Technical Specification for the Air Handling and Pressure Cascading System

1. Scope

This specification lists the technical requirements for the “Air Handling and Pressure Cascading System (AHPC system)”. The system shall be installed in a building already constructed near Devi Ahilya Bai Holker Sabzi Mandi, Indore.

The site has full road connectivity and is at a distance of ~ 10 km from Indore railway station. The bidder is encouraged to visit the site before preparing the tender.

There will be a pre-bid meeting and the bidders are encouraged to attend the pre-bid meeting.

2. Scope of work

2.1. Preparation of

- Configuration and layout design, component selection based on the requirements listed in this specifications, control system design and preparation of a design report,
- Manufacturing, and installation drawings and control programming flow-charts of the system (to be editable in AutoCAD),
- List of standard bought out components (with make, model & catalogue),
- O&M manuals,
- QA plan and its editable electronic copy, including manufacturing, inspection and testing details,
- Obtaining approval of RRCAT on the design report, manufacturing drawings, standard components within one month of release of purchase order and prior to actual procurements and manufacturing.
- Modern technologies of energy efficiency, maintainability and environment conservation shall be employed in keeping with Government norms.

Documents shall be prepared using MS Office.

2.2. All components and materials shall be of reputed market leader makes with modern design, high efficiency, long life and high quality suitable for tough industrial surroundings. No outdated schemes, materials or components shall be accepted. Only the items proven in the industrial field shall be used. Standard cataloged components at largest factory integration level available (AHU + blower + refrigeration + damper + drive + control) and of same make/compatible make certified by manufacturer shall be used.

2.3. Fabrication, inspections and tests as per RRCAT approved drawings, components, processes and procedures (including ducts).

2.4. Safe delivery, installation and commissioning of the AHPC system (all supports, hangers, materials, civil work, manpower, tools, consumables, measuring devices, computers required for the installation are in the scope of the supplier).

2.5. Testing and commissioning of the AHPC system.

2.6. Maintenance of the system for one year after commissioning, including all spares, to be covered under Guarantee.

2.7. Plastic covers for protection of the equipment(s) and epoxy coated floor already existing near the place of installation shall be provided during installation.

2.8. Work areas shall be cleaned by dust capturing techniques (vacuum cleaning, wet scrubbing) after the work completion.

2.9. Work shall be done as per the guidelines of ASHRAE, SMACNA standards and other relevant National/International standards (wherever they exist and applicable for such work).
2.10. Any components older than 18 months (date of manufacturing) shall not be used.

3. **Information to be provided with the bids**

3.1. Point wise technical details for execution (Section by Section).

3.2. Details of the standards bidder shall follow.

3.3. Separate lists of the “Items to be procured as standard items” and of the “Items which shall be fabricated”.

3.4. Details of makes, models and compliance standards of all the standard components with catalogue copies.

3.5. Details of the process qualification procedures for the component to be fabricated.

3.6. Accuracy, repeatability and least count for pressure and temperature measuring devices.

3.7. Information about the quality of materials and processes.

3.8. Details of maintenance needs (servicing and component replacement) shall be specified as follows –

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Servicing requirements</th>
<th>Component replacement requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.8.1. Per week</td>
<td>Bidder to mention</td>
<td>Bidder to mention</td>
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<tr>
<td>3.8.2. Per month</td>
<td>Bidder to mention</td>
<td>Bidder to mention</td>
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<tr>
<td>3.8.3. Per three month</td>
<td>Bidder to mention</td>
<td>Bidder to mention</td>
</tr>
<tr>
<td>3.8.4. Per year</td>
<td>Bidder to mention</td>
<td>Bidder to mention</td>
</tr>
</tbody>
</table>

3.9. Details of power consumption, efficiency of equipment, efficiency of insulation, efficiency of filters and maintenance requirements are important factors for technical functionality, life and operating costs. Bidder shall mention the proposed values and the proposed procedures for certifying/testing values of these parameters in the bid.

3.10. Details of the facilities to be used for completing this work (including sub-contractors and standard equipment suppliers) along with written agreement with the sub-contractors.

3.11. Details of the works executed (completed) in last five years along with the customer contact details.

3.12. **Quantity, Cost and basis for comparison**

   Bidder shall provide quantity and ratings for all major items to meet the functionality of this specification.

   Bidder shall provide item wise cost break up (including per unit cost).

   The bidder shall mention separately the basic cost, packing, forwarding, transportation, installation, commissioning etc. and taxes.

   The total project cost shall be the basis of comparison of the bids.

4. **Bidder qualification criteria, bid evaluation and presentation of offer**

4.1. The bidders shall have proven capability in HVAC works as per national/international/professional body standards. He shall have completed fabrication, installation and test of at least three HVAC works involving similar flow rates (80% of this specs or higher) as per national/ international standards in last five years. The executed work shall have included use of standard AHU, pre-fabricated ducts, filters, instrumentation and controls. These completed works shall be in proper working conditions for verification. Adverse feedback on project completion/performance/servicing shall be a cause of rejection of bid.

4.2. Details asked in this specification shall be verified. Purchaser will be free to ask additional information concerning the execution of the work.

