

	<p style="text-align: center;"><b>INDIAN INSTITUTE OF TECHNOLOGY MADRAS</b> Chennai 600 036</p> <p style="text-align: center;">Telephone: [044] 2257 9798/9723 E-mail: <a href="mailto:arpp@iitm.ac.in">arpp@iitm.ac.in</a></p>	
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Senior Manager (Project Purchase)

Ref: ELE/DRAY/011/2019

Date: 24.05.2019

**Limited Tender No: ELE/DRAY/011/2019**

**Due Date: 14<sup>th</sup> June 2019, 3 PM**

**Technical Bid opening meeting on 19<sup>th</sup> June 2019, 4:00 PM at  
Department of Electrical Engineering, IIT-Madras.**

Dear Sir/Madam,

On behalf of the Indian Institute of Technology Madras, offers are invited for the design, detailed engineering, sourcing and supply, delivery, handling, erection/installation, commissioning, validation, and carrying out acceptance tests at site (including transportation from storage place to works) of all the plants, equipment and other items required for the cleanrooms and its utilities at Department of Electrical Engineering, Indian Institute of Technology, Madras for Active Matrix Organic Light Emitting Diode fabrication for display application conforming to the technical specifications given in Annexure I.

Parties/Vendors/Contractors meeting the requirement by submitting all the documents sought in the EOI released on 25.02.2019 are only eligible to participate in this tender. Those who have not participated in the EOI and pre-bid technical meeting are not eligible to bid.

**Instructions to the Bidder**

- I. **Preparation of Bids:** - The tenders should be submitted under two-bid system (i.e.) Technical bid and Financial bid.
- II. **Delivery of the tender:** - The tender shall be sent to the addresses mentioned below, either by post or by courier so as to reach our office before the due date and time specified in our schedule. The offer/bid can also be dropped in the tender box on or before the due date and time specified in the schedule.

The tender box is kept in the office of the:

**Senior Manager,  
Project Purchase,  
IC & SR Building 2<sup>nd</sup> floor,  
I.I.T. Madras,  
Chennai – 600 036.**

- III. **Opening of the tender:** - The offer/bids will be opened by a committee duly constituted for this purpose. The technical bids will be opened first and will be examined by a technical committee which will decide the suitability of the bids as per our specifications and requirements. All bidders will be invited for opening of the technical bids. With respect to opening the financial bid, only technically qualified bidders will be called.

- IV. Prices:** - The price should be quoted in net per unit (after breakup) and must include all packing and delivery charges to the **Department of Electrical Engineering**. The offer/bid should be exclusive of taxes and duties. The percentage of tax & duties should be clearly indicated separately. Kindly note that IIT Madras is eligible for concessional GST and relevant certificate will be issued.

In case of import supply, the price should be quoted without custom duty. IIT Madras is exempted from levy of IGST on Imports and eligible for concessional custom duty (not exceeding 5%) and the price should be quoted on EX-WORKS and CIP basis indicating the mode of shipment.

- V. Agency Commission:** - Agency commission, if any, will be paid to the Indian agents in rupees after receipt of the equipment and its satisfactory installation. Agency Commission will not be paid in foreign currency under any circumstances. The details should be explicitly shown in the tender document even in the case of 'Nil' commission. The tenderer should indicate the percentage of agency commission to be paid to the Indian agent. The foreign Principal should indicate the percentage of payment and it should be included in the basic price quoted originally (if any)..
- VI. Terms of Delivery:** - The item should be supplied to the **Department of Electrical Engineering, IIT Madras** as per the Purchase Order. In case of import supply, the item should be delivered at the cost of the supplier to our Institution. The Installation/Commissioning should be completed as specified in our important conditions.
- VII. Technical Bid Opening:** The technical bid will be on 19th June 2019, 4:00 PM at the **Department of Electrical Engineering, IIT-Madras**. The financial bids of those tenders who are technically qualified will be opened at a later date under intimation to them.
- VIII. IIT Madras** reserves the full right to accept / reject any tender at any stage without assigning any reason.

Yours sincerely,

**Senior Manager (Project Purchase)**  
**IC&SR Building, I.I.T. Madras,**  
**Chennai – 600 036.**

## SCHEDULE

### Important Conditions of the tender

1. The due date for the submission of the tender is **14.06.2019, 3 PM.**

The offers / bids should be submitted in two bids systems (i.e.) Technical bid and financial bid. The Technical bid should consist of all technical details / specifications only. The Financial bid should indicate item-wise price for each item and it should contain all Commercial Terms and Conditions including Taxes, transportation, packing & forwarding, installation, guarantee, payment terms, pricing terms etc. The Technical bid and financial bid should be put in separate covers and sealed. Both the sealed covers should be put in a bigger cover. The limited Tender for supply of the "Design, detailed engineering, sourcing and supply, delivery, handling, erection/installation, commissioning, validation, and carrying out acceptance tests at site (including transportation from storage place to works) of all the plants, equipment and other items required for the cleanrooms and its utilities" should be written on the left side of the Outer bigger cover and sealed.

2. **EMD: - The EMD in the form of account payee DD for 2% value of the item in favor of The Registrar - IIT Madras, payable at Chennai should be enclosed in the cover containing financial bid.** Any offer not accompanied with the EMD shall be rejected summarily as non-responsive.

