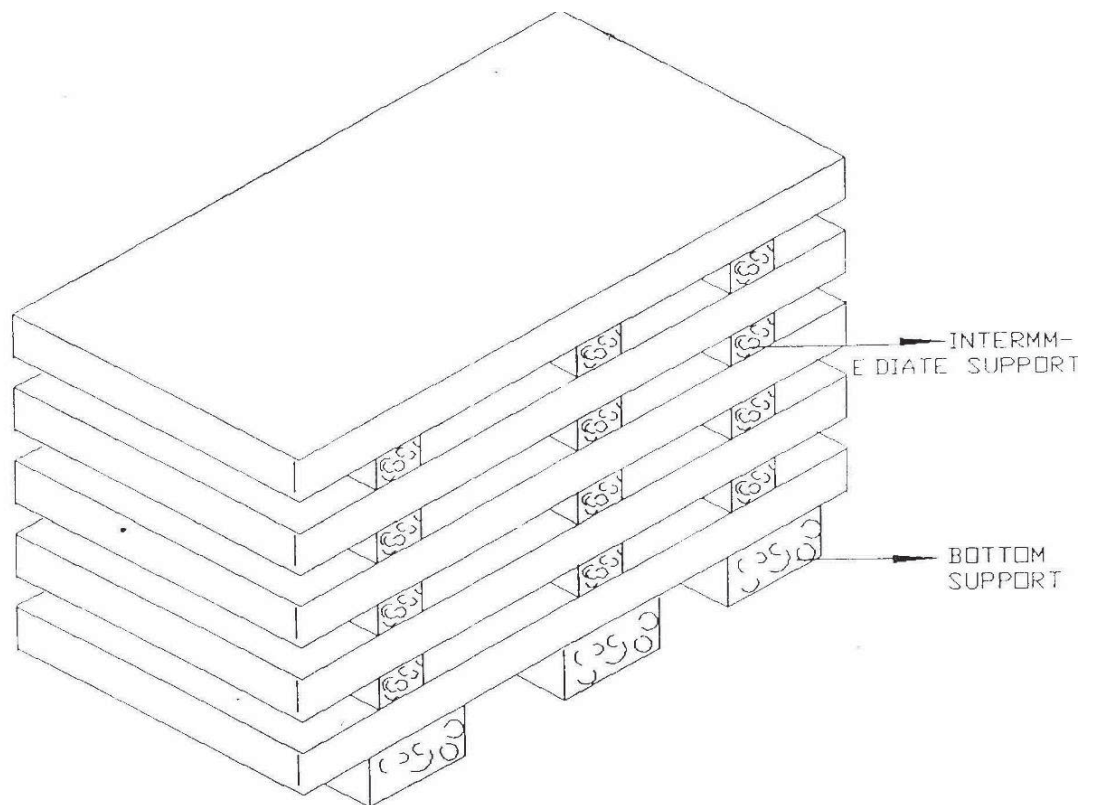


Figure – 1 – PLATE STACKING ARRANGEMENT

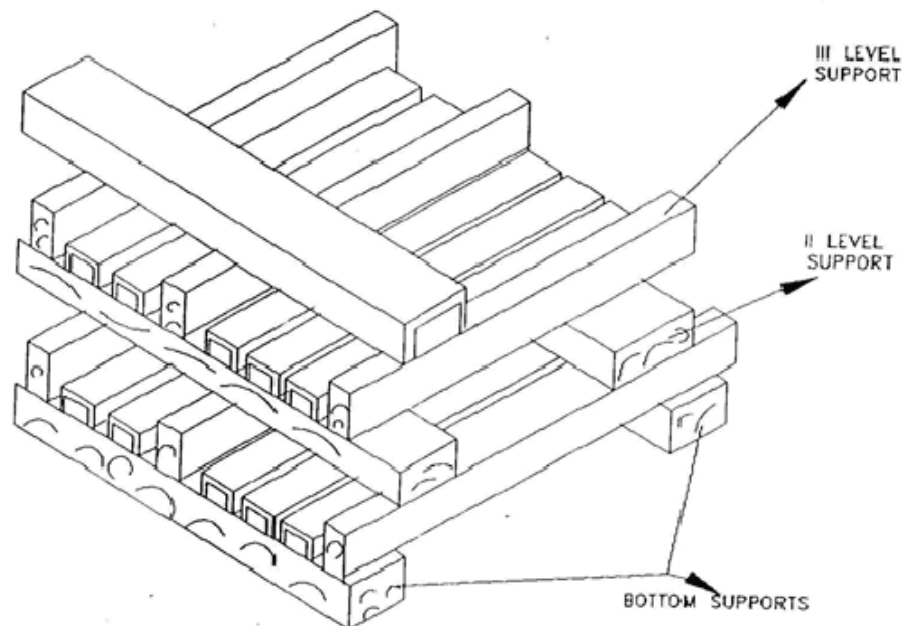


Figure – 2 – STRUCTURAL STEEL STACKING ARRANGEMENT



**1 X 660 MW SAGARDIGHI TPS UNIT NO. 5  
PHASE III  
VENTILATION SYSTEM  
PAINTING & COLOUR SCHEME**

**SPECIFICATION No: PE-TS-445-554-A001**

**SECTION : I**

**SUB-SECTION : E**

**REV 00**

**DATE: AUGUST 2021**

**SHEET 1 OF 1**

**SECTION-I  
SUB SECTION E  
ANNEXURE-VIII  
PAINTING & COLOUR SCHEME  
(AS PER SECTION C2-B)**



**1 X 660 MW SAGARDIGHI TPS UNIT  
NO. 5 PHASE III  
VENTILATION SYSTEM  
PACKING PROCEDURE**

**SPECIFICATION No: PE-TS-445-554-A001**

**SECTION : I**

**SUB-SECTION : E**

**REV 00**

**DATE: AUGUST 2021**

**SHEET 1 OF 1**

**SECTION-I**

**SUB SECTION E**

**ANNEXURE-IX**

**PACKING PROCEDURE  
(COVERED UNDER SECTION C2-B)**



**1 X 660 MW SAGARDIGHI TPS UNIT  
NO. 5 PHASE III  
VENTILATION SYSTEM**

**SPECIFICATION No: PE-TS-445-554-A001**

**SECTION: II**

**REV. 00**

**DATE: AUGUST 2021**

## **SECTION-II**



**1 X 660 MW SAGARDIGHI TPS UNIT  
NO. 5 PHASE III  
VENTILATION SYSTEM  
INSPECTION AND TESTING**

**SPECIFICATION No: PE-TS-445-554-A001**

**SECTION: II**

**SUB-SECTION: 1**

**REV 00**

**DATE: AUGUST 2021**

**SHEET 1 OF 4**

**SECTION-II  
SUB-SECTION-1  
INSPECTION AND TESTING**

|                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                             |                          |
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|  | <b>1 X 660 MW SAGARDIGHI TPS UNIT<br/>NO. 5 PHASE III<br/>VENTILATION SYSTEM<br/>INSPECTION AND TESTING</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <b>SPECIFICATION No: PE-TS-445-554-A001</b> |                          |
|                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>SECTION: II</b>                          |                          |
|                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>SUB-SECTION: 1</b>                       |                          |
|                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>REV 00</b>                               | <b>DATE: AUGUST 2021</b> |
|                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>SHEET 2 OF 4</b>                         |                          |
| 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                                                                           | <p>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.</p> <p>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.</p> <p>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.</p> <p>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.</p> |                                             |                          |
| 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                                                                           | <p>All the individual and assembled rotating parts shall be statically and dynamically balanced in the works.</p> <p>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.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                             |                          |
| 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                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                             |                          |