4.3. Written records of the processes to be used for procurement, fabrication and quality control shall be available with the bidder for verification. The purchaser will verify the technical information of the
components/products/materials/processes proposed by the bidder.

4.4. Copy of relevant chapters/sections/pages of the ASHRAE and SMACNA and other standards proposed to be followed, shall be available with the bidder for verification.

4.5. The bidder shall have a design office for engineering drawings and detailing of the work involved.

4.6. The bidder shall have proper technical understanding of the work content including AHU/HVAC, instrumentation, accuracy, involved thermodynamics and fluid mechanics, advantages of using standard components, quality control of fabricated components, installation processes, quality control and test processes.

4.7. The supplier would be asked to make a presentation in front of a technical committee of the purchaser where he will need to explain the technical details of the proposed bid and understanding of the technical work content.

4.8. The purchaser may visit the facilities proposed to complete the work and may interact with the personnel responsible for carrying out various activities of the work for verification of capability, including visits to the works previously completed by the bidder and referred in the bid. Bidder shall facilitate these visits.

4.9. If the bidder fails to submit the additional information asked during bid evaluation within set time limit (typically 5 days) or fails to facilitate the evaluation visits, his bid would be rejected.

4.10. If the facilities or the personnel are not found to be capable of completing the work as per these specifications, the bid would be rejected.

4.11. The bid shall be evaluated after bringing all quotations on par for the technical work content (like provided flow rates, cooling capacity, filters, design scheme and details etc.). Therefore, vendor shall be required to submit items, quantities and offered values of parameters.

4.12. Only those bids which fulfil these requirements shall be evaluated.

5. Applicable drawings

The applicable drawings are listed below. Please read the drawings in color prints or view them in color on screen to see the details with more clarity.

5.1. Drawing No. RRCAT/IMA/ARPF/0801/R0 sheet 1 of 7; Layout for Circuit-1.

5.2. Drawing No. RRCAT/IMA/ARPF/0801/R0 sheet 2 of 7; Layout for Circuit-2 (Recirculation mode).

5.3. Drawing No. RRCAT/IMA/ARPF/0801/R0 sheet 3 of 7; Layout for Circuit-2 (Once through mode).

5.4. Drawing No. RRCAT/IMA/ARPF/0801/R0 sheet 4 of 7; Instrumentation System.

5.5. Drawing No. RRCAT/IMA/ARPF/0801/R0 sheet 5 of 7; Partition-1 & Partition-2 (P. No.-16).

5.6. Drawing No. RRCAT/IMA/ARPF/0801/R0 sheet 6 of 7; Pressure zones.

5.7. Drawing No. RRCAT/IMA/ARPF/0801/R0 sheet 7 of 7; Layout for Circuit-2 (Enlarged views).

All items of the AHPC system shown on the drawings, their “Bill of Material”, and item required for the assembly and making the AHPC system functional are included in the scope of supply.

6. General description of the system

6.1. There are two different flow circuits namely Circuit-1 and Circuit-2. Each flow circuit will have its independent AHU, instrumentation and controls. Flow directions and component details are given in the drawings and this specification.

6.2. The system shall be used for creating a pressure, temperature, humidity and dust controlled work areas
for assembly of electron accelerators. The system shall also be used for exhausting diluted ozone and maintaining pressure cascade from the linac room during test operations.

7. **Quantities and BOM**

   Please refer to the details given in these specifications and the drawings.

8. **Configuration**

   The configuration of ducts, AHU and all other components will be such as to fit in the available building space and facilitate servicing needs. Building dimensions are shown in the drawings and can be scaled for estimation work. Actually measured dimensions from the building shall be used for design, selection and manufacturing of all the components.

9. **Functional and parametric details**

   9.1. Irrespective of individual values provided in these specs, the parameter sets as governed by mechanics, thermodynamics, thermal and psychometric considerations shall be acceptable, if calculations justifying the differences are provided in the design report. The parameters shall be calculated in following sequence of preference - flow rate, differential pressure, humidity, temperature (viz. to meet the specified flow rate, other parameters of differential pressure, humidity and temperature, arrived at as per the design calculations, shall be acceptable).

   9.2. Fresh air enters the system only through droplet elimination system and dust filter banks.

   9.3. Fresh air (FA) required for ten working personnel (engaged in medium engineering activity) shall always be supplied whenever the system is “ON”.

   9.4. **Circuit-1**: Air circulation for ventilation, equipment cooling and human occupation.

      9.4.1. **Circulation** - 6000 m³/hour

          (Adjustable between 2000 m³/hour to 6000 m³/hr through Variable Frequency Drive (VFD). The set flow, adjusted once, shall be maintained through automatic control).

      9.4.2. **Fresh air**: Adequate fresh air for minimum 10 persons engaged in normal engineering activity (fresh air – 400 m³/hour) as per AHRAE 62.2.

      9.4.3. **Temperature**: Less than 28°C

      9.4.4. **Relative Humidity**: Less than 75%

      9.4.5. **Pressure cascading**: Pressure in Circuit-1 areas will be detectably higher than in Circuit-2 areas.

      9.4.6. **Control**: Automatic control of flow rate, temperature and humidity with the limits prescribed by keeping the circulation and fresh air components constant.

