6.12.1 Scope of Work

The scope of work covered by this specification shall include the following:

(a) The contractor shall have to submit detailed drawings showing fabrication details, hangers, location of dampers etc for approval of Owner before commencement of erection.

(b) Supply of materials at erection site

(c) Fabrication and sub assembly of ducting and other components.

(d) Transportation to erection site.

(e) Taking over the foundation, building and structure.

(f) Assembly, erection, alignment etc of ducting as detailed.

(g) Painting and any other associated work needed for completion of the job except grouting.

(h) Testing, commissioning and balancing.

(i) Supply and application of insulations and jacketing.

(j) The Contractor shall alter the openings in the wall, if required, with written permission from the Owner. The Contractor shall not be allowed to remove any material from the erection site without the consent of the Owner.

6.12.2 Supply & Erection

The supply and erection of plant for Air conditioning system covered under this specification includes the following items. (It shall be noted that the list is indicative and not exhaustive.)

6.12.3 Supply _

(a) Grilles, registers, dampers, canvas cloth expansion joints and fire

dampers as required.

(b) Insulating material for ducts as required.

(c) Supply of GI sheets and any other material required.

(d) Nuts, bolts, rivets, adhesives, anchor fasteners/clinch anchors etc required for ducting and duct supports.

(e) Supply of hangers/supports, duct flanges & bracings.

(f) Fan supporting structure.

(g) Any other material required for completion of work including commissioning thereof.

6.12.4 Erection

(a) All the items mentioned as above.

(b) Ducting along with hangers, supports as per ducting layout drawings.

(c) The insulation of duct as given elsewhere in the specification

6.12.5 Standards and Codes

The design, fabrication, inspection and testing, erection and commissioning of the material included in the specification shall comply with the latest editions of the standards unless otherwise stated.

6.12.6 Operating Condition

As given elsewhere in this specification.

6.12.7 Duct Work

The actual quantity of duct work shall be governed by construction drawings. All duct work shall be fabricated of Galvanized Steel Sheets

properly reinforced to prevent sagging, buckling or vibration. The interior of all ducts shall be smooth and free from obstruction.

All duct sections shall be cross-broken. The air velocity inside the duct shall be limited to 8 m/sec for AC system and that for return air duct shall not exceed 5 m/s.

6.12.8 Duct Thickness

The ducting system envisaged is a low-pressure system. The thickness of the G.I. sheets to be used for fabrication of ducts shall be as follows:

Sr. No.	Dimension of larger side (in mm)	Thickness of sheet (in mm)	Gauge Number	Galvanise Class as per IS: 277
(a)	Rectangular Low Pressure Duct:			
(i)	0-300	0.63	24 G	IV
(ii)	325-1350	0.80	22 G	IV
(iii)	1375-2100	1.00	20 G	IV
(iv)	Above 2100	1.25	18 G	IV
(b)	Circular Duct – Low Pressure			
(i)	150-500 dia	0.63	24 G	
(ii)	501-1000 dia	0.80	22 G	
(iii)	1001-1250 dia	1.00	20 G	
(iv)	Above 1250 dia	1.25	18 G	

All the G.I. Sheets procured shall be of lock forming quality.

6.12.9 Joints

All longitudinal joints shall be Pittsburgh lock seam. The other type of joints shall be accepted at the discretion of owner.

For rectangular ducts, all transverse joints shall be continuous. Around the four sides, corner closures are required. The type of transverse joints shall be as under:

Sr. No.	Large side (mm)		Type of Transverse Joint
(a)	Upto 300	:	25 mm wide pocket, drive or S-slip
(b)	301-750	:	25 mm wide, bar slip or pocket slip
(c)	751-1500	:	Bar slip or pocket slip reinforced with 35 mm x 35 mm x 5 mm galvanized angle.
(d)	1501-2250	:	40 mm x 40 mm x 6 mm galvanized angle connection.
(e)	Above 2250	:	50 mm x 50 mm x 6 mm galvanized angle connection

External edges and corners formed from cleaved joints shall be neatly dressed down and joints made airtight.

6.12.10 Bracing

Intermediate transverse bracing continuous around the duct sides shall be provided between the joints as follows :

Sr. No.	Dimensions of Larger Side		Bracing details
(a)	0-450 mm	:	None
(b)	451-1500 mm	:	35 x 35 x 5 mm angles, 1200 mm joints
(c)	1500 & above	:	35 x 35 x 5 mm angles, 600 mm joints

All flat surfaces between bracing or joints for duct of above 900 mm but below 1500 mm wide shall be reinforced by a longitudinal internal standing seam located in the centre of the duct width.

All flat surfaces over 1500 mm wide shall be reinforced by two longitudinal internal standing seams located approximately one third of duct width away from duct wall.

6.12.11 Riveting, Sealing & Brazing

All joints, slips and seams shall be made secure by riveting on centres not exceeding 150 mm. All transverse stiffeners and all reinforced bars slip joints shall be riveted on centres not exceeding 200 mm. All angle iron joints shall be riveted to duct on 75 mm centres and shall be bolted together on centres not exceeding 75 mm.