The EMD of the unsuccessful bidders shall be returned within 30 days of the end of the bid validity period. The same shall be forfeited, if the tenderers withdraw their offer after the opening during the bid validity period. The Institute shall not be liable for payment of any interest on EMD. EMD is exempted for Micro and Small Enterprises (MSE) as defined in MSE Procurement Policy issued by Department of Micro, Small and Medium Enterprises (MSME).

3. **Performance Security: -** The successful bidder should submit Performance Security for an amount of 5% of the value of the contract/supply. The Performance Security may be furnished in the form of an Account Payee DD, FD Receipt from the commercial bank, Bank Guarantee from any nationalized bank in India. **The performance security should be furnished within 21 days from the delivery of the purchase order.**

**Performance Security in the form of Bank Guarantee:-** In case the successful bidder wishes to submit Performance Security in the form of Bank Guarantee, the Bank Guarantee should be routed through the Beneficiary Bank to the end user bank. Otherwise, the Indian Agent of the foreign vendor has to submit a Bank Guarantee from a Nationalized Bank of India.

The Bank Guarantee should remain valid for a period of sixty days beyond the date of completion of all contractual obligations of the supplier including the warranty obligations.

4. **Indian agent:** If an Indian agent is involved, the following documents must be enclosed:  
Foreign principal's proforma invoice indicating the commission payable to the Indian Agent and nature of after-sales service to be rendered by the Indian Agent.
  - ✓ Copy of the agency agreement with the foreign principal and the precise relationship between them and their mutual interest in the business.
5. The offer/bids should be sent only for a machine that is available in the market and supplied to a number of customers. A list of customers in India and abroad with details must accompany the quotations. Quotations for a prototype machine will not be accepted.
6. Original catalogue (not any photocopy) of the quoted model duly signed by the principals must accompany the quotation in the Technical bid.
7. Compliance or Confirmation report with reference to the specifications and other terms & conditions should also be obtained from the principal.
8. **Validity:** Validity of Quotation not less than 90 days from the due date of tender.

9. **Delivery Schedule:** - The tenderer should propose clearly the time required for achieving each of the milestones given in the table below. **The cleanroom must be commissioned and delivered over to IITM within six months after the release of the purchase order.**

Sl.no	Milestone	Approval process by IITM	Payment schedule after successful completion of the milestone	Penalty deduction percentage for each milestone
1	Submission of cleanroom design package	Technical review and approval of cleanroom design package	10%	@ 1% up to one week; @ 2.5% up to two weeks; @ 5% up to three weeks; @ 10% for four weeks and above
2	Confirmation of readiness for construction	<ul style="list-style-type: none"> <li>▪ IITM provides the space for construction of cleanroom</li> <li>▪ Tenderer should confirm the availability of all necessary cleanroom construction materials</li> </ul>	30%	
3	Commissioning of cleanroom	Demonstration of cleanroom performance as per specifications provided in the cleanroom design package	50%	
4	Certification of cleanroom	By independent Accredited Agency to be arranged by tenderer	10%	

In the event of delay in completion of the any of the proposed milestone, the tenderer shall be liable for a penalty deduction at a percentage which is mentioned above. For the purpose of this clause, part of the week is considered as a full week.

If there is delay, the penalty will be @1% per week of delay subject to a max of 10% of the value of purchase order and if the delay is more than accepted time frame by IITM, the PO would be cancelled and liquidated damages will be enforced.

10. **Risk Purchase Clause:-** In the event of failure of supply of the item/equipment within the stipulated delivery schedule, the purchaser has all the right to purchase the item/equipment from other sources on the total risk of the supplier under risk purchase clause.

11. **Payment:-** You can propose a payment structure (In case)

- (i) No Advance payment will be made for Indigenous purchase. However 90% Payment against Delivery and 10% after installation are agreed to wherever the installation is involved. In case of import supplies the payment will be made only through 100% Letter of Credit i.e. (90% payment will be released against shipping documents and 10% after successful installation wherever the installation is being done).
- (ii) **Advance Payment:** No advance payment is generally admissible. In case of specific percentage of advance payment is required, the Foreign Vendor has to submit a Bank Guarantee equal to the amount of advance payment and it should be routed through the Beneficiary Bank to the end user Bank. Otherwise, the Indian Agent of the foreign vendor has to submit a Bank Guarantee through a Nationalized Bank of India.

12. **On-site Installation:** - The cleanroom must be commissioned and delivered over to IITM within six months after the release of the purchase order.
13. **Warranty/Guarantee:** - Comprehensive warrantee for a period of Three (3) years for all equipment and system supplied and workmanship. The tenderer shall propose the terms and conditions of Annual Maintenance Contract (AMC) after the expiry of the warranty period.
14. **Late offer:** - The offers received after the due date and time will not be considered. The Institute shall not be responsible for the late receipt of Tender on account of Postal, Courier or any other delay.
15. **Acceptance and Rejection:** - I.I.T. Madras has the right to accept the whole or any part of the Tender or portion of the quantity offered or reject it in full without assigning any reason.
16. **Do not quote the optional items or additional items unless otherwise mentioned in the Tender documents / Specifications.**
17. **Disputes and Jurisdiction:**  
**Settlement of Disputes:** Any dispute, controversy or claim arising out of or in connection with this PO including any question regarding its existence, validity, breach or termination, shall in the first instance be attempted to be resolved amicably by both the Parties. If attempts for such amicable resolution fails or no decision is reached within 30 days whichever is earlier, then such disputes shall be settled by arbitration in accordance with the Arbitration and Conciliation Act, 1996. Unless the Parties agree on a sole arbitrator, within 30 days from the receipt of a written request by one Party from the other Party to so agree, the arbitral panel shall comprise of three arbitrators. In that event, the supplier will nominate one arbitrator and the Project Coordinator of IITM shall nominate on arbitrator. The Dean IC&SR will nominate the Presiding Arbitrator of the arbitral tribunal. The arbitration proceeding shall be carried out in English language. The cost of arbitration and fees of the arbitrator(s) shall be shared equally by the Parties. The seat of arbitration shall be at IC&SR IIT Madras, Chennai.
- a. **The Applicable Law:** This Purchase Order shall be construed, Interpreted and governed by the Laws of India, Court at Chennai shall have exclusive jurisdiction subject to the arbitration clause.
- b. Any legal disputes arising out of any breach of contract pertaining to this tender shall be settled in the court of competent jurisdiction located within the city of Chennai in Tamil Nadu.