9.5. **Circuit-2**:

   9.5.1. **Once through mode**: Fresh air flow of 2000 m³/hour shall be maintained duly assisted by the first fan in the AHU and a second fan (discharge blower) just before the 32 m tall stack.

      9.5.1.1. **Flow rate** - 2000 m³/hour

          (Adjustable between 2000 m³/hour to 6000 m³/hr through VFD. The set flow, adjusted once, shall be maintained through automatic control).

      9.5.1.2. **Fresh air**: Full flow will be with fresh air intake and full discharge through 32 m tall stack.

      9.5.1.3. **Temperature**: Less than 35°C
9.5.1.4. **Relative Humidity**: Less than 65 %

9.5.1.5. **Control**: Automatic control of flow rate, temperature and humidity with the limits prescribed.

9.5.1.6. **Pressure cascading**: Pressure in Circuit-2 areas will be detectably lower than in Circuit-1 areas.

9.5.2. **Recirculation mode**: Air circulation for ventilation and human operators (6000 m³/hour) with adequate fresh air for 10 persons engaged in normal engineering activity (fresh air – 600 m³/hour).

9.5.2.1. Recirculation mode shall be only possible with the installation of a specific duct segment “A” as shown in drawing No. RRCAT/IMA/ARPF/00801/R0 sheet no. 2 of 7 with associated damper in open condition. Once the segment “A” is removed and ends closed, the flow will switch to once through mode with no possibility of recirculation.

9.5.2.2. **Interlock**: Two interlock signals based on totally independent measurement principles shall be provided for recirculation mode.

9.5.2.3. **Circulation**: 6000 m³/hour

(Adjustable between 2000 m³/hour to 6000 m³/hr through VFD. The set flow, adjusted once, shall be maintained through automatic control).

9.5.2.4. **Fresh air**: Adequate fresh air for 10 persons engaged in normal engineering activity (fresh air – 600 m³/hour).

9.5.2.5. **Temperature**: Less than 28°C

9.5.2.6. **Relative Humidity**: Less than 75 %

9.5.2.7. **Control**: Automatic control of flow rate, temperature and humidity with the limits prescribed by keeping the circulation and fresh air components constant.

9.5.2.8. **Pressure cascading**: No specific requirement of pressure cascading in this mode.

9.6. **Flow balancing and velocities**: Flow balancing shall be completed as per standards applicable for control rooms and HVAC devices used.

10. **Components**

All components shall be fit for continuous duty at the specified parameters.

Thermal breaks and thermal barrier using modern techniques and materials shall be used in AHU, ducting, and profiles to enhance the efficiency of the system.

Wherever “makes” have been specified components of equivalent quality, endurance, life and functional specifications can be selected provided service network is available in India. However, it will be the responsibility of the bidder to supply all relevant technical data sheets, information about life and reliability, test reports, and field use data of the proposed makes to prove equivalence. In such cases prior evaluation and approval of RRCAT shall be necessary.

10.1. **AHU**

10.1.1. Type: Double skin, weather proof, factory made standard catalogued product,

10.1.2. Mixing chamber with return air damper control. Fusible contact controlled fire damper,

10.1.3. Filter cascade, fan section and supply plenum with supply air control damper,

10.1.4. Pressure measurement ports, instrumentation, interfacing and communication for filters for
differential pressure monitoring and choking indication,

10.1.5. AHU shall be mounted on anti-vibration damper (cushy foot type),

10.1.6. NO/NC contact for interface with central Fire Alarm System,

<table>
<thead>
<tr>
<th>Table-1: AHU-1 and AHU-2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description</strong></td>
</tr>
<tr>
<td>10.1.7. Air flow rate, controllable using VFD</td>
</tr>
<tr>
<td>10.1.8. Pressure rating</td>
</tr>
<tr>
<td>10.1.9. Fan</td>
</tr>
<tr>
<td>10.1.10. Cooling capacity</td>
</tr>
<tr>
<td>10.1.11. Heater (with required fins)</td>
</tr>
<tr>
<td>10.1.12. Droplet elimination for intake air</td>
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<tr>
<td>10.1.13. Combination of coarse and fine filters.</td>
</tr>
<tr>
<td>▪ Bag/pocket filters to be taken for ensuring required dust holding capacity to get a maintenance interval of 3 months or more (parallel filter lines can be used for alternate operation). See Section “Operation and maintenance requirement for the overall system”.</td>
</tr>
<tr>
<td>▪ Preferably washable (Disposable to be considered, if required to meet filtration needs).</td>
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<tr>
<td>▪ Material of the filters shall be suitable for use in food industries.</td>
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<tr>
<td>▪ Full provision of factory fitted instrumentation and control for filter condition monitoring based on differential pressure measurement.</td>
</tr>
<tr>
<td>▪ Eurovent/AHRI certified or equivalent</td>
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<tr>
<td>10.1.14. Properly engineered condensed water drain to building exterior shall be provided</td>
</tr>
<tr>
<td>▪ All VFD drive and power supply system shall permit fan rotation only in the correct direction.</td>
</tr>
<tr>
<td>▪ Sound pressure level – 85 dBA at 1 m or less</td>
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<tr>
<td>▪ Motor protection unit against high current.</td>
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<tr>
<td>▪ Controller shall have interlocking with the centralized Fire Alarm System of the building (already in place).</td>
</tr>
<tr>
<td>▪ The blower has to be tested for air flow rate, pressure, power and efficiency at operational range of speeds as per AMCA standard 210.</td>
</tr>
<tr>
<td>▪ The supplier shall submit the parameters and procedures adopted for selection of the blower and get it approved by RRCAT.</td>
</tr>
<tr>
<td>▪ Make: Ventus (<a href="http://vtsgroup.in/">http://vtsgroup.in/</a>) / Systemair India (<a href="http://www.systemair.com">www.systemair.com</a>) / SAIVER (<a href="http://www.transcoldappliances.in/AHU.html">http://www.transcoldappliances.in/AHU.html</a>) / Fedders Lloyd Corporation Ltd.</td>
</tr>
</tbody>
</table>