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|                              | <b>1 X 660 MW SAGARDIGHI TPS UNIT<br/>NO. 5 PHASE III<br/>VENTILATION SYSTEM<br/>INSPECTION AND TESTING</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <b>SPECIFICATION No: PE-TS-445-554-A001</b> |                          |
|                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>SECTION: II</b>                          |                          |
|                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>SUB-SECTION: 1</b>                       |                          |
|                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>REV 00</b>                               | <b>DATE: AUGUST 2021</b> |
|                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>SHEET 3 OF 4</b>                         |                          |
| <p>Regulations shall be certified by a Competent Authority under the regulations in the specified format.</p> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                             |                          |
| 1.01.08                                                                                                       | <p>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.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                             |                          |
| 1.01.09                                                                                                       | <p>All necessary non-destructive examinations shall be performed to meet the applicable code requirements.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                             |                          |
| 1.01.10                                                                                                       | <p>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.</p> <p>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.</p> |                                             |                          |
| 1.02.00                                                                                                       | <p>Performance Tests at Site</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                             |                          |
| 1.02.01                                                                                                       | <p>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.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                             |                          |
| 1.02.02                                                                                                       | <p>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.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                             |                          |
| 1.02.03                                                                                                       | <p>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.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                             |                          |
| 1.03.00                                                                                                       | <p>For details of specific tests required on individual equipment refer to respective section of this specification.</p> <p>All Statutory testing / clearance is in Bidder’s scope including payment of all fees, etc. as required</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                             |                          |