All construction joints and seams shall be machine formed. Hand made joints are not considered acceptable unless unavoidable. However, final decision shall be taken by Owner.

All exhaust ducts shall be made air tight by an approved Pittsburgh Lock Seam Joint and 3 m high velocity duty sealant.

An adhesive shall be applied on all the contacting surfaces before making up the joints.

6.12.12 Access Doors

All main duct work shall be accessible throughout using tight fitted hinged access doors. Access doors are generally to be provided where fittings like dampers, controls etc are located.

The actual locations for these doors shall be designed by the Contractor with due approval from the Owner. Doors shall have cemented on sponge rubber gaskets. Approved heavy duty latches shall be provided such that an air tight closure is ensured, despite frequent operation. The Contractor shall supply all necessary accessories i.e. latches, handles etc for this work.

6.12.13 Grilles and Registers

Grilles and registers shall be provided as per requirement.

G.I. sections/sheets shall be used for the manufacture of grilles and registers for AC areas.

All grilles and registers shall be true to shape and shall be checked with a level gauge before being secured in position. No distortion or wrapping is permitted.

All duct mounted registers shall be complete with rubber gaskets and flanged holding frames of suitable design for the intended installation. They shall be mounted on collar extending from the duct. No part of register shall project into the main duct.

(a) Type A Grilles

These are supplying Grilles (side throw type) having two sets of adjustable louvers and with opposed blade damper. The front of louvers shall be vertical to provide horizontal deflections and the rear back of horizontal louvers shall adjust vertical deflection. The damper shall have horizontal opposed blades regulated by an operating lever in the frame.

(b) Type B Grilles

These are exhaust transfer registers having single deflection louvers with opposed blade dampers.

(c) Type C Grilles

These are supply diffusers suitable for mounting on false ceiling. These grilles are fitted at the bottom portion of horizontal ducts, which are square or rectangular in shape.

(d) Type-D Grilles

These are exhaust diffusers suitable for mounting on false ceiling.

Ducting in horizontal position and are square/rectangular in shape respectively.

(e) Type-E Grilles

These are circular supply diffusers suitable for mounting on false ceiling.

(f) Type-F Grilles

These are circular exhaust diffusers suitable for mounting on false ceiling.

Type-C to F grilles shall be fitted with opposed blade dampers and built in vane and louver arrangement as per manufacturer's standard design subject to approval of the owner. The grilles shall have 1, 2, 3 or 4 way discharge patterns. 2-way discharge pattern means discharge of air from two opposite side of grille. Grille schedule shall give type of grille along with discharge pattern, e.g. C2 means C type grille with 2-way discharge pattern.

6.12.14 Hangers And Supports

All duct work shall be provided with adequate supporting arrangement to ensure rigid support and to prevent vibration. Hangers and supports types and locations have been decided by the Owner and shall be marked on the drawings to be released for construction. The type of support to be adopted for each location shall also be marked on the drawing. A total of four types of supports shall be used (Types A, B, C & D). Fabrication details of each support including size of members shall be decided by Contractor.

Support may be welded directly to the embedded/anchored plates in slabs /beam/floors, which have been provided for this purpose.

6.12.15 Dampers, Deflectors, Vanes

Dampers and deflectors shall be installed as per requirement.

Manually operated dampers in duct runs shall be provided with indicating

and locking devices consisting of a quadrant with large thumb screws and shall be installed with the quadrant parallel to the blade of the damper so that the position of the damper within the duct shall be clearly indicated from the outside of the duct.

Damper blades shall be made of 16 gauges Galvanized sheet with maximum width of 250 mm. The damper frame shall be fabricated from channel (Min. ISMC-75) and be finished with suitable rust proofing paints. Edges of the blades of the dampers shall be fitted with neoprene edging material for tight shut-off.

The deflectors and turning vanes shall have aerofoil construction which shall be provided in the duct to have streamlined flow. They shall be of heavy gauge construction galvanized and free from vibration.

Internal bend radius of the ducts shall be at least equal to the width of the duct. Where this is not practicable, square elbow with turning vanes shall be provided.

Take offs from the main ducts shall be provided of conical shape. Duct size right angle take off shall not be permitted.

Fire dampers as required shall be provided and installed. They shall be of fuse link type operated by thermal sensors.

6.12.16 Insulation

Duct shall be insulated wherever required.

Expanded Polystyrene Type SE slabs shall be used for insulation purpose.

Surface to be insulated shall be cleaned and dried thoroughly. A coat of Hot Bitumen, Grade 85/25 as per IS: 702 shall be applied at 15 kg/m^2 on the cleaned and dried surface and inside surfaces and edges of insulation slab.

Gaps between joints shall be filled with insulation granules mixed with hot bitumen.

A thick vapour seal of hot bitumen at 2.5 kg/m2 shall be applied uniformly

on the outer surface of the insulation and allowed to dry.