10.2. Refrigeration unit and heaters

10.2.1. DX type, Capacity - As required, but not less than 12 TR with continuous rating.

10.2.2. Heater (with required fins) – As required, but not less than 12 kW preferably through refrigerator operating in reverse mode (or comprising of modular independently switchable heaters each of 3 kW (typical)).

10.2.3. Type: Standard outdoor unit (inverter type having variable speed capability, duly integrated with control system).
10.2.4. Make: Hitachi/Daikin/ O General/ Mitsubishi/ Panasonic /Blue Star/ Voltas/Carrier/LG

10.3. AHU-1 Fan

10.3.1. Type: Direct driven high efficiency plug fan
10.3.2. Flow rate : 2000 to 6000 m³/hour (Adjustable using VFD)
10.3.3. Static pressure
   - 150 mm of WG or more at 6000 m³/hour and 4000 m³/hour
   - 50 mm of WG or more at 2000 m³/hour
   The fan, motor, VFD, controller and all associated systems shall be rated to run in the full speed range required for this flow control.
10.3.4. Sound pressure: 85 dBA at 1 m
10.3.5. Make: Kruger/Nicotra/ EBM-PAPST/PUNKER/Nadi/Greenheck
   (For example Nicotra Gebhardt - RLM .-3135 Tolerance Class -1)
10.3.6. Motor & drive: Variable Frequency Drive of HVAC series (Make: ABB/Danfoss/ Siemens/Marathon/ Schneider electric/ Bharat Bijlee)
10.3.7. Starter: Siemens / L&T/BCH/ ABB/ Schneider electric.

10.4. AHU-2 Fan

10.4.1. Same as those for AHU-1 Fan above

10.5. Discharge Fan at exhaust (Part No. 7 of Drawing No. RRCAT/IMA/ARPF/0801/R0 sheet 2 of 7)
10.5.1. Rating same as those for AHU-1 Fan above, but SISW type.

10.6. Filter cascade

Airborne Suspended Particulate Matter (ASPM) near the site is about 500 microgram/m³. The high ASPM is due to the proximity to vegetable market and high loading/unloading activities in the vicinity and road with high vehicular traffic.

All intake air shall be filtered by suitable droplet elimination louvers and pre-filters at the suction inlet, and pre and fine filters inbuilt in the AHU duly mounted on rails for quick replacement.

Engineering justification for the choice of louvers, pre-filters, fine filters shall be included in the design report with regards to performance, dust holding capacity, pressure drop, maintenance duration and life expectancy.

If required, a separate additional set of filter bank (in parallel) shall be included to get a filter maintenance interval of three months.

10.6.1. Three parallel lines shall be provided to meet the maintain duration requirement.
10.6.2. Coarse filter: MERV 8 (additional pre-filter line can be used)
10.6.3. Fine filter: MERV 10 (or higher MERV rating)
10.6.4. Final pressure drop: 35 - 45 mm WG (Typical)
10.6.6. Droplet elimination stage through factory made standard intake louvers.
10.7. **Fresh air intake louvers**

10.7.1. Designed for low air flow resistance, high resistance to rain water penetration and shall have engineered water drain arrangements.

10.7.2. Make: Greenheck/ Ruskin Titus India Pvt. Limited/ BETEC CAD

10.8. **Duct**

The design for distribution ductwork including duct sizing, layout, dampers, grills, supports, hangers for the given flow rates shall be done by the supplier. Design report giving the standard followed, duct sizing, layout, joints, and compatibility with the adjoining standard components, flanges, seals, thickness, supports, hangers and other relevant factors shall be included.

10.8.1. Machine made factory fabricated, GI material of TATA/National/SAIL/JINDAL, TDC/TDF prefabricated flanges with factory made holes/provision for clamping as per SMACNA.

10.8.2. Gasket: Fiber free open nitrile rubber, leak tight, prefabricated item of a standard manufacturer with machine punched holes matching with flanges.

10.8.3. Finish: Thermal insulation lining as per this specifications.

10.8.4. Connection with AHU: Flexible connection, antibacterial, fire retardant, double canvas (with four sets of canvas as spare), window Make – Resistoflex/Airflow (www.airflow.com)

10.8.5. All drains, duct work and wall openings shall be fully sealed trough traps/ well engineered plugs to avoid undesired entry of fluids, dust or animals.