|                                                                                   |                                                                                                                                     |  |                                      |                   |
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|  | <b>1 X 660 MW SAGARDIGHI TPS UNIT<br/>NO. 5 PHASE III<br/>VENTILATION SYSTEM<br/>LIST OF DOCUMENTS TO BE SUBMITTED<br/>WITH BID</b> |  | SPECIFICATION No: PE-TS-445-554-A001 |                   |
|                                                                                   |                                                                                                                                     |  | SECTION : II                         |                   |
|                                                                                   |                                                                                                                                     |  | SUB-SECTION : 2                      |                   |
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## SECTION: II

### SUB SECTION: 2

#### LIST OF DOCUMENTS TO BE SUBMITTED WITH BID

|                                                                                   |                                                                                                                                     |  |                                      |                   |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|--|--------------------------------------|-------------------|
|  | <b>1 X 660 MW SAGARDIGHI TPS UNIT<br/>NO. 5 PHASE III<br/>VENTILATION SYSTEM<br/>LIST OF DOCUMENTS TO BE SUBMITTED<br/>WITH BID</b> |  | SPECIFICATION No: PE-TS-445-554-A001 |                   |
|                                                                                   |                                                                                                                                     |  | SECTION : II                         |                   |
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|                                                                                   |                                                                                                                                     |  | REV: 00                              | DATE: AUGUST 2021 |
|                                                                                   |                                                                                                                                     |  | SHEET 2 OF 2                         |                   |

**BIDDER SHOULD SUBMIT THE SIGNED AND STAMPED COPY OF THE FOLLOWING DOCUMENTS:**

1. Compliance cum confirmation certificate
2. Guaranteed power consumption
3. Un priced format for AC package
  - a. Unpriced format for Main package, mandatory spares, tools and tackles and commissioning spares on BHEL e-procurement portal.
4. Deviation schedule /No deviation certificate in attached format 'Deviation sheet (Cost of withdrawal)'.
5. Pre-bid clarification schedule and signed copy of technical corrigenda, if any.



**1 X 660 MW SAGARDIGHI TPS UNIT  
NO. 5 PHASE III  
VENTILATION SYSTEM  
COMPLIANCE CUM CONFIRMATION  
CERTIFICATE**

**SPECIFICATION No: PE-TS-445-554-A001**

**SECTION : II**

**SUB-SECTION : 3**

**REV. NO. 00**

**DATE: AUGUST 2021**

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**SECTION: II**

**SUB SECTION: 3**

**COMPLIANCE CUM CONFIRMATION CERTIFICATE**



**1 X 660 MW SAGARDIGHI TPS UNIT  
NO. 5 PHASE III  
VENTILATION SYSTEM  
COMPLIANCE CUM CONFIRMATION  
CERTIFICATE**

**SPECIFICATION No: PE-TS-445-554-A001**

**SECTION : II**

**SUB-SECTION : 3**

**REV. NO. 00**

**DATE: AUGUST 2021**

**SHEET: 2 OF 3**

**COMPLIANCE CUM CONFIRMATION CERTIFICATE**

The bidder shall confirm compliance with following by signing / stamping this compliance certificate (every sheet) and furnish same with the offer.