Insulation shall be reinforced by wire netting (12.5 mm x 0.71 mm hexagonal galvanized chicken wire netting), the ends of which shall be stitched with soft annealed 0.884 mm dia lacing wire passing through wire netting.

Insulation protection saddles made out of 0.8 mm thick GI sheets shall be provided at each duct support.

The insulation shall be wrapped with Aluminium sheet of 32 G thick.

Special care shall be taken to provide satisfactory insulation for damper, access door etc to facilitate maintenance and inspection.

6.12.17 Provision for Air Flow Rate Measurement

Air flow rates are to be measured in main and branch ducts during commissioning of the system. The Contractor shall arrange for all instruments required to establish the airflow rates. The Contractor shall also provide test holes at suitable locations for this purpose. The test hole shall preferably be provided on straight duct and as far as possible away from bends, dampers or other obstruction that could cause uneven or spiral flow. Location of test hole shall also be easily accessible for mounting measuring device such as pitot tube.

6.12.18 Flexible Connections in the Duct

Flexible connections shall be provided in the ducts at locations, where the duct is passing from one building to another. The flexible connections shall be of same size as that of duct and shall be made out of plastic impregnated canvas cloth with MS flanges. The flexible connection piece shall be designed to provide following relative displacement between two ends of the connection pieces in erected position, occurring simultaneously, without causing any wear and tear to the flexible connection as well as duct.

(a) 12 mm in longitudinal direction (compression or expansion)

(b) 12 mm in lateral direction.

Flexible connections shall be provided as per requirement.

6.12.19 Painting

All mild steel members shall be thoroughly wire-brushed, cleaned and given two coats of red oxide zinc phosphate primer coating. Adequate protective painting shall have to be provided by the Contractor where galvanized portion of the duct work is damaged.

Duct carrying exhaust from battery rooms shall be painted with epoxy paint externally as well as internally along with the supporting structure.

6.12.20 Inspection And Testing

All components and duct work supplied shall be subject to inspection and testing as per relevant codes and standards. G.I. sheet shall be suitable for lock forming quality.

All duct work shall be carefully examined to determine their conformance with the specification with respect to dimensions, materials, workmanship, marking, leakage and other requirements.

All manually operated dampers and deflectors shall be checked for ease of operation and tight shut-off.

Ducting system specified in this system is low-pressure system. Therefore no separate test for checking leakage is required apart from flow balancing of the system.

The contractor shall provide assistance for all site tests of the equipment according to prescribed procedure laid down by the Owner. All the test instruments and equipment likely to be needed for commissioning the system covered under this specification are to be provided by the contractor.

6.13 AIR OPERATED DAMPERS

This part of specification is intended to cover the design, manufacture, assembly, testing, painting, delivery at site properly packed for

transportation and protected from weather, erection and commissioning and guarantee of Air Operated Dampers to be used in Air Conditioning system.

The scope of supply shall include but not limited to the following:

(a) Dampers complete with accessories like bearing, spindle sleeves, linkages etc.

(b) The pneumatic type operator to operate the spindle of the damper.

(c) Two (2) Limit switches along with linkages mounted on actuator to indicate open and close position of damper.

(d) Control Panel complete with four-way solenoid valve, PRV etc, cables from control panel to limit switches.

(e) Nuts, Bolts, Gaskets etc.

(f) Cleaning, Protection, Painting as specified.

6.13.1 Fire Dampers

These Dampers shall be installed in supply/return duct of air conditioning system and are required to suit off within the duct to cut off the supply/ return air to/from the air conditioned space where fire took place.

The above dampers shall get actuated by smoke detectors to be provided in air conditioned space. There shall be provision for indication lamps to show open/close position of damper.

6.13.2 Performance Required

The fire dampers shall posses 1.5 hour standard fire protection rating in accordance with "Standard for Fire Damper UL – 555". The fire damper shall be smoke tight type.

All Dampers shall remain tightly closed upon the operation of sensing device.

6.13.3 General Design Requirement

The equipments to be supplied shall be suitably constructed for safe and proper operation under all conditions described or supplied in this specification without undue vibration, strain, corrosion or other difficulties. Contractor's scope of work with respect to design and procurement of control and procurement of control and instrumentation is specified elsewhere in this specification.

For each damper, following instrumentation shall be provided.

(a) Local control panel complete with solenoid valve, PRV (if needed), terminal blocks and any other instrument required. Minimum Ten (10) of spare terminals shall also be provided for Owner's future use.

Solenoid valve shall be wired to the terminal block. Solenoid valve shall get de-energised on receiving signal from smoke detector or any other control logic to close the damper.

(b) Limit switches mounted on damper actuator shall be suitably wired to the terminal block in the control panel.

(c) Copper tubes of suitable size shall be laid from solenoid valve, installed in control panel to the actuator.

All parts subject to substantial temperature changes shall be designed and supported so as to permit free expansion or contraction without resulting in leakage, distortion and excessive strains in the equipment. Parts subject to wear, corrosion or other deterioration or requiring adjustment, inspection or repairs shall be accessible and have reasonable convenience for removal, replacement and repair. All such parts shall be of suitable material or suitably lined for keeping maintenance to a minimum.