18. All Amendments, time extension, clarifications etc., will be uploaded on the website only and will not be published in newspapers. Bidders should regularly visit the above website to keep themselves updated. No extension in the bid due date/ time shall be considered on account of delay in receipt of any document by mail.

**Acknowledgement:** - It is hereby acknowledged that the tenderer has gone through all the conditions mentioned above and agrees to abide by them.

**SIGNATURE OF TENDERER  
ALONG WITH SEAL OF THE  
COMPANY WITH DATE**

## **ANNEXURE - I**

**TECHNICAL SPECIFICATION**

**CLEAN ROOM & UTILITIES FOR  
AMOLED FACILITY AT IIT MADRAS**

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## **1. PROJECT INTRODUCTION**

Department of Electrical Engineering, Indian Institute of Technology, Madras invites technical and commercial proposal from selected parties/organization post EOI released dated 25.02.2019 for cleanroom construction which will be used for fabrication of Organic Light Emitting Diodes in mobile phone display applications.

The following detailed technical specification refers to the design, detailed engineering, sourcing and supply, delivery, handling, erection/installation, commissioning, validation, and carrying out acceptance tests at site (including transportation from storage place to works) of all the plants, equipment and other items required for the cleanrooms and its utilities at Department of Electrical Engineering, Indian Institute of Technology, Madras. It also covers the third party certification of clean rooms, HVAC for entire clean room facility, electrical, fire detection & protection system, safety system, utilities, tool hook-ups, BMS, cleanroom furniture and necessary minor civil works including wall breaking etc. The specifications/numbers/data provided by IITM in this technical document are approximate/indicative in nature.

The vendors should treat the specified quantities/numbers/data for various segments of the cleanroom and utility as a guideline to initiate their calculations. The vendors are supposed to provide IITM with the accurate estimate of each and every component related to the cleanroom and its utility during their bid submission.

This scope of work includes design, engineering, manufacturing, shop testing, inspection, packing, dispatching, loading, unloading and storage at site, transit, storage and construction insurance, assembly, erection, complete pre-commissioning checks, testing & commissioning at site and handing over the work to IIT Madras. For realizing the same IIT Madras intends to engage an experienced Contractor to execute the work as per the detailed technical specifications defined under the aforesaid work packages.

The work shall be executed as per the Approved for Construction (AFC) Drawings. The eligible and selected vendor (referred also as 'Contractor') will prepare design document complying with the technical specifications, the tender drawings as well as the Bill of quantities including complete scope of work mentioned above as part of the detailed design & engineering, and submit the detailed engineering drawings to IIT Madras as a part of technical bid for approval.

IIT Madras shall review the detailed engineering drawings and other documents submitted as part of technical bid and may also invite selected vendors for technical presentation.

Commercial bid of contractors selected post evaluation of technical bid and technical presentation shall be opened.

Commercial bid of contractors not getting selected in this process shall not be opened and returned to the respective contractors. Hence it is very important to submit all the drawings, technical documents, unpriced BOQ, and all necessary documents sought in the eligibility criteria.

Eligible contractors must visit the site selected for clean room construction and understand the requirement in detail before submitting the technical bid.



Request for site visit shall be entertained till 7 days before the tender submission date. Any request post this timeline shall not be entertained. Request must be raised via E-mail to tender committee at [dray@ee.iitm.ac.in](mailto:dray@ee.iitm.ac.in).

Clean room must be certified under “As-Built “condition and At- Rest” Condition upon Tool Hook-up, as per the specifications in this document. As per the Utility Matrix and tool layouts provided by IITM, all the required services and utility facilities shall be provided up to the point of use of each tool.

Vendors shall quote rates against each item in the Itemized Bill of Quantities (BOQ) derived by vendor based on drawings and design of clean room proposed by vendor. All items must adhere to the specification given in this document. Bidders are advised not to quote any rate in the BOQ provided in the Technical specification document. Any price indication in the technical bid may lead to bid rejection.

Bill of quantities must include all the major items required for the scope of work and commercial bid must include unit supply rate, unit installation rate and all other costs explicitly mentioned.

Vendor shall impart on-site hands-on training to IITM personnel, on operations, troubleshooting and preventive maintenance of the Clean Rooms, equipment / systems supplied and installed under the Contract, during installation and commissioning.