- a) The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusions, other than those mentioned under "exclusion and those resolved as per 'Schedule of Deviations', with regard to same.
- b) There are no other deviations w.r.t. specifications other than those furnished in the 'Schedule of Deviations'. Any other deviation, stated or implied, taken elsewhere in the offer stands withdrawn unless specifically brought out in the 'Schedule of Deviations'
- c) Bidder shall submit QP in the event of order based on the guidelines given in the specification & QP enclosed therein. QP will be subject to BHEL / CUSTOMER approval & customer hold points for inspection / testing shall be marked in the QP at the contract stage. Inspection / testing shall be witnessed as per same apart from review of various test certificates/ Inspection records etc. This is within the contracted price without any extra implications to BHEL after award of the contract.
- d) All drawings/ data-sheets / calculations etc. submitted along with the offer shall not be taken cognizance off.
- e) The offered materials shall be either equivalent or superior to those specified in the specification & shall meet the specified / intended duty requirements. In case the material specified in the specifications is not compatible for intended duty requirements then same shall be resolved by the bidder with BHEL during the pre-bid discussions, otherwise BHEL / Customer's decision shall be binding on the bidder whenever the deficiency is pointed out.

For components where materials are not specified, same shall be suitable for intended duty, all materials shall be subject to approval in the event of order.

- f) The commissioning spares shall be supplied on 'As Required Basis' & prices for same included in the base price itself.
- g) All sub vendors shall be subject to BHEL / CUSTOMER approval in the event of order.
- h) Guarantee for plant/equipment shall be as per relevant clause of GCC / SCC / Other Commercial Terms & Conditions
- i) In the event of order, all the material required for completing the job at site shall be supplied by the bidder within the ordered price even if the same are additional to approved billing break up, approved drawing or approved Bill of quantities within the scope of work as tender specification. This clause will apply in case during site

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                  |                                             |                          |
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| <p>commissioning, additional requirements emerges due to customer and / or consultant's comments. No extra claims shall be put on this account</p> <p>j) Schedule of drawings submissions, comment incorporations &amp; 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.</p> <p>k) As built drawings shall be submitted as and when required during the project execution.</p> <p>l) The bidder has not tempered with this compliance cum confirmation certificate and if at any stage any tempering in the signed copy of this document is noticed then same shall be treated as breach of contract and suitable actions shall be taken against the bidder.</p> <p>m) Successful bidder shall furnish detailed erection manual for each of the equipment supplied under this contract at least 3 months before the scheduled erection of the concerned equipment / component or along with supply of concerned equipment / component whichever is earlier.</p> <p>n) Document approval by customer under Approval category or information category shall not absolve the vendor of their contractual obligations of completing the work as per specification requirement. Any deviation from specified requirement shall be reported by the vendor in writing and require written approval. Unless any change in specified requirement has been brought out by the vendor during detail engineering in writing while submitting the document to customer for approval, approved document (with implicit deviation) will not be cited as a reason for not following the specification requirement.</p> <p>o) In case vendor submits revised drawing after approval of the corresponding drawing, any delay in approval of revised drawing shall be to vendor's account and shall not be used as a reason for extension in contract completion.</p> |                                                                                                                                  |                                             |                          |



**1 X 660 MW SAGARDIGHI TPS UNIT  
NO. 5 PHASE III  
VENTILATION SYSTEM  
PRE-BID CLARIFICATION SCHEDULE**

**SPECIFICATION No: PE-TS-445-554-A001**

**SECTION : II**

**SUB-SECTION : 4**

**REV. NO. 00**

**DATE: AUGUST 2021**

**SHEET: 1 OF 2**

**SECTION: II**

**SUB SECTION: 4**

**PRE-BID CLARIFICATION SCHEDULE**



**1 X 660 MW SAGARDIGHI TPS UNIT  
NO. 5 PHASE III  
VENTILATION SYSTEM  
PRE-BID CLARIFICATION SCHEDULE**

**SPECIFICATION No: PE-TS-445-554-A001**

**SECTION : II**

**SUB-SECTION : 4**

**REV. NO. 00**

**DATE: AUGUST 2021**

**SHEET: 2 OF 2**

**PRE-BID CLARIFICATION SCHEDULE**

| S. NO. | SECTION/CLAUSE/PAGE NO. | STATEMENT OF THE REFERRED CLAUSE | CLARIFICATION REQUIRED |
|--------|-------------------------|----------------------------------|------------------------|
|        |                         |                                  |                        |
|        |                         |                                  |                        |
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The bidder hereby clarifies that above mentioned are the only clarifications required on the technical specification for the subject package.