6.13.4 Operator

The Operator shall be piston and cylinder type, installed on the duct. The movement of the piston from one end to the other shall be used, through linkage, to open or close the damper blades. The operator shall be actuated by instrument air to be supplied at 7.0 kg/cm^2 (g), after using a suitable

PRV, lubricator, if needed. The energized condition of the solenoid valve shall open the dampers, which shall close on de-energised condition of the solenoids. The pneumatic tubing shall be of copper.

The dampers shall be provided with manual local operation.

6.13.5 Solenoid Valves

(a) The solenoid valve shall be 4-way type, the solenoid being operated by 48 V DC supply. The valve body shall be forged brass confirming to ASTM-B124 and the seat shall be of soft material like nylon or neoprene for tight shut-off. The end connections shall be threaded female NPT.

(b) The valve shall be suitable for a design pressure of 10.0 kg/cm^2 (g) and body hydrotest pressure of 15.0 kg/cm^2 (g). The solenoid valve shall be as per specification enclosed elsewhere.

6.13.6 Dampers

(a) All dampers shall be multi-blade type.

(b) Materials of construction for damper shall be suitable for 1.5 hr Standard fire protection.

(c) The frames shall be fabricated from channel (min ISMC-75) and shall be finished with rust proofing paints after application of primer.

(d) The blades shall be maximum 250 mm wide. The blades shall be stiffened by formed edge. The edges shall be fitted with neoprene edging material for tight shut-off. An indicating device shall be provided outside to denote open/close position of the damper. The dampers shall be suitable for mounting inside the ducts, complete with rubber gaskets and flanged holding frame.

6.14 PERFORMANCE GUARANTEE

The Contractor shall guarantee that upon completion of the satisfactory commissioning and acceptance of the equipment by Contractor, all the

portions thereof, shall be in accordance with requirement of the contract and shall be perfect as to design, materials, workmanship etc.

If stipulated requirements are not fulfilled, the contractor shall make good the deficiency in every case by altering and/or replacing the part of whole equipment free of charge to Owner immediately. All replaced parts/ equipments shall be removed from site at Contractor's expenses.

6.15 SPECIAL CLEANING, PROTECTION AND PAINTINGS

Internal surfaces of all parts shall be cleaned to remove loose scale and dirt. All sharp edges shall also be removed. Weld rod stubs and other foreign objects shall be removed prior to final assembly. All M.S parts shall be painted with two coats of red oxide/zinc chromate primer and one coat of aluminium paints before despatch of material. All parts provided with zinc spray shall be coated with aluminium paint.

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9.0 GUARANTEED PERFORMANCE TESTING

All equipment shall be guaranteed by the Bidder for workmanship, materials and satisfactory performance. The guarantee for performance shall cover individual items and systems including electrical for their ratings/outputs as well as for the integrated operation of the equipment and its auxiliaries as a whole.

9.1 On completion of satisfactory commissioning, the Bidder shall conduct performance/acceptance tests on the equipment and system as a whole for demonstrating the guaranteed performance parameters specified. All instruments, gauges installed for the normal operation of equipment shall

be made use of during the acceptance test as far as practicable. If additional instruments are required for the tests, these shall be brought by bidder free of cost and shall be taken back after performance test.

9.2 The guarantee tests shall cover but not be limited to the following rated parameters for smooth operation of air conditioning system.

9.2.1 Design dry bulb temperature and relative humidity of Air Conditioned area.

9.2.2 Consumption of refrigerant

9.2.3 Auxiliary power consumption

9.2.4 Vibration and noise level

10.0 SPECIAL CLEANING, PROTECTION AND PAINTING

10.1 Internal surfaces of all parts shall be cleaned to remove loose scale and dirt. The external surface of the motor and cover shall be sand blasted to remove all rust, scale etc. All sharp edges shall also be removed. Weld rod stubs and other foreign objects shall be removed prior to final assembly. Excess oil and grease shall be removed by wiping.

10.2 All parts shall be painted with two coats of red or zinc-chromate primer and one coat of aluminium paint before dispatch.

11.0 DRAWING, DATA AND INFORMATION REQUIRED

11.1 For Drawing, Data and Information required along with BID, please refer **Volume VIII**.

ANNEXURE - A

MINIMUM INSPECTION AND TESTING REQUIREMENTS

VOID

1.0 GENERAL REQUIREMENTS

1.1 SHOP TESTS

Shop tests shall include all tests to be carried out at Contractor's works, at works of his sub-contractor and at works where raw material supplied from manufacture of equipment is fabricated.

The testing and inspections listed herein are the minimum requirements as perceived by the Owner; the bidder shall consider this only as a general guidance and is not meant to be exhaustive. The bidder shall consider requisite testing and inspections across the equipments/systems forming the proposed power plant unit based on his own experience and in line with the current industry practices for identically rated power plant for the technology under consideration. The comprehensive list of tests considered for each of the equipment/ systems shall be furnished as part of the bid.

