

## **7.4 ENVIRONMENT CONTROL**

### **7.4.1 GENERAL**

Air conditioning and / or other environmental control systems shall be provided for the Valve Hall to ensure satisfactory operation of the HVDC system under the range of climatic conditions to which the station may be subjected. These systems shall be provided for equipment operational reliability.

The systems shall consist of all necessary component parts including, but not limited to:

- Ventilation equipment including instrumentation, centrifugal fans, axial flow fans, filters, exhaust fans, dampers, etc.
- Air conditioning units.
- Ductwork including dampers, louvers, diffusers, grilles, filters, insulation and all required accessories, etc.

### **7.4.2 DESIGN CONDITIONS**

All air conditioned Spaces shall be designed

- To achieve Ventilation rate for a/c areas shall be minimum 1.5 air changes per hour or 15 CFM per person; whichever is higher.

Ventilated systems shall be designed for the following:

Valve Hall: As per 7.4.3.1.1

### **7.4.3 DESCRIPTION OF THE SYSTEMS**

#### **7.4.3.1 VENTILATION SYSTEM**

##### **7.4.3.1.1 Ventilation system for valve hall**

Each valve hall shall have an independent ventilation system. Each ventilation system shall consist of two 100% capacity systems, one operating and one stand-by.

The total air volume in the valve hall shall be re-circulated through the main filters at least once every four hours.

The ventilation system shall be a closed cycle with fresh air intake limited to a maximum of 20% of the total air requirement. Once through ventilation system will not be acceptable. Exhaust Dampers in the valve hall shall be normally closed and will be opened under high pressure/emergency conditions only.

To ensure that the air being supplied to the valve hall is free from dust particles, a minimum three stage dust filtration process shall be supplied. This shall consist of at least the following:

1. Pre Filters: To remove dust particles down to 10 micron in size with at least 95% efficiency.
2. Fine Filters: To remove dust particles down to 5 microns in size with at least 99% efficiency.
3. Absolute Filters: To remove dust particles down to 0.3 microns in size with at least 99.5% efficiency.

All the filters shall be panel type. Easy access should be available to the filters for replacement/cleaning.

The ventilation of the valve hall shall be of a positive pressure type. Fresh outdoor air shall be filtered and dehydrated before being blown into the valve hall by the air fans to avoid dust accumulation and condensation on components present in the valve hall. Suitable measures shall be taken to minimise stagnant air. Each valve hall shall be provided with remotely operated motorized exhaust dampers.

It shall be possible to maintain specified conditions continuously inside the valve hall, both automatically and manually controllable from the station service panel (located in the control room) as well as from the local control panel.

In addition to the alarms for particular parameters like pressure, temperature & relative humidity etc. indicating instruments shall be provided for each valve hall. These parameters shall be integrated with station HVDC SCADA system also.

The valve hall shall be kept at a pressure above the atmospheric pressure under all conditions. The test shall be conducted at site to measure the pressure inside the valve hall for 48 hours.

The pressure inside valve hall shall be at least 3 mm of water Column over the pressure outside the valve hall for total duration of test.

#### 7.4.3.1.2 Not used

#### 7.4.3.2 AIR CONDITIONING SYSTEM

Air Each Valve hall will have an independent Air Conditioning System, shall consist of two (2), each 100% capacity, chilled water type or Direct Expansion type air conditioning units; one

operating and one stand-by.

The temperature inside valve hall shall not exceed the design values as per the bidder supplied valve hall equipments. Air Cooled water Chilling units or DX Chiller units, with unit mounted starter should be able to start / switch-on during the operation of converter hall at a maximum return / ambient air temperatures as required. Each system, i.e. working and standby machine shall have 100% independent piping and control system.

Following are conditions to be mentioned inside the converter hall.

- No Condensation shall be allowed inside the Converter Hall
- During maintenance, equipment / heat load will not be available. The allowed
- minimum temperature limit is 10°C & RH ≤ 60%.
- During operation inside Valve hall no access is allowed.
- HVA/C system provided in the converter hall shall be such that which can be manually operated during shut down for maintenance activities in valve hall.

HVAC system is expected to perform the following tasks-

- Removal of waste heat of the converter / valve hall equipment.
- Maintaining the defined hall conditions.
- Removal of building heat (solar, radiation).
- Maintaining the defined humidity conditions.
- Maintaining a positive indoor pressure to prevent outdoor air infiltration

Both units shall be interconnected so that, in the event of breakdown of one unit, the stand-by unit can be placed into service. Stand-by and operating units shall be alternated monthly during regular operation. The operation of the units shall be automatically controlled including sequential start and stop with single command. This should include necessary instrumentation and control like motorized valve etc. for its implementation.

Each A/C unit shall be complete with all the relevant appurtenances including compressor, air handling unit, heater, humidifier, condenser, fans, casing, filters, piping, valve, controls, instruments MCC control panel, chilled water pumps, ducting, diffuser, grills, insulation and other required accessories to complete the system.