10.9. **Insulation**

Flexible close cell duct insulation with microbial protection and water vapour resistance, properly bonded to the sub-surface shall be used. Measures shall be taken to avoid excessive condensation on the ducts and walls using insulation taking due care of hygiene and aesthetics.

The insulation shall be self-extinguishing type and as per standards applicable for industrial buildings.

10.9.1. Pasting-OEM recommended adhesive and pins.

10.9.2. Material

10.9.3. Thermal-Flexible closed cell Elastomeric Nitrile rubber with 19 mm thick (typical) with factory laminated Aluminum clad of 0.3 mm thickness.

10.9.4. Make- Armacell/ Aeroflex/ Supreme/ ALP/ Kflex/Duraflex

10.10. **Mounting**

The ducts shall be supported using factory made GI hangers, ties, angles, brackets and frames shall be light weight, strong and shall meet the aesthetic needs.

The vendor shall show the details in the drawing.

10.11. **Grills and diffusers**

10.11.1. Diffusers shall be mounted with sound engineering detailing ensuring strong fixing such as to withstand air discharge and direction adjustment forces.

10.11.2. Type: Spot jet diffuser.

10.11.3. Powder coated, double deflection, extruded aluminum grill/diffuser with manual volume control damper (VCD) all standard factory fabricated,
10.11.4. Make: System air/Ruskin/ Greenheck/Draftair/Dynacraft/ Carryaire

11. Instrumentation

As shown on the drawing.

12. Electrical panel, drives and actuators

The Electrical panel shall be supplied with proper air cooling fans for cooling the components with safety enclosures. All electrical controls and instruments shall be housed in an industrial standard control console and fully wired to operate on 3 Phase, 50 Hz (± 3%), 415 VAC (± 10%) mains power supply along with power neutral and ground connection. The Electrical Panel shall comprise of MCCBs with microprocessor based over current and short circuit protection, air break contactors, over load relays and variable frequency drives of the suitable rating independently for the various blowers and different sub-systems.

The Electrical Panel and its control shall have following features:
12.1. Incomer MCCB of suitable rating with microprocessor based over current, short circuit and earth fault protection.
12.2. 3-phase light indication on the panel with Emergency OFF push switch,
12.3. Primary & secondary voltage and current digital type indicating meters on the panel,
12.4. A suitable HMI touch screen shall be provided to view all the critical parameters of the AHPC system (12 inch).
12.5. Necessary interlocking of control devices for its safe operation,
12.6. Suitable earthing to all control panels and their instruments.

In case of power failure, the entire system shall be shut down safely without jeopardizing the operation of system. This would require powering of the control system other than the blowers/AC system through a dedicated static UPS with VRLA batteries of required capacity (to be supplied under the scope of this tender).

Bidder shall provide details of the system offered including scheme, single line diagram, bill of materials (BOM), make, model and catalog

13. Control and operation

13.1. Approval of RRCAT shall be taken on the detailed engineering drawing including SLD, GA drawing, QAP, layout and format of the control panel and also the details of the control system on PC before taking up the fabrication work (including all buttons, switches, displays, indicators, alarms, control elements, interlocks etc).

13.2. The Air Handling and Pressure Cascading System (AHPCS) shall be provided with PC- PLC (Programmable logic controller) based control system for AHU control, operation, diagnostics and interfacing with accelerator machine for machine control (PC will be kept in accelerator machine control room). The PLC – PC shall be used for interlocking and self-control of the AHPCS along with required control cards (temperature, pressure etc.). The PC shall have user-friendly Microsoft Windows based standard control software (HMI). The HMI software shall be provided in removable media (CD, DVD etc) as a licensed copy of Run Time and Configuration version from the OEM. The controller integrates with the software running on a personal computer to provide Supervisory Control and Data Acquisition (SCADA). The PC based controller shall be able to control the two AHPCS circuits individually. The recorder capability shall be in the same PC based controller.

The data acquisition shall be able to record data (differential pressure, flow, humidity, temperatures, pressure, etc.) from various zones and keep the data in memory. The controller, software and displays shall be user friendly for easy programming, monitoring and operation of the system.

Alarm of the faults with time stamp.
Two energy meters showing separately the power consumption of both the circuits (in kW) shall be provided.

13.3. Functionality

Control of all the devices to maintain the required differential pressure, air flow directions, humidity, temperature, fresh air ratio, filter bank selection, for both the circuits.

Selection of recirculation mode/once through mode from the PC.

Display of all the measured parameters as per drawing and, in addition,

13.3.1. Differential pressure (across filter cascade in addition to all other locations)

13.3.2. Flow rate (at the exit of both AHUs)

13.3.3. RH (at exit of underground duct)

13.3.4. Temperature (at linac room, occupied enclosed area, control room, equipment room)

13.4. Operation in Auto and Manual mode

The system shall operate in auto mode with PC-PLC and it shall be possible to operate the system in manual mode even when the control PC is not working. In such a scenario the circuit-1 shall operate on the specified parameters and the circuit-2 shall operate in once through mode on the specified parameters. A suitable electrical switching device shall be provided.