2.0 REFRIGERANT COMPRESSOR (RECIPROCATING/SCREW/ CENTRIFUGAL)

2.1 Hydraulic/Pneumatic test of castings for cylinder block/crank case/ casings etc. shall be carried out. No leakage shall be permitted.

2.2 DPT on connecting rod, piston, crankshaft, screw, Impeller with shaft, Vanes, crank case/cylinder/casing after machining shall be carried out.

2.3 All rotating parts of reciprocating,/screw and centrifugal compressor shall be statically and dynamically balanced to ISO 1940 Gr. 6.3.

2.4 Leak tightness & vacuum check for chilling units/compressors in assembled condition shall be carried out. No leakage shall be permitted.

2.5 Performance test of assembled compressor shall be done to check for following :

2.5.1 Capacity test for oil pump for reciprocating compressor.

2.5.2 No load air run (free run) test of all types of compressors / chilling units to check FAD (Free air delivery), Noise, Vibration & Temp. rise of bearing & body.

2.5.3 Pump up & leak back rate for reciprocating compressor.

2.5.4 Functional run test and Capacity control (for part load performance) check shall be carried out

3.0 CONDENSER & EVAPORATOR

3.1 DPT shall be carried out on finish welds.

3.2 10% RT of butt weld joints on shell shall be carried out.

3.3 Dimensional check including tube hole dia, ligament, pitch etc. shall be carried out.

3.4 Mock-up test for tube to tube sheet expansion shall be carried out. In case such a test is already conducted for similar tube/tube sheet thickness and materials, record for the same shall be furnished for review.

3.5 Hydraulic/Pneumatic test of Shell Side and Tube Side of condenser and evaporator as applicable shall be carried out. No leakage shall be permitted.

4.0 VAPOUR ABSORPTION MACHINE

4.1 All materials used for fabrication shall be of tested quality. Mill Test Certificates for Chemical & Mechanical properties shall be furnished by the manufacturer. In absence of correlated mill test certificates, check test shall be carried out.

4.2 Tubes for heat exchangers/vessels and interconnecting pipes shall be tested as per the requirement of relevant code/standard.

4.3 All welding shall be performed as per approved Welding Procedure Specification and IBR qualified procedure and welders.

4.4 Mock-up test for tube to tube sheet expansion shall be carried out. In case such a test is already conducted for similar tube/tube sheet thickness and materials, record for the same shall be furnished for Owner's review.

4.5 RT on butt weld joints of heat exchangers / vessels shall be carried out as per the requirement of design code/approved drawing.

4.6 D.P. test on Root run after back gouging and on finished welds shall be carried out.

4.7 Vessels/Heat exchangers like high temperature & low temperature generator/condenser/high temperature & low temperature heat exchanger /evaporator/absorber shall be subjected to hydraulic pressure test and leakage test under vacuum with nitrogen gas and helium gas, both tube side and shell side as applicable for individual component prior to assembly. Helium leak test shall also be conducted on complete assembly under suitable cover to detect any leakage into the system.

4.8 The complete assembled unit (VAM) shall be performance tested in shop for capacity (TR) and Steam consumption at the rated conditions and part load conditions. Manufacturer shall furnish a detailed procedure along with calculation for conducting such test for approval and in case of any limitation same shall be clearly brought out in the bids. All the controls shall be tested for proper functioning during the above test.

5.0 AIR HANDLING UNIT

5.1 20% DPT of welding on fan hub, blades, casing and impeller as applicable shall be carried out.

5.2 UT of fan shafts (diameter greater than or equal to 50 mm) shall be carried out.

5.3 DPT of fan shafts after machining shall be carried out.

5.4 DPT of welding on shaft (in case of fabricated shaft) shall be carried out.

5.5 Blower fan shall be statically and dynamically balanced to ISO 1940 Gr. 6.3.

5.6 One fan of each type and size shall be performance tested as per AMCA / IS for Air flow, Static Pressure, Speed, Efficiency, Power Consumption, Noise and Vibration.

5.7 One per type of assembled AHU (AHU casing & fan assembly) shall be subject to free run test. Noise, Vibration and Temperature Rise of bearing shall be measured during run test.

5.8 All cooling coil shall be pneumatically tested and no leakage shall be permitted.

6.0 CENTRIFUGAL PUMP

6.1 UT on pump shaft (diameter greater than or equal to 50 mm), MPI/DPT on pump shaft and impeller after machining shall be carried out.

6.2 All rotating components of the pumps shall be statically and dynamically balanced to ISO-1940 Gr. 6.

6.3 A standard hydrostatic test shall be conducted on the pump casing with water at 1.5 times the shut off pressure or twice the rated pressure whichever is higher, for a minimum duration of 30 minutes.