Vendor shall demonstrate performance and quality parameters of the Clean Rooms, equipment/systems/networks etc. installed under the Contract at the rated capacity/as per design. Clean room validation shall be done by an independent Accredited Agency as mentioned in the tender document.

On successful completion of the entire work, the Contractor shall provide ‘As Built’ drawings for all the systems executed under the Contract. One (01) sets of hard copies and one (01) set in soft copy (Pen Drive) in Auto-CAD format shall be submitted as a part of handover document for its record and reference. Contractor shall also provide all instruction / Operation manual(s) and maintenance manuals for the all equipment.

## **2. GENERAL INSTRUCTIONS:**

### **2a. Clean Room Construction Protocol**

Standard Build clean protocol during installation and testing/certification as applicable for Class 100 Clean Rooms shall be strictly followed by the vendor who shall arrange at his cost shoe covers, Booties, Masks, Hand Gloves etc. for vendor’s workmen, supervisor(s) and IITM staff. No street shoes shall be permitted in the work area. Regular cleaning of the work space/area by deploying adequate workmen and using industrial vacuum cleaners, lint free and low particulate Clean Room wipes suitable for Class 100/Class 1000 etc. shall also be vendor’s responsibility at no extra cost to IITM. Vendor shall ensure that Tools for installation are cleaned up regularly using Class 100/1000 Clean Room compatible tissue papers, lint free wipes, Isopropyl alcohol wipes etc. to ensure use of clean tools & tackles.

### **2b.Safety**

Vendor shall ensure adherence to safe construction practices which shall include use of Personnel Protection Equipment (PPE) by their workmen, supervisors etc. deployed on the work. PPE viz., safety helmets, safety shoes, harnesses, safety glasses, gloves etc. shall be provided by the vendor for the safety of all the personnel at the site of work. Vendor shall take

adequate measures to ensure that no damage or loss is caused to IITM buildings, equipment and personnel due to any activity carried out by the vendor relating to the performance of the Contract. Vendor shall be liable to make good the loss/damage including any consequential damage caused by them and in case of failure to do so, IITM shall effect financial recovery for the same from the vendor.

### **2c. Technical Manpower**

The contractor shall deploy qualified and experienced engineers and supervisory staff during execution for an efficient and effective supervision of the work ensuring compliance to the specifications and the drawings. The Project Manager shall have experience of 7 years (minimum) post degree qualification in Engineering in relevant field, and the engineers shall have experience of 3 years post degree qualification in Engineering or 5 years' experience post Diploma in engineering in the relevant field. The technical manpower strength shall be: one (1) Project Manager and two (1) engineers' minimum during the project execution.

### **2d. Materials**

All material selection shall be as per the Recommended Makes/Manufacturers' listed in the Tender document.

### **2e. Site Visit**

Interested bidders may visit the site of work to get fully acquainted with the site conditions and the facilities contiguous to the work area. The site visit shall be arranged up-to one week before the bid submission closing date.

### **2e. Site Office**

Vendor shall make own arrangement for their Site Office within IIT MADRAS premises. Electricity connection for the site office will be given by IIT MADRAS on metered basis and charges recovered from vendor as per PSPCL (state utility) tariff chargeable to IIT MADRAS.

### **2f. Electricity**

Electricity required for installation shall be provided by IIT MADRAS at no charge basis to the vendor. For this, Electricity connection will be provided at single point and further distribution shall be the vendor's responsibility. Vendor shall provide wattage of all the electrical loads required for installation and install all safety and protection devices viz., MCB/MCCB/ELCB/RCCB etc. as per the applicable electricity rules.

### **2g. Civil Works**

Minor civil works are included in vendor's scope of work. Making cut-outs/ penetrations etc. for routing utility piping lines, ducts etc. in the building and making good the same is in the vendor's scope of work. The quoted rates shall be deemed to be inclusive of the costs on these activities.

### 3. ELIGIBILITY CRITERIA

Parties/Vendors/Contractors meeting the requirement by submitting all the documents sought in the EOI released on 25.02.2019 are only eligible to participate in this tender. **Those who have not participated in the EOI and pre-bid technical meeting are not eligible to bid.**

#### 4. TECHNICAL SPECIFICATION

##### SECTION 1: CLEAN ROOMS

The proposed facility comprises of the following Clean rooms as per layout shown in Drawing No. IITM-009041-Layout-01 in EOI. The selected contractor shall design, carry out detailed engineering, Supply, Install, commission and Validate Cleanroom (through independent Clean room certification agency) meeting the following specifications:

**a. CLASS 100 Process area:**

S. No.	Description	Specification
1.	Total Area	165 Sq. feet (approx.) Refer Layout drawing
2.	Room Height	8.0 feet
3.	Room Temperature	22 ± 2 ° C
4.	Room Relative Humidity	55 ± 5%
5.	Room positive pressure (w.r.t atm. pressure)	25 ± 4 Pa
6.	Air flow Pattern	Vertical Flow
7.	Air change Rate	320 ACPH (min.)
8.	Effective Filter Coverage	Minimum 52%
9.	Particle Counts	As per ISO 14644
10.	Intensity of light	Clean Rooms: 500 Lux;
11.	Filters	ULPA filters, U15 grade
12.	Supply Air	Fan Filter Unit with ULPA Filter
13.	Room heat load	5 TR
14.	Return Air system	Dehumidified Air through ducted raiser to plenum from clean room, Balance air through ducted raiser to RAH from clean room for sensible cooling