13.5. Differential pressure and interlock signal

Interlock signals shall be provided and used to maintain the pressure cascade. The differential pressure detection unit shall provide NO/NC contact when the differential pressure has reversed the direction.

13.6. Switching the system from recirculating mode to once through mode shall be possible only after a period of eight hours (to avoid condensation on the equipment).

13.7. The flow rate of the chimney blower (discharge blower) shall always be 10% more than the AHU-2 blower (to ensure a negative pressure in the linac vault).

14. Electric supply at the site: 415 ±10% V AC, 50 Hz ± 3%, 3 Phase

All equipment and distribution shall have rugged earth protection through well engineered connections. Power and water shall be supplied only at one place by RRCAT.

All further distribution for power, control/instrumentation cables and connectors shall be under the scope of the supplier including all the materials and installation. All the cables shall be FRLS PVC sheathed. Power cables shall be preferably of Finolex/CCI/Raveen/KEC/Radiant.

15. Operation and maintenance requirement for the overall system

| 15.1.1. | Operation | Continuous operation for 12 hours every day for 10 years. |
| 15.1.2. | Operation duty cycle | 250 hours per month. |
| 15.1.3. | Interval before maintenance for all system including filtration unit. | 600 Hours of operation in all seasons. |

16. Spares

16.1. Eight sets of filters (for replacing "all" filters installed in the system) shall be supplied and included in the scope of this tender.
17. Conditions for civil works at site

17.1. All breaking ups shall done using proper machine saws and drills. Hammering/chisel breaking shall not be permitted. Proper and safe anchors shall be used (Hilti/Fischer make).

17.2. The subsequent repair work of walls/concretes shall be of high finish and quality.

18. RRCAT approval: stages and schedule

Prior approval of RRCAT shall be taken on the documents/stages and only the approved scheme shall be used for implementation as listed in different sections of this specifications. RRCAT will accord its approval generally within 10 working days.

19. Stages and schedule of supply

<table>
<thead>
<tr>
<th>Activity</th>
<th>Schedule from the date of PO</th>
<th>Estimated percentage of work</th>
</tr>
</thead>
<tbody>
<tr>
<td>19.1. Supply of complete documented files related to design, manufacturing, inspection, testing, component lists, catalogues and QA and their approval by RRCAT</td>
<td>30 days</td>
<td>10%</td>
</tr>
<tr>
<td>19.2. Delivery of air distribution system components – ducts, insulation, grills at site and its stage acceptance by RRCAT.</td>
<td>60 days</td>
<td>10 %</td>
</tr>
<tr>
<td>19.3. Delivery of all AHUs, ACs and Filters at site and its stage acceptance by RRCAT.</td>
<td>75 days</td>
<td>15 %</td>
</tr>
<tr>
<td>19.4. Delivery of all instrumentation, controls, PC, cables, connector, panels at site and its stage acceptance by RRCAT.</td>
<td>90 days</td>
<td>15 %</td>
</tr>
<tr>
<td>19.5. Installation and testing of complete system and warranty</td>
<td>120 days</td>
<td>Remaining</td>
</tr>
</tbody>
</table>

20. Documents to be submitted to RRCAT

20.1. Design report on the duct work.

20.2. As built drawings including full specifications of the components, makes, models and catalog pages.

20.3. Manufacturing and installation drawings.

20.4. Digital photographs of the installation with following details

20.4.1. Name plate photo of each component with description in a word document (tabular form).

20.4.2. Photograph of the full system with description (several snap shots to cover the whole system).

20.5. O&M manuals and procedures including for all the bought out components.

20.6. Guaranty / Warranty certificates of the integrated HVAC system and bought out components from the original manufacturer.

20.7. List of recommended spares for operation beyond AMC duration.

21. Inspection and tests at supplier's works

Purchaser would reject materials, components and processes if the quality is not as per the standards or if the components/materials have not been stored in proper protection.
All components and systems shall be inspected/tested as per the applicable standards and approved QA plan. Detailed inspection report, including digital pictures, in paper format and electronic format shall be submitted to RRCAT for approval.

Additional tests/re-tests, inspections as suggested by RRCAT shall be done and reports shall be submitted to RRCAT for approval. Any rejections by RRCAT for lack of quality, damage, substandard/outdated supplies shall be binding.

RRCAT may decide to inspect all components and fabrications at the respective manufacturer’s sites and witness the testing. Contractor shall provide 7 days’ notice for such inspection schedule.

22. **Inspection and tests at RRCAT**

22.1. All the supplies shall be inspected/tested prior to installation including for transit damage.

22.2. The complete system shall be inspected for its proper functionality after installation.

22.3. Flow variation through VFDs and measurements of pressure, pressure cascade and differential pressure.

22.4. Power consumption, efficiency of equipment, efficiency of insulation, efficiency of filters and maintenance durations and maintenance requirements are important factors for technical functionality, life and operating costs. These shall be tested during actual operation tests against quoted values.

22.5. The subsequent repair work of walls/concretes shall be inspected for quality and finish.

22.6. Tests of the system after installation – 72 hours no-fault, continuous running during which the flow rates, temperature, humidity, filter performance, component performance, overall performance will be tested.