6.4 STANDARD RUNNING TEST

6.4.1 All pumps shall be tested in the manufacturer's works preferably with contract motor for capacity, efficiency, head and brake horsepower. Pump shall be given running test over the entire operating range covering from the shut-off head to the maximum flow. The duration of test shall be minimum one (1) hr. A minimum of five readings approximately equidistant shall be taken for plotting the curves with one point at design flow. Testing of pumps shall be in accordance with stipulations of Hydraulic Institute Standard (HIS) and/or as per applicable Indian Standard or equivalent. Acceptance shall be as per approved datasheet & HIS standard only.

6.4.2 Noise and vibration shall be measured at shop for reference purpose only.

6.4.3 Pumps shall be subjected to strip down examination visually to check for mechanical damages after testing at shop in case abnormal noise level and/or excessive vibration are observed during the shop test.

6.4.4 NPSH test shall be conducted with water as the medium, if required as per approved data sheets.

7.0 COOLING TOWER

7.1 UT of fan shaft and drive shaft (diameter greater than or equal to 50 mm) shall be carried out.

7.2 DPT of fan hub and shafts shall be carried out after machining.

7.3 Colors of fills shall be as per approved data sheet.

7.4 Fan assembly shall be statically balanced.

7.5 Cooling Towers being supplied to site in assembled condition shall be subjected to run test at shop to measure FAD, Noise & Vibration. Cooling Towers being supplied in knocked-down condition, these tests shall be done at site.

8.0 FANS

8.1 20% DPT of welding on fan hub, blades, casing and impeller as applicable shall be carried out.

8.2 DPT of fan shafts shall be carried out after machining.

8.3 UT of fan shafts (diameter greater than or equal to 50 mm) shall be carried out.

8.4 Rotating components of all fans shall be statically and dynamically balanced to ISO-1940 Gr. 6.3.

8.5 All Centrifugal Fans shall be subjected to run test for 4 hrs. or till temperature stabilization is reached. Vibration, Noise level, Temp. rise and current drawn shall be measured during the run test.

8.6 One fan of each type and size will be performance tested as per corresponding IS code for Airflow, Static Pressure, Total Pressure, Speed, Efficiency, Power Consumption, Noise, Vibration and Temp. Rise.

9.0 LOW PRESSURE AIR DISTRIBUTION SYSTEM

9.1 Functional test for fire damper along with solenoid shall be done.

9.2 Prototype tests for fire resistance rating as per UL-555 of each type and size of damper shall be carried out. In case prototype tests have already been done, the bidder shall submit the test report for verification and approval.

9.3 SITE TEST:-After completion, all ducting system shall be checked/tested for air leakages/tightness (smoke test) at site.

10.0 INSULATION

10.1 Insulation material shall be tested for all mandatory tests only as per relevant code/standard.

10.2 Thermal conductivity tests (for thermal insulation only) shall be done once in six months for insulation material manufactured during six months period for the same density, outer diameter and thickness of material as applicable as per IS:3346 or equivalent standard.

11.0 AIR FILTERS

11.1 Pre/Fine filters shall be tested for initial and final pressure drop Vs flow and average synthetic dust weight arrestance as per the requirement of BS 6540/ASHARE-52-76/EN779.

12.0 PIPES & FITTINGS

12.1 Dye penetration test of welds of pipes/fittings (including welds of rolled and welded pipes, if any) shall be carried out.

12.2 All pipes and fittings shall be tested as per applicable codes/standards at manufacturer's works. Piping shall be tested at site hydraulically/ pneumatically as per application requirement.

13.0 VALVES & SPECIALTIES

13.1 Visual and dimensional check of valves as per relevant code/approved drawing.

13.2 All the water line valves shall be hydraulically tested for body, seat and back seat (wherever provided) as per the relevant standard to which these valves are supplied irrespective of the working pressure for which these valves are selected. Check valves shall also be tested for leak tightness test at 25% of the specified seat test pressure.

13.3 Refrigerant line valves shall be pneumatically tested for body and seat leakage test.

13.4 All valves shall be offered for hydro test and pneumatic test in unpainted condition.

13.5 Functional check of the valves for smooth opening and closing shall be done.

13.6 Performance test to check pressure drop Vs flow shall be carried out for one valve of each type, size and rating for 'Balancing Valve'/Globe Valves with orifice.

13.7 One valve of each type, size and rating for 3-way mixing valve shall be subjected to cycle test for 500 cycles.

14.0 PACKAGED/SPLIT/WINDOW AIR CONDITIONERS: PAC

14.1 Compressor of Packaged Air Conditioner shall be tested as per relevant code/standard

14.2 PAC shall be subjected to production routine test in accordance with IS: 8148 for the following.

14.2.1 General Running Test.

14.2.2 Pressure/Leakage Test of refrigerant.

14.2.3 Insulation resistance test.

14.2.4 High Voltage Test.

14.2.5 Performance test on one PAC of each type/size at ambient condition to check for following.

(a) DBT & WBT of supply and return air.