Signature: \_\_\_\_\_

Name: \_\_\_\_\_

Designation: \_\_\_\_\_

Company: \_\_\_\_\_

Date: \_\_\_\_\_

Company Seal

|                                                                                   |                                                                                                               |  |                                      |                   |
|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|--|--------------------------------------|-------------------|
|  | <b>1 X 660 MW SAGARDIGHI TPS UNIT<br/>NO. 5 PHASE III<br/>VENTILATION SYSTEM<br/>NO DEVIATION CERTIFICATE</b> |  | SPECIFICATION No: PE-TS-445-554-A001 |                   |
|                                                                                   |                                                                                                               |  | SECTION : II                         |                   |
|                                                                                   |                                                                                                               |  | SUB-SECTION : 5                      |                   |
|                                                                                   |                                                                                                               |  | REV: 00                              | DATE: AUGUST 2021 |
|                                                                                   |                                                                                                               |  | SHEET 1 OF 3                         |                   |

## SECTION: II

### SUB SECTION: 5

### NO DEVIATION CERTIFICATE (REFER ANNEXURE-II OF GCC REV 07)

|                                                                                                                                                                                                                                                                                                                                        |                   | <b>1 X 660 MW SAGARDIGHI TPS UNIT<br/>NO. 5 PHASE III<br/>VENTILATION SYSTEM<br/>NO DEVIATION CERTIFICATE</b> |             |                                              |                                    | SPECIFICATION No: PE-TS-445-554-A001 |                                                                                     |                                                                 |                                |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|---------------------------------------------------------------------------------------------------------------|-------------|----------------------------------------------|------------------------------------|--------------------------------------|-------------------------------------------------------------------------------------|-----------------------------------------------------------------|--------------------------------|
|                                                                                                                                                                                                                                                                                                                                                                                                                         |                   |                                                                                                               |             |                                              |                                    | SECTION : II                         |                                                                                     |                                                                 |                                |
|                                                                                                                                                                                                                                                                                                                                                                                                                         |                   |                                                                                                               |             |                                              |                                    | SUB-SECTION : 5                      |                                                                                     |                                                                 |                                |
|                                                                                                                                                                                                                                                                                                                                                                                                                         |                   |                                                                                                               |             |                                              |                                    | REV: 00                              |                                                                                     | DATE: AUGUST 2021                                               |                                |
|                                                                                                                                                                                                                                                                                                                                                                                                                         |                   |                                                                                                               |             |                                              |                                    | SHEET 2 OF 3                         |                                                                                     |                                                                 |                                |
| SL NO                                                                                                                                                                                                                                                                                                                                                                                                                   | VOUL ME/ SECTI ON | PAG E NO.                                                                                                     | CLAU SE NO. | TECHNIC AL SPECIFICA TION/ TENDER DOCUM E NT | COMPLETE DESCRIPTI ON OF DEVIATION | COST OF WITHDR AWAL OF DEVIATI ON    | REFERENCE OF PRICE SCHEDULE ON WHICH COST OF WITHDRAW AL OF DEVIATION IS APPLICABLE | NATURE OF COST OF WITHDRA WAL OF DEVIATION (POSITIVE/ NEGATIVE) | REASON FOR QUOTIN G DEVIATI ON |
| <b>TECHNICAL DEVIATIONS</b>                                                                                                                                                                                                                                                                                                                                                                                             |                   |                                                                                                               |             |                                              |                                    |                                      |                                                                                     |                                                                 |                                |
|                                                                                                                                                                                                                                                                                                                                                                                                                         |                   |                                                                                                               |             |                                              |                                    |                                      |                                                                                     |                                                                 |                                |
|                                                                                                                                                                                                                                                                                                                                                                                                                         |                   |                                                                                                               |             |                                              |                                    |                                      |                                                                                     |                                                                 |                                |
|                                                                                                                                                                                                                                                                                                                                                                                                                         |                   |                                                                                                               |             |                                              |                                    |                                      |                                                                                     |                                                                 |                                |
| <b>COMMERCIAL DEVIATIONS</b>                                                                                                                                                                                                                                                                                                                                                                                            |                   |                                                                                                               |             |                                              |                                    |                                      |                                                                                     |                                                                 |                                |
|                                                                                                                                                                                                                                                                                                                                                                                                                         |                   |                                                                                                               |             |                                              |                                    |                                      |                                                                                     |                                                                 |                                |
|                                                                                                                                                                                                                                                                                                                                                                                                                         |                   |                                                                                                               |             |                                              |                                    |                                      |                                                                                     |                                                                 |                                |