22.7. At the end of the test, the system shall be inspected for any draining water, leaks, filter malfunction, controls, measurements, and overall components. The system shall be in fully working condition as per the original specifications.

22.8. **Flow pattern test**

A total of four flow pattern tests in the “**Linac Room and Interaction Chamber**” shall be done at different flow rates and different equipment configurations which will be informed by RRCAT (in writing). The tests shall be done following national/international/professional standards under the full responsibility of the bidder using safety practices and procedures. During each flow pattern test, digital videography of the full volume of the Linac Room area and interaction chamber shall be done after “multipoint” (at least ten points) release of aerosol fog. A proper digital videography camera with time and date stamping on the recording shall be used.

The flow pattern test shall demonstrate that the flow is directed towards the suction inlet.

Recordings of all the four tests shall be submitted to RRCAT on DVDs and flash drives (on both media). The flow pattern test shall be accepted on receipt of high quality videos.

23. **Acceptance**

The system shall be accepted subject to completion of following activities -

23.1. Delivery and RRCAT acceptance of all the supplies,

23.2. Completing all QA, inspection and testing activities with proper reports and their acceptance by RRCAT,

23.3. Completing the installation and 72 hours no-fault system operation and its acceptance by RRCAT.

23.4. Completing after-work repair and cleaning of the site areas and its acceptance by RRCAT.

23.5. Receiving design, manufacturing, catalogues, manuals, QA documents, and videography copies from the supplier including inspection and test reports and their approval by RRCAT.

23.6. The copy of the guarantee certificates of the brought out items received by the supplier/vendor will be
submitted to RRCAT along with the warranty of the whole system.

23.7. Completion of training to the technical personnel’s of RRCAT for operation and maintenance of the ACHPS system.

24. **Transportation to RRCAT**

All the equipment shall be supplied in the original packing of the manufacturer. Safe delivery is the sole responsibility of the supplier. Components received in damaged condition shall be rejected.

25. **Installation, commissioning and test operation of the system**

The installation, commissioning and test operation of the system shall be done under the scope of this tender. To create a reference condition all unintended openings shall be closed during the test. Proper tools and safety procedures shall be used. The bidder shall provide all accessories such as stands, platforms, metal frame/structure/vibration isolators, holders, fasteners, mounting brackets/clamps etc. required for installation and commissioning. All these accessories shall be factory fabricated and finished with fabrication->descaling->primer coating->painting.

Bidder shall prepare a drawing and plan showing step by step installation and commissioning activities. Bidder shall visit the site for this purpose and take the details and dimension as required. No request for alteration/modification/construction of building/site will be entertained at any level of work execution.

The bidder shall arrange facilities like mobile/boom-crane for loading/unloading of items, working at height, qualified welder and welding machine etc, manpower, carpentry works, electrical works, piping works.

RRCAT will provide three phase power supply and water for this purpose.

26. **Training**

The manufacturer shall provide two days training for operation and maintenance of the system to three engineers of the purchaser at the installation site.

27. **Schedules**

The work shall be completed in six months from the date of Order.

28. **Guarantee**

The supplier shall provide guarantee for trouble-free operation of the system for one year after final acceptance by RRCAT. Any spares and services required to keep the system in full operation state during the Guarantee Period shall be in the scope of the supplier. Supplier shall specify an email address where the complaints are to be registered. All durations between complaint registration and complaint resolution shall be added to the guarantee period.
Annex – Suggestive BOQ

A brief description of some of the items required for this work is given in the following list, with relevant Section number of the specifications and the applicable drawing numbers.

Note: This list is only suggestive and is not exhaustive. It is the responsibility of the bidder to check for the required quantities/requirements from the technical specifications of AHPC system for meeting the full scope of the work for preparing the bid.