(b) Air flow

(c) Current, voltage measurement & power consumption

(d) Noise and Vibration measurement

14.3 Split & Window Air conditioners:-Manufacturer's standard Test certificate/ Guarantee certificate to be submitted.

SECTION: I

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CUSTOMER SPECIFICATIONS
PROJECT SPECIFIC GENERAL REQUIREMENTS

VOLUME II

SECTION – 4

GENERAL TECHNICAL REQUIREMENTS

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ANNEXURE–D	SPECIFIC LAYOUT CONSIDERATIONS

1.0 CODES AND STANDARDS

1.1 Except where otherwise specified, the Plant shall comply with the appropriate Indian Standard or an agreed internationally accepted Standard Specification as listed in the Annexure to this Section and mentioned in detailed Specifications, each incorporating the latest revisions at the time of tendering. Where no internationally accepted standard is applicable, the Bidder shall give all particulars and details as necessary; to enable the Owner to identify all of the Plant in the same detail as would be possible, had there been a Standard Specification.

1.2 Where the Bidder proposes alternative codes or standards, he shall include in his tender one copy (in English) of each Standard Specification to which materials offered shall comply. In such case, the adopted alternative standard shall be equivalent or superior to the standards mentioned in the specification.

1.3 Wherever specified or required, the Plant shall conform to various statutory regulations such as Indian Boiler Regulations, Indian Electricity Rules, Indian Explosives Act, Factories Act etc. Wherever required, approval for the plant supplied under the specification from statutory authorities shall be the responsibility of the Bidder.

1.4 In the event of any conflict between the codes and standards referred above and the requirements of this specification, the requirements, which are more stringent, shall govern.

1.5 In case of any change of code, standards and regulations between the date of purchase order and the date the Contractor proceeds with manufacturing, the Owner shall have the option to incorporate the changed requirements. It shall be the responsibility of the Contractor to advise Owner of the resulting effect.

1.6 Successful Bidder shall furnish two (2) sets of latest of national/international codes and standards to owner.

2.0 RESPONSIBILITY FOR DESIGN

2.1 The Bidder shall assume full responsibility for the design of the whole and every part of the Plant, whether or not the design work was undertaken specifically in relation to the Contract and whether or not the Contractor was directly involved in the design work.

2.2 Notwithstanding the Owner's wish to receive the benefits of new, advanced and improved technologies, a prime requirement is that all the systems and components proposed shall have been already adequately developed and shall have demonstrated good reliability under similar or more arduous conditions elsewhere, at least for continuous two (2) years in two different power stations.

2.3 The successful bidder shall have to carry out surge analysis and other transient condition studies as may be necessary and as required by the Owner as per proven engineering practice.

2.4 The Bid shall include a detailed discussion on the development status of and the reasons for any changes made in proposed systems or components for the Plant, as compared with similar items previously supplied in other installations cited by the bidder as reference plants.

2.5 The Bidder may also make alternate offers, provided such offers are superior in his opinion in which case adequate technical information, operating feed back etc are to be enclosed with the offer, to enable the Owner to assess the superiority and reliability of the alternatives offered. In case of each alternative offer, its implications on the performance, guaranteed efficiency, auxiliary power consumptions etc shall be clearly brought out to the Owner to make an overall assessment. In any case, the base offer shall necessarily be in line with the specifications i.e. Base offer shall be as per the technical specifications and the same will be considered for techno-commercial evaluation.

3.0 NAME PLATES (RATING PLATES)

3.1 Instruction plates, nameplates or labels shall be permanently attached to each main and auxiliary item of Plant in a conspicuous position. These plates shall

be engraved with the identifying name, type and manufacturers serial number, together with the loading conditions under which the item of Plant has been designed to operate.

3.2 Items such as valves etc which are subject to hand operation, shall be provided with nameplates so constructed as to remain clearly legible throughout the life of the plant giving due consideration to the difficult climatic conditions to be encountered. Nameplates shall be securely mounted where they will not be obscured in service by insulation, cladding, actuators or other equipment. Direction of flow is also to be engraved.

3.3 All trade nameplates and labels shall be in English language. All measurements shall be in M.K.S. Units.

3.4 The size and location of nameplates shall be subject to Approval of the Engineer.

4.0 SAFETY AND SECURITY

4.1 The design shall incorporate every reasonable precaution and provision for the safety of all personnel and for the safety and security of all persons and property. The design shall comply with all appropriate statutory regulations relating to safety. All structures and equipment shall be designed and constructed to withstand every foreseeable static and dynamic loading condition, including loading under earthquake conditions, with an adequate margin of safety.

4.2 Ready and safe access with clear head room shall be provided to all parts of the plant for operation, inspection, cleaning and maintenance.

4.3 Escape routes and clear ways shall be provided to allow speedy evacuation of the plant in the event of fire or explosion and the plant layout shall allow for ease of access to all parts of the Works by rescue and fire fighting teams. The plant layout shall be designed to localize and minimise the effects of any fire or explosion. The recommendations of NFPA, OSHA and TAC etc as necessary shall be followed in all respects.