|                                                                                                                                                                                                                                                                                                                                                                                                                         |                   |                                                                                                               |             |                                              |                                    |                                      |                                                                                     |                                                                 |                                |
| <b>PARTICULARS OF BIDDERS/ AUTHORISED REPRESENTATIVE</b>                                                                                                                                                                                                                                                                                                                                                                |                   |                                                                                                               |             |                                              |                                    |                                      |                                                                                     |                                                                 |                                |
|                                                                                                                                                                                                                                                                                                                                                                                                                         |                   |                                                                                                               |             |                                              |                                    |                                      |                                                                                     |                                                                 |                                |
| <b>NAME</b>                                                                                                                                                                                                                                                                                                                                                                                                             |                   |                                                                                                               |             | <b>DESIGNATIONS</b>                          |                                    | <b>SIGN &amp; DATE</b>               |                                                                                     |                                                                 |                                |
| <b>NOTES:</b>                                                                                                                                                                                                                                                                                                                                                                                                           |                   |                                                                                                               |             |                                              |                                    |                                      |                                                                                     |                                                                 |                                |
| 1. Cost of withdrawal 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 & Commercial Deviations (if any) in detail in the above format.                                                                                                                                                                                                                                                                                              |                   |                                                                                                               |             |                                              |                                    |                                      |                                                                                     |                                                                 |                                |
| 3. Any deviation not mentioned above and shown separately or found hidden in offer, will not be taken cognizance of.                                                                                                                                                                                                                                                                                                    |                   |                                                                                                               |             |                                              |                                    |                                      |                                                                                     |                                                                 |                                |
| 4. Bidder shall submit duly filled unpriced copy of above format indicating "quoted" in "cost of withdrawal of deviation" column of the schedule above along with their Techno-commercial offer, wherever applicable. In absence of same, such deviation (s) shall not be considered and offer shall be considered in total compliance to NIT.                                                                          |                   |                                                                                                               |             |                                              |                                    |                                      |                                                                                     |                                                                 |                                |
| 5. Bidder shall furnish price copy of above format along with price bid.                                                                                                                                                                                                                                                                                                                                                |                   |                                                                                                               |             |                                              |                                    |                                      |                                                                                     |                                                                 |                                |
| 6. The final decision of acceptance/ rejection of the deviations quoted by the bidder shall be at discretion of the Purchaser.                                                                                                                                                                                                                                                                                          |                   |                                                                                                               |             |                                              |                                    |                                      |                                                                                     |                                                                 |                                |
| 7. Bidders to note that any deviation (technical / commercial) not listed in above and asked after Part I opening shall not be considered.                                                                                                                                                                                                                                                                              |                   |                                                                                                               |             |                                              |                                    |                                      |                                                                                     |                                                                 |                                |
| 8. For deviations w.r.t. Credit period, Liquidated damages, Firm prices if a bidder chooses not to give any cost of withdrawal of deviation loading as per Annexure-VII, will apply. For any other deviation mentioned in un-priced copy of this format submitted with Part-I bid but not mentioned in priced copy of this format submitted with Priced bid, the cost of withdrawal of deviation shall be taken as NIL. |                   |                                                                                                               |             |                                              |                                    |                                      |                                                                                     |                                                                 |                                |
| 9. Any deviation mentioned in priced copy of this format, but not mentioned in the un-priced copy, shall not                                                                                                                                                                                                                                                                                                            |                   |                                                                                                               |             |                                              |                                    |                                      |                                                                                     |                                                                 |                                |

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|                                                                                   |                                                                                                               | SECTION : II                         |                   |
|                                                                                   |                                                                                                               | SUB-SECTION : 5                      |                   |
|                                                                                   |                                                                                                               | REV: 00                              | DATE: AUGUST 2021 |
|                                                                                   |                                                                                                               | SHEET 3 OF 3                         |                   |

be considered.

10. All techno-commercial terms and conditions of NIT shall be deemed to have been accepted by the bidder, other than those listed in unpriced copy of this format.

11. Cost of withdrawal is to be given separately for each deviation. In no event bidder should club cost of withdrawal of more than one deviation else cost of withdrawal of such deviations which have been clubbed together shall be considered as NIL.

12. In case nature of cost of withdrawal (positive/negative) is not specified it shall be assumed as positive.

13. In case of discrepancy in the nature of impact (positive/ negative), positive will be considered for evaluation and negative for ordering.