<table>
<thead>
<tr>
<th>SN</th>
<th>Item</th>
<th>Quantity</th>
<th>Section</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>AHU</td>
<td>02 nos.</td>
<td>10.1</td>
<td>Drawing No. RRCAT/IMA/ARPF/0801/R0 sheet 1 of 7; Layout for Circuit-1.</td>
</tr>
<tr>
<td>2.</td>
<td>Refrigeration unit and heater</td>
<td>02 nos.</td>
<td>10.2</td>
<td>Drawing No. RRCAT/IMA/ARPF/0801/R0 sheet 2 of 7; Layout for Circuit-2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(Recirculation mode).</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Drawing No. RRCAT/IMA/ARPF/0801/R0 sheet 3 of 7; Layout for Circuit-2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(Once through mode).</td>
</tr>
<tr>
<td>3.</td>
<td>Fan</td>
<td>02 nos.</td>
<td>10.3, 10.4</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Discharge fan at exhaust</td>
<td>01 no.</td>
<td>10.5</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Filter cascade</td>
<td>02 sets</td>
<td>10.6</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Filter (spares)</td>
<td>08 sets</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>Fresh air intake louvers</td>
<td>02 nos.</td>
<td>10.7</td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>Duct</td>
<td>02 sets</td>
<td>10.8</td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>Insulation</td>
<td>02 sets</td>
<td>10.9</td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td>Mounting</td>
<td>02 sets</td>
<td>10.10</td>
<td></td>
</tr>
<tr>
<td>11.</td>
<td>Grills</td>
<td>02 nos.</td>
<td>10.11</td>
<td></td>
</tr>
<tr>
<td>12.</td>
<td>Diffuser</td>
<td>06 nos.</td>
<td>10.11</td>
<td></td>
</tr>
<tr>
<td>13.</td>
<td>Partition 1 &amp; 2</td>
<td></td>
<td></td>
<td>Drawing No. RRCAT/IMA/ARPF/0801/R0 sheet 5 of 7; Partition-1 &amp; Partition-2 (P. No.-16).</td>
</tr>
<tr>
<td>14.</td>
<td>Electrical panel, drives and actuator</td>
<td>01 set</td>
<td>12</td>
<td>Drawing No. RRCAT/IMA/ARPF/0801/R0 sheet 4 of 7; Instrumentation System.</td>
</tr>
<tr>
<td>15.</td>
<td>PC for PC-PLC based system for control and operation</td>
<td>01 no.</td>
<td>13.2</td>
<td></td>
</tr>
<tr>
<td>16.</td>
<td>Temperature sensor</td>
<td>05 nos.</td>
<td>13</td>
<td>Table-1 of Drawing No. RRCAT/IMA/ARPF/0801/R0 sheet 4 of 7; Instrumentation System</td>
</tr>
<tr>
<td>17.</td>
<td>Relative humidity sensor</td>
<td>03 nos.</td>
<td></td>
<td>Table-2 of Drawing No. RRCAT/IMA/ARPF/0801/R0 sheet 4 of 7; Instrumentation System</td>
</tr>
<tr>
<td>No.</td>
<td>Description</td>
<td>Quantity</td>
<td>Reference</td>
<td></td>
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<td>------</td>
<td>------------------------------------------------------------------------------</td>
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<td>---------------------------------------------------------------------------</td>
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</tr>
<tr>
<td>18.</td>
<td>Differential air pressure</td>
<td>09 nos.</td>
<td>Table-3 of Drawing No. RRCAT/IMA/ARPF/0801/R0 sheet 4 of 7; Instrumentation System</td>
<td></td>
</tr>
<tr>
<td>19.</td>
<td>Condensation monitoring sensor with extension unit (WBT)</td>
<td>02 set</td>
<td>Table-4 of Drawing No. RRCAT/IMA/ARPF/0801/R0 sheet 4 of 7; Instrumentation System</td>
<td></td>
</tr>
<tr>
<td>20.</td>
<td>Air velocity sensor</td>
<td>03 nos.</td>
<td>Table-5 of Drawing No. RRCAT/IMA/ARPF/0801/R0 sheet 4 of 7; Instrumentation System</td>
<td></td>
</tr>
<tr>
<td>21.</td>
<td>Control</td>
<td>01 set</td>
<td>Table-6 of Drawing No. RRCAT/IMA/ARPF/0801/R0 sheet 4 of 7; Instrumentation System</td>
<td></td>
</tr>
<tr>
<td>22.</td>
<td>Plant operating software and interface hardware</td>
<td>01 set</td>
<td>Table-7 of Drawing No. RRCAT/IMA/ARPF/0801/R0 sheet 4 of 7; Instrumentation System</td>
<td></td>
</tr>
<tr>
<td>23.</td>
<td>Controllers</td>
<td></td>
<td>Table-8 of Drawing No. RRCAT/IMA/ARPF/0801/R0 sheet 4 of 7; Instrumentation System</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Heating</td>
<td>02 nos.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ventilation and air conditioning</td>
<td>02 nos.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Universal I/O extension module</td>
<td>06 nos.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Room controller</td>
<td>02 nos.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>24.</td>
<td>Air flow measurement station</td>
<td>02 nos.</td>
<td>Table-9 of Drawing No. RRCAT/IMA/ARPF/0801/R0 sheet 4 of 7; Instrumentation System</td>
<td></td>
</tr>
</tbody>
</table>

_________End of this document_________
1. Sliding window is an auto sliding salters (electrical water type) and operate using electric traction in vertical direction for opening/closing.
2. Switch (sliding window) to be provided on partition 1.

DETAIL VIEW OF SLIDING WINDOW

PARTITION-1 & PARTITION-2 (P. NO.-16)
(AIR HANDLING & PRESSURE CASCADING SYSTEM)

GOVERNMENT OF INDIA
DEPARTMENT OF ATOMIC ENERGY
RAJA RAMAN CENTRE FOR ADVANCED TECHNOLOGY
SKETCH NO. -2019/014-ECE-02597-RO
Pressure zone | Relation for cascading & interlock (setable) values
---|---
Pressure zone-1 (P1) | Outside atmospheric pressure
Pressure zone-2 (P2) | More than instantaneous atmospheric pressure within 5 Pa
Pressure zone-3 (P3) | More than instantaneous pressure in pressure zone-2 up to 5 Pa
Pressure zone-4 (P4) | Less than instantaneous pressure in pressure zone-2
Pressure zone-5 (P5) | Less than instantaneous pressure in pressure zone-4