**b. CLASS 1000 Process area (including Gowning):**

S. No.	Description	Specification
1.	Total Area	1614 Sq. feet (approx.) Refer Layout drawing
2.	Room Height	8.0 feet
3.	Room Temperature	22 ± 2°C
4.	Room Relative Humidity	55 ± 5%
5.	Room positive pressure (w.r.t atm. pressure)	15± 4 Pa
6.	Air flow Pattern	Vertical Flow
7.	Air change Rate	160 ACPH (min.)
8.	Effective Filter Coverage	Minimum 25%
9.	Particle Counts	As per ISO 14644
10.	Intensity of light	Clean Rooms: 500 Lux;
11.	Filters	ULPA filters, U15 grade
12.	Supply Air	Fan Filter Unit with ULPA filter
13.	Room Heat Load	20 TR
14.	Return Air system	Dehumidified Air through ducted raiser to plenum from clean room, Balance air through ducted raiser to AHU from clean room for sensible cooling

c. **CLASS 10000 Corridor:**

S. No.	Description	Specification
1.	Total Area	462 Sq. feet (approx.) Refer layout Drawing
2.	Room Height	8 Feet
3.	Room Temperature	23 ± 2° C
4.	Room Relative Humidity	55 ± 5%
5.	Room positive pressure (w.r.t atm. pressure)	8± 4 Pa
6.	Air flow Pattern	Vertical Flow
7.	Air change Rate	70 ACPH (min.)
8.	Effective Filter Coverage	Minimum 15%
9.	Particle Counts	ISO 14644
10.	Intensity of light	Grey areas : 350 Lux
11.	Filters	HEPA filters, H14 grade
12.	Supply Air	FFU with HEPA filter
13.	Room Heat Load	8.5 TR
14.	Return Air System	Dehumidified Air through ducted raiser to plenum from clean room, Balance air through ducted raiser to AHU from clean room for sensible cooling

## 1.1 CLEAN ROOM WALL SYSTEM

The Clean Room Wall System shall be smooth, cleanable, non-contaminating, flexible, easily modifiable, modular, attractive and air tight.

The Clean Room Wall System shall consist of the following:

### 1.1.1 Wall Panels

- 44 mm thick (nominal) Aluminium Honeycomb core(17.32mm diameter and 0.06 thick cell honeycomb) panel made up of using thermosetting epoxy adhesive with non-outgassing property, studless (non-structural), non-progressive wall system.
- The vertical joints in the panels are to be secured utilizing Aluminium batten strips/Vertical post powder coated matching with clean room wall system.
- All wall panels shall be double skin type having Aluminium skins (min. 0.8mm thick) on outer surfaces with Aluminium Honey Comb Core with Static dissipative protection(**10<sup>6</sup> - 10<sup>9</sup>ohm**) Ohms/Sq. EOS/ESD-S11-1993 supersedes ASTM D257. All wall panels shall have a roll coated polyester instandard designer white colour.
- The wall system must easily accommodate pipe, duct and tool penetration and doors while maintaining its air seal and structural integrity.
- The system must be capable of performing as a free standing wall.
- The wall system is to be held in place, utilizing a gasketed head track (secured to the suspended ceiling) and floor track assembly.
- The height of the outer wall system will be 3.7 M till the true ceiling and inner wall system shall be flushed with clean room height 2.45 M
- All the framing members like head track, floor track, batten strips, corner posts, wall ends, vertical post etc. shall be made of extruded Aluminium in designer white finish matching wall panel system Clean Room Doors
- The Clean Room wall systems shall include all doors completewith all associated hardware.
- The Clean Room doors shall be of 1.5 mm thick Aluminium (Al) construction 6063-T3 grade for both the frame and door, of approximate size 915 mm wide x 2150 mm high, flush configuration, swing type, double skin, Al frame and powder coated matching with clean room wall system, with concealed door closer, handles, lock sets with option of one or both side access,

## 1.2 CLEAN ROOM FLOOR SYSTEM

- Floor of the entire clean rooms shall be covered with homogeneous flexible 2mm thick Static dissipative PVC sheet/roll flooring, of approved make.

- Skirting min 100mm height in the corridor walls
- The static dissipative floor material shall have a Resistance level of  $1 \times 10^6$  to  $1 \times 10^9$  ohms suitable for Clean Room.
- Load carrying capacity of the material shall be 750PSI (min.) confirming to BS2050.
- The joints shall be welded by thermo chord weld. The flooring shall include providing and laying (P/L) suitable copper strip (foil) grid of size 10' x 10' (approx.) or as recommended by manufacturer and connecting to the earthing. Contractor must include minor civil work to accomplish this task.
- Work includes preparation of existing surface (with tile flooring, compatible for clean room application) floor levelling material so as to make the surface free from any undulations, fixing the PVC sheet roll with conductive adhesive (water based) of approved make (Fevicol SR 505 or as per manufacturer's recommendation) sealing up the joints with fuse welding as per manufacturer's specification.

### 1.3 CLEAN ROOM CEILING SYSTEM

Clean Room Ceiling System shall comprise of ceiling grid, FFU (ULPA Filters), FFU (HEPA filters), Ductwork, Return air raisers and Lighting, clean gas based Fire suppression system.