The Air-Cooled Chillers with chilled water pumps or Direct expansion type Chillers shall be placed adjacent to the service building at suitable location. The Air-Handling units (2 x 100% basis) shall be installed at the roof of the valve hall building specifically earmarked for the purpose. The system shall also consist of two (1W+1S) each 100% capacity.

#### 7.4.3.3 AIR CONDITIONING UNIT DETAILS

##### .1 Compressors

The compressor shall be hermetic or semi-hermetic reciprocating/scroll type complete with drive package, oil heater, safety controls, shut off valves, purge valve, by-pass safety valve etc. It shall be complete with oil level port; oil drain plug with magnet and adequately sized inspection covers and oil level sight glass. The lubrication system shall be Forced Feed complete with reversible gear oil pump adequately sized oil filters, oil coolers etc. as required. Electrically operated crank case oil heater suitable for specified power supply shall be provided. Heater shall be automatically actuated when the compressor is stopped, either by a relay or by means of auxiliary contacts on the compressor motor starter. The compressor shall be equipped with automatic unloading device, to ensure for partial load starting of the compressor as well as multi-step capacity control.

Compressor shall be complete with required accessories, such as shut off valves, pipe flanges, suction strainer, pressure gauge and following controls:-

- Anti- Freeze Thermostat
- Solid state operating Thermostat
- Liquid Line strainer
- Water flow switches at the outlet of cooler
- H.P., L.P. Oil pressure cut outs and pressure gauges.
- TX-valve or valves as required.
- Refrigerant solenoid valve or valves as required.
- Fan control Thermostat
- Inherent motor protectors.

The condenser Casing shall be heavy gauge, Zinc coated steel, backed on enamel weatherised for outdoor installation; Panel shall be easily removable for complete accessibility. Condenser Coils shall be seamless copper tubes in staggered formation and shall be expanded into aluminium fins. A Sub-cooling coil circuit shall be integral part of condenser. The fans shall be propeller type direct drive by independent motors and shall be positioned for vertical air discharge. The blades shall be dynamically and statically balanced and provided with heavy gauge anodised guards. Fan motors shall be permanent -split

capacitor induction type and provided with permanently lubricated drive. The motors shall be isolated from the unit by resilient rubber mounts.

The Chiller shall be shell and tube, multi-pass, direct expansion type. The shell shall be of welded construction fitted with steel sheets on either side. The tubes shall be supported in the shell by adequate stiff supports to eliminate vibration and noise. The tube ends shall be properly expanded in the tube sheet to prevent leakage of refrigerant.

The refrigerant heads shall be made of cast iron and the faces ground to close tolerances to prevent leakage of refrigerant between passes and between the circuits in case of a multi-circuit cooler. The cooler shall be factory insulated to avoid condensation on coil. The cooler shall be complete in all respect and shall include:-

- Filter drier
- Relief valve, charging connection with valve and drain valve, sight glass, moisture liquid indicator.
- Water inlet and outlet connections with stem type thermometer and dial type pressure gauges.
- Supports for mounting.
- Steel sockets between each baffle complete with removable plug to drain entrapped water from chiller shell.

The refrigerant piping between Compressors, Chiller and Condenser shall be of heavy gauge copper with brazed joints. The circuit shall include sight glass, moisture indicator, solenoid valves, thermostatic expansion valves, filter dryers and necessary shut off valves with charging connections.

## .2 Air Handling Unit

The air handling units shall be Double skin, draw through/ blow through type, modular construction and shall include filter section, fan section, coil section and mixing box (wherever required). The AHU shall be made of Double skin design with main structure made of 16G GI powder coated/ extruded Aluminium frame work. The panels shall be double skin sandwich type with minimum 24G GI powder coated external sheet and 24G GI powder coated internal sheet with 25mm thick rockwool/glass wool insulation material in between. All sections shall be bolted to each other with neoprene rubber gasket.

The fan shall be double inlet, double width type. The wheel & housing shall be fabricated from heavy gauge galvanised steel. The impeller & fan shaft shall be statically and dynamically balanced. Fan housing with motor shall be mounted on a common steel base mounted inside the air handling housing on anti-vibration springs

mounts. The fan outlet shall be connected to casing with the help of fire retardant flexible canvass. The fan shall be complete with multi V belt drive, belt guard and adjustable motor mounting base.

The cooling coil shall be of seamless copper tubes, with aluminium fins. The tubes shall be staggered in the direction of air flow. The headers shall be complete with water in/out connections. Air velocity across the cooling coil shall not exceed 2.5 m/sec.

Each system shall have washable pre-filter of 90% efficiency down to 10 microns at the inlet of AHU and a micro-vee filter of 99% efficiency down to 5 microns at the inlet of AHU.