4.4 The use of corrosive, explosive, toxic or otherwise hazardous materials shall be kept to a minimum during construction and the design of the plant shall

minimise the requirement for such materials during operation and maintenance. Where such materials must be used, all necessary precautions shall be taken in the design, manufacture and layout of equipment to minimise the resulting hazard and all equipment necessary for the protection and first-aid treatment of personnel in the event of accidents shall be provided. Particular attention is drawn to avoid the use of materials containing asbestos in any form.

5.0 GUARDS

5.1 Effective guards and fences must be provided to prevent injury to operators through accident or malpractice.

5.2 Mesh guards which allow visual inspection of equipment with the guard in place are generally preferable. The guards shall be constructed of mesh attached to a rigid framework of mild steel rod, tube, or angle and the whole galvanised to prevent loss of strength by rusting or corrosion. The guards shall be designed to facilitate removal and replacement during maintenance.

5.3 All drive belts, couplings, gears, sharp metallic edges and chains must be safely guarded. Any lubricating nipple requiring attention during normal running must be positioned where they can be reached without moving the guards.

5.4 Guards for couplings and rotating shafts shall be in accordance with BS 5304-1975 or similar approved standard. All rotating shafts and parts of shafts must be covered.

5.5 Suitable fencing shall be provided to enclose all openings or doorways used for the hoisting and lowering of machinery etc. This fencing must be securely fixed but quickly detachable when required. A secure hand hold must be provided on each side of the opening or doorway.

6.0 LOCATION AND LAYOUT REQUIREMENTS

The majority of plant and equipment shall all be of indoor installation. Layout should facilitate access for operation-maintenance and inspection of any one or more equipment / components at a time without disturbing the operation or installation of rest of the plant. Further, Bidder should comply with the criteria

given under the various equipment and system specifications as well as those stipulated in Annexure-B attached to this section.

Enclosed General Layout and other tender layout drawings show the location of major installations and auxiliary buildings. The Bidder shall try to retain these locations as far as practicable. The layout of equipment within the powerhouse as shown in the tender drawings is indicative. The Bidder may, subject to Owner's approval alter the same to suit the space requirement of the equipment offered.

Bidder may give as an alternative his own preferred layout clearly indicating the advantages and other implications, if any. Such alternative will not be considered for evaluating the bid, but may be considered with the successful Bidder if Owner / Engineer find the proposal more attractive in terms of techno-economic consideration.

6.1 While developing the layout of buildings the following criteria shall be given effect:

6.1.1 The minimum width of clear access corridors around equipment shall be one (1) meter.

6.1.2 Each building shall have an identified vacant space for equipment unloading and maintenance and preferably a separate bay altogether in buildings housing heavy equipment. Provision for handling equipment by monorail hoist and/or overhead crane shall be made as specified.

6.1.3 The plinth level with respect to the existing grade level shall be as indicated elsewhere in this specification. Finished Grade Level (FGL) above Mean Sea Level (MSL) for the plant area, CHP area and for PWS area inside plant to be developed. Mean sea level for the plant is 210 m.

6.1.4 The minimum clear height available between two consecutive floor slabs shall not be less than five (5) meters. A clear head room of two (2) meters shall be maintained between the floor and any overhead piping/cables or other obstruction. Adequate provision for natural ventilation and illumination shall be made as per good engineering practices.

6.1.5 There shall be at least two (2) main access doors, one on either side of each building, of which one shall be minimum three (3) meters wide with rolling shutters for equipment entry. For multistoried buildings, at least two (2) regular staircases diagonally opposite to each other shall be provided connecting all the floors and roof. These minimum requirements shall be augmented as required depending on the floor area, statutory requirements and TAC recommendations.

6.1.6 All buildings shall have provision for toilet and associated effluent discharge system together with facility for drinking water. The criteria for ventilation, fire protection and illumination of building spaces specified elsewhere in this specification shall be complied with.

6.1.7 All rail/road crossings for pipe/cable racks shall be done with minimum Seven (7) meters headroom from top of rail/road to bottom of rack. Similarly, top cover over underground pipes/cables shall be minimum one (1) meter.

6.1.8 Cubicle for operating personnel shall be located at safe place near the equipment.

6.1.9 Cable racks / pipe racks shall have hand railings in walkways on both sides at appropriate heights.

6.1.10 Concept of various mechanical and electrical equipment location and building dimensions (including column-row spacing) as shown in Plot Plan/Floor Plan drawing are to be adhered as far as possible. Any departure from this suggestive layout is primarily not recommended.

6.2 The following requirements for equipment layout shall be complied with:

6.2.1 The regular basement floor is not acceptable in Boiler & Mill Bunker bay building. Further, local pits/trenches shall be avoided as far as possible.

6.2.2 Mills shall be located by the side of Boiler. The width of Mill/Bunker building shall be 12.5 M and the length of the same shall be 10.5 M per Mill. A clear walkway of 1200 mm (min) shall be ensured between the mills/ its foundation/ mill reject vessel edge and inner face of mill bay column. Raw coal bunker shall be circular in shape unless otherwise approved.