#### 1.3.1 Ceiling Grid

- The clean Room ceiling system shall provide rigid frame work to install the FFU (ULPA filters) in Clean Rooms and FFU (HEPA filters) in corridor area. The ceiling grid shall be heavy duty with walkover capability.
- The ceiling grid shall be 60 +/- 5 mm heavy duty, inverted "T" grid system with MOC of Aluminium extrusion 6063-T3 and height of the Grid shall be 70 +/- mm.
- The ceiling grid shall be extruded aluminium construction with white powder coated to match the clean room wall system.
- The grid system shall include "hold-down" devices, to be used for all Fan filter units ceiling modules and blank ceiling panels and hardware to be used at all joints and suspension points.
- The ceiling grid size shall be of standard size i.e. 1200mm x 600mm to accommodate the filters / Blank ceiling panel etc.
- Ceiling grid shall comprise of individual ceiling lengths interconnected by cruciform sections which allow connections through grid made up of zinc Die cast for sprinklers, wiring etc.
- The ceiling grid should provide a leak proof filter grid system.
- The grid shall be designed for gasket seal type ULPA filters & HEPA filters.
- Lighting shall be mounted on to the ceiling grid (T5).



- Blank ceiling panels, as required, shall be provided in the ceiling grid.
- All Blank ceiling panels shall be of 8mm (minimum) thick aluminium Honey Comb, with aluminium facing the finish to the blank ceiling panels shall match the Clean Room wall system.
- The grid system shall be suspended utilizing M8 (minimum) threaded rod and turn buckles (for levelling) with lockingnuts.
- The overall ceiling grid shall be levelled within  $\pm 1.5\text{mm}$  in 3m and not over  $\pm 2.5\text{ mm}$  throughout the room.
- The ceiling grid shall accommodate airtight seals around all penetrations including fire sprinklers (if opted by IITM), electrical lines etc. The System shall be pre-drilled, permitting assemblies to be easily carried out in the field.

### 1.3.2 ULPA Filters

- The Clean Room (class 100 and Class 1000) ceiling system shall include Fan filter unit with replaceable ULPA filter ceiling modules and Corridor (class 10k area) shall include Fan filter unit with HEPA filter ceiling modules.
- The Fan filter unit will be used as terminal air distribution device. The air supply negative plenum shall have fan filter units.
- The FFU shall be U15 class of ULPA filters as per EN1822 with an efficiency of 99.9995% at MPPS for class 100 and class 1000 Clean rooms and H14 HEPA filters as per EN 1822 with and efficiency of 99.995% at MPPS
- The design Air velocity through filter shall be 0.45m/s with IPD of  $110\pm 5\%$  Pa or better with static pressure of the blower motor assembly shall be 415 pa.
- The frame of the Fan filter unit shall be of Extruded Anodized Aluminium construction.
- The filter media shall be Glass Fibre with hot melt separator.
- The filter shall have expanded sheet metal face guard on upstream and downstream. The face guard shall be powder coated in off-white colour.
- The filter shall be having endless polyurethane D-profile, Liquid pour to solid in extrusion profile seal at the outlet.
- All the filters shall be individually tested according to EN1822 and computerized scan test report should accompany each filter.
- The filter shall be held in place utilizing 'hold down' devices with the Ceiling grid using channel on the filter top and T-bolts in the ceiling grid pressing the filter against ceiling grid.

- All filter modules shall be complete with 10micron pre-filter at air inlet.
- Top sheet should be of G.I./Aluminium single piece drawn with seamless neck. In case, neck is not seamless, neck joint to the top sheet be a proper leak proof joint and with the capability of supporting a person standing on the top surface.
- Filter media shall be bonded to extruded aluminium cell sides.

### 1.3.3 Lighting

- The envisaged Lighting level in clean Rooms is 500 Lux and 350 Lux in grey areas, at 80 cm above the floor.
- Vendor to design the lighting layout for clean rooms and grey areas to achieve the prescribed lighting levels and submit for approval

### 1.3.4 General

- Each ULPA filter module installation shall be handled by no less than two (2) persons at all times.
- All individual ULPA filter modules shall be packaged (at the factory) in polythene bags and heat sealed after certified factory scanning procedures.
- Primary support steel required for Clean Room ceiling suspension System is also included in the scope of work

### 1.4 AIR SHOWER

- Supply, Installation, Testing and Commissioning of Air Shower at the location shown on the Drawing is included in the Scope of Work.
- Dimension of air shower shall be 1.5m x 1.5m (approx.).
- Material of construction of Air shower shall be SS304.
- Air shower shall be compatible for Clean Room Class 100.
- Door interlocking arrangement should permit opening of only one door at a time. During operation, neither entrance nor exit door should be operated. A lock switch for overriding the electronic control system ensuring manual operation should also be provided.

### 1.5 PERFORMANCE TESTING OF CLEAN ROOM

- Certification of Clean Rooms shall be done through an experienced “independent” agency to be engaged by the Contractor and approved by IIT MADRAS.
- Tests shall be performed in ‘As- Built’ and “At-Rest” condition in accordance with the testing Procedure specified in ISO 14644.

- The “independent” testing firm shall have experience of having conducted Clean Room testing for certification of minimum 3 (three) Class 100 Clean Rooms in the last 5 years.
- The Clean Room Certification agency shall submit performance testing report for approval of IIT MADRAS.
- In the event of non-conformance to the defined Clean Room parameters, the Contractor shall take corrective action at his cost. The Clean Room certification shall be re-done at Contractor’s cost, to establish conformance to specifications.
- Clean room Testing and certification shall comply to at least the following:
  - a) Clean room testing and certification shall be based on NFPA 318.
  - b) Air velocity measurements, Leakage test, Parallelism test, room pressurization according to VDI 2083 Part3.
  - c) Cleanliness classification according to Fed. Standard 209E/ ISO 14644.
  - d) Sound, Pressure level– Measured at one point per 25 sq. m.
  - e) Uniformity of temperature and humidity. The temp. & Humidity shall be measured at one point per 25 sq. m. The measuring time shall be 10 min. per measurement.

### **RECOMMENDED MAKES FOR CLEAN ROOMS**

S.NO.	DESCRIPTION	RECOMMENDED MAKES
1	Clean Room Wall System	Plascore/Channel system/American Cleanroom Systems/ Modular Cleanroom/Micron
2	Clean room Doors	Plascore/Channel system/ American Cleanroom Systems/Micron
3	Clean Room PVC Floor	Poly Flor, LG, Armstrong
4	Ceiling Grid System	AAF/Plascore/Channel system/ American Cleanroom Systems /Modular Cleanroom/M+W Products/Micron
5	ULPA Filter Ceiling Modules	Camfil Farr/ American Air Filters (AAF)/ Flanders/ Terra Universal/ Freudenberg/Mayair/Micron
6	Blank Ceiling Panels	Plascore/Channel system/ American Cleanroom Systems/Micron
7	Air shower	Terra Universal/Liberty/Micron
8	Temperature and RH Sensor for Clean room	Vaisala / Honeywell / Emerson
9	Positive pressure sensor for clean Room	Rosemount/ Vaisala / Emerson / Honeywell

**Any deviations from above recommended makes should be discussed with IITM and mutually agreed upon.**

## **SECTION 2: HEATING VENTILATION & AIR CONDITIONING (HVAC)**

The contractor shall design suitable Return Air Handler (RAH) / Air handling Unit (AHU) using Refrigerant based system instead of chilled water due to constraints of water on the site.

### 2.1 Variable Refrigerant flow (VRF/VRV) system (high side)

- The Scope of work covers Design, Detailed engineering and SITC of VRF/VRV at the proposed location as shown in the drawing number IITM-009041-AFD-01.
- The VRF should be capable for cater refrigerant to AHU units and the units which will take care of the sensible load of all the clean rooms.
- Units shall be air cooled split type multi-system air conditioner consisting of one outdoor unit and AHU/MAU/RAH units, each having capacity to cool independently for the requirement of the rooms.
- Compressor shall be inverter type controller
- Capable to change the rotating speed to follow variation in cooling load.
- Suitable for 415±10 volts.
- The AHU/RAH/MAU should be provided with Cordless Remote Control as a standard accessory

The refrigerant piping shall be extended up to 100 mm with 50 m level difference without any oil traps.

### **Outdoor unit for VRF System**

- The outdoor unit shall be factory assembled unit housed in a sturdy weatherproof casing constructed from rust proof mild steel panels coated with baked enamel finish and a coil guard.
- Shall have Multiple scroll compressor to obtain 10% to 100% step less capacity control for enhanced Power saving
- Able to operate even in case one of the compressor is out of order.
- Connectable range of AHU/MAU/RAH unit's evaporator shall be designed from 0.8 HP to 10 HP with all the outdoor units as desired by the system.
- Noise level shall not be more than 48db(A) normal operation for ducted type for while high wall and exposed units it shall be 35db(A) measured horizontally in 1m away and 1.5 m above ground
- Modular design with allowed for side by side installation

## **Compressor**

- Each outdoor module shall have a combination of both fixed and variable capacity of scroll type compressors.
- The motor of variable speed compressor shall be a DC reluctance motor driven by smooth sine wave DC inverter.

## **Heat Exchanger**

- The heat exchanger shall be constructed with copper tubes mechanically bonded to aluminium fins to form a cross fin coil. The aluminium fins shall be covered by anticorrosion resin film.
- The System must have sub-cooling heat exchanger further to Condenser to increase refrigerating effect in Indoor units.

## **Fan motor Speed control**

- The condensing unit fan motors to have at least two speed operations to maintain constant head pressure control in all ambient temperatures and modes of operation.

## **Refrigerant Circuit**

- The refrigerant circuit shall include an accumulator, liquid and gas shut off valves and a solenoid Valves.
- All necessary safety devices shall be provided to ensure the safety operation of the system

## **Safety Devices**

- The following safety devices shall be part of the outdoor unit; High Pressure Switch, Low Pressure Switch, Fan Motor Safety Thermostat, Over Current Relay, etc.

## **Oil Recovery System**

- Shall be direct expansion, constructed from copper tubes expanded into aluminium fins to form a rigid mechanical bond.

## **REFRIGERANT PIPEWORK:**

- All interconnecting pipe-work between the condensing unit & indoor units.
- Refrigerant quality seamless copper tubes with brazed connections and the appropriate

distribution joints and headers shall be used. The piping should be routed at site in such a manner, that brazed joints in the Refrigeration Piping are kept to a minimum.

**Joint Orientation:**

- Proprietary distribution refrigeration pipe joints and headers shall be installed in an appropriate orientation to enable correct distribution of refrigerant.

**Cleanliness of Piping:**

- All pipe-work must be kept clean and free from contamination to prevent breakdown of the system. All pipe ends shall be kept sealed until immediately prior to making a joint.

**Pressure Testing:**

- After complete installation of refrigerant piping, it shall be pressure tested and repaired if necessary and further pressure tested to 3,800 Pa, to hold for a minimum 24 hours with dry nitrogen prior to insulating the joints. After satisfactory testing, the refrigerant pipe shall be evacuated and dehydrated to (- 755 MM HG) and held for one to four hours depending on the pipe length.

**Refrigerant Charge**

- Refrigerant charge must be calculated based on the actual length of the refrigerant pipe work. The refrigerant charging process must be carried out with an appropriate charging station.

**Fixing Pipe Work & Electrical Conduit:**

- The insulated refrigerant piping and electrical conduit shall run on GI tray properly supported by GI rods. The exposed tray on terrace shall be covered by open able GI covers.
- OD & wall thickness of copper refrigerant piping shall be as follows:

Size	Thickness	Specification
6.4mm (1/4 in)	22 G	C1220T-O (ANNEALED)
9.5mm (3/8 in)	22 G	C1220T-O (ANNEALED)
12.7mm (1/2 in)	22 G	C1220T-O (ANNEALED)
15.9mm (5/8 in)	22 G	C1220T-O (ANNEALED)
19.1mm (3/4 in)	20 G	C1220T-1/2 H (HALF-HARD)
22.2mm (7/8 in)	20 G	C1220T-1/2 H (HALF-HARD)
28.6mm (1 1/8 in)	18 G	C1220T-1/2 H (HALF-HARD)
34.9mm (1 1/4 in)	18 G	C1220T-1/2 H (HALF-HARD)

## **DRAIN PIPING**

- The indoor units shall have u PVC drain pipe suitable for 10 kg/cm<sup>2</sup>.
- The pipes shall be laid in proper slope for efficient drainage of condensate water.

## **Drain Pipe Insulation**

- Drain pipes carrying condensate water shall be insulated with 6 mm/9mm Nitrile rubber insulation as specified to avoid any condensation.
- The joints shall be properly sealed with synthetic glue to ensure proper bonding of the ends.

## **2.2 Recirculation Air handler (RAH) / Air Handling Unit (AHU)**

The unit shall be designed to maintain the air Dew point of  $11\pm 0.5$  Deg C and DBT of  $22\pm 1$  Deg C, at the outlet of the unit around the year with the outside ambient conditions as under:

Summer	39.4 Deg C (DB) 27.7 Deg C (WB)
Monsoon	28.3 Deg C (DB) 26.6 Deg C (WB)
Winter	18.3 Deg C (DB) 13.8 Deg C (WB)

- The unit shall be packaged Air Handling unit and shall be having following sections:
  - a) Pre filter section-1 (Precooling coil capacity)
  - b) Pre cooling Coil (Capable for Fresh air to maintain required dew point)
  - c) Blower section (Capable for fresh air airflow and Pressure drop across the precooling system)
  - d) Strip Heater (Capable for Fresh air to maintain required dew point)
  - e) Pre filter section 2
  - f) DX cooling coil section
  - g) Fans section
  - h) Micro filter



i) HEPA filter

- Quantity -- One (01) numbers
- Capacity: Each having a capacity of suitable CFM (approx.) of air flow, with a total fan static suitable to withstand the pressure drop of the system.
- RAH shall be of modular construction and of draw through type comprising of pre filter section, fine filter section, cooling coil section and fan section. The frame work shall be of extruded Al sections joined by moulded high tensile reinforced plastic and shall be assembled to provide a sturdy, strong and self-supporting frame work for various sections. Each section shall be complete with its own independent base and mounted on 14G galvanised sheet steel and aluminium die cast channels. Zinc deposition on the GI sheets shall be minimum 120gsm.
- RAH shall be of double skin, with  $43 \pm 2$  mm thick PUF insulation sandwiched panel, 1 mm GI outer skin pre coated and 0.8 mm thick pre coated GI inside. The density of PUF insulation shall be minimum 40 Kg/m<sup>3</sup>.
- The frame work for each section shall be joined together with soft rubber gasket in between to make joints air tight.
- Suitable airtight access doors with Aluminium die cast heavy duty hinges and locks shall be provided for various sections.
- The casing shall incorporate thermal break profile and all other necessary design features to ensure that condensate does not occur during all seasons.
- The RAHs shall be having Sound attenuators at Suction and delivery of RAHs to reduce the sound to  $72 \pm 2$  dB (A).

The detailed specifications of the RAH systems are as under:

2.2.1 CIRCULATION FANS

- Fan Quantity: 2 No. (1 No. for total CFM of Designed AHU and 1 No. for Precooling capacity)
- Fan Type: Direct driven, Plug type centrifugal fan.
- Noise level shall be reduced to  $72 \pm 2$  dB (A) or less by suitable sound attenuators on supply and return airpath.
- Capacity: Suitable CFM as Required for RAH and Precooling.
- Total static pressure: suitable to manage the filter drops across the system.

- Fans shall have backward curved blades.
- Fan blades shall be made of Carbon steel, galvanised or powder coated.
- Motor and fan assembly shall be floor mounted and placed on sections and on vibration isolators to reduce amplitude.
- Motor: Adequately sized