The drain pan of AHU shall be double skin internally insulated with 25mm expanded polystyrene. The drain pan shall be constructed of 0.8mm thick CRCA sheet power coated on outside and 0.63 mm GI sheet on inside with 25mm thickness rockwool/glass wool insulation in between. The cooling coil and condensate pan shall be assembly mounted on slides such that cooling coil and condensate pan can be wholly removed for maintenance.

The cooling coils, standard filters, etc., shall all be housed in a separate enclosure of suitable size and length. The inspection doors shall have double synthetic rubber seals doors and locking arrangements.

Each unit shall be provided with factory assembled humidifier section to accommodate hot dipped galvanised pan humidifier complete with immersion heater of suitable capacity, low level cut-out, float valve, sight glass. The humidifier section shall be coated with heat hardened polyester based power paint.

### .3 CHILLED WATER PUMPS

The chilled water pump sets shall be split casing type with suction and discharge flange connections and drip proof squirrel cage induction motor. Pump set shall be as per IS: 1520-1960, IS: 5120, IS-9079, and IS-325. Drive ratings, at 50°C ambient, shall be 10% in excess of maximum BHP of Pump plus transmission losses

### .4 MCC & Controls

Each unit shall be capable of being controlled locally and remotely from the station control room. Additional contacts shall be provided to effect interlocking of each unit with the fire detection system.

The locally mounted control panel shall be installed in the casing of the unit and wired complete with magnetic starters for both fans and motors, high and low pressure cut outs, oil pressure safety switch, and motor winding protectors.

The remote-control panel shall provide central control of cooling and shall be installed in the control room. Indication lights for unit functions shall be provided including system "COOL-AUTO-OFF" and

fan "ON-OFF-TRIP". The main thermostat shall be located in the control room.

All conduit and wiring between controls and operating units shall be provided.

#### 7.4.3.4 DUCTWORK AND RELATED ACCESSORIES

All ductwork including accessories required for the proper distribution of air for the air conditioning system and for the ventilation system shall be provided. The valve hall ventilation system shall also have ducts for complete air circulation, air inlet and air outlet along with all accessories. No part of the housing/room/civil construction shall be used as supply and /or return air path of ventilation system **for Valve hall.**

Duct and fittings shall be made of galvanized cold rolled steel sheets. Ductwork connections to units shall be made with fireproof flexible material. Supply, return and outdoor air ductwork and mixing sections with manual dampers, and bypass damper arrangement shall be shop or field fabricated.

Under deck insulation of at least 50mm thickness rockwool/glass wool shall be provided to all the air-conditioned rooms where the ceiling is exposed to direct sunlight. (Isolation of noise from AHU, etc.)

The air velocity in the supply section shall not be more than 460 m/min. The air velocity in the return section shall not be more than 180 m/min. The minimum thickness of GI sheets shall be as follows:

Dimension of the duct:

Gauge

up to 750 mm:24G

from 751 - 1500 mm:22G

from 1501 - 2250 mm: 20G

above 2250 mm: 18G

#### .1 Dampers

The dampers shall be provided in every main branch so arranged that they can be adjusted with a quadrant on the

outside of the duct and can be permanently fixed in position after the system is properly balanced. Damper regulator sets shall be cadmium plated stamped steel and shall be mounted directly on the ducts without insulation. Spacer studs shall be provided for insulated ducts.

#### .2 Louver Dampers

Louver dampers shall be provided where required and shall be carefully made to ensure tight shut-off and accurate positioning, manually or by damper motors. They shall be constructed with opposed blades, and shafts shall be fitted in "Oiltite" or approved equal bearings.

#### .3 Louvers

Louvers in walls for ventilating units shall be provided. Louvers shall be extruded aluminium, with interlocking mullions, integral caulking slots and reinforced corners. Louvers shall be at least 100 mm wide and complete with 50 mm diamond galvanized bird screens.

#### .4 Hangers

Ducts shall be permanently hung from rigid supports with the horizontal runs level and the vertical runs plumb. Additional hangers shall be installed at all bends, transformations and take-off connections. Hanger rods shall be sway-braced by means of crossed rods at not more than 6 m spacing.

#### .5 Vibration Isolation

Floor mounted equipment having a frequency of vibration of 1200 cycles per minute or less, shall be mounted on spring isolators with sound absorbing pads.

#### .6 Sleeves

Where ducts pass through walls or partitions, suitable sleeves of a gauge not less than that of the duct shall be provided.

Ducts through plenum chambers shall be made air tight by caulking with asbestos rope between the duct and sleeve.

#### .7 Thermal insulation

Anti-sweating insulation material shall be supplied and installed on all air conditioning (supply as well as return) ductwork. The insulation shall have a fire retarding vapour barrier jacketing and shall be covered with aluminium jacketing. Insulation thickness shall not be less than 25 mm. Fibre glass insulation shall have a normal density of 24kg/cub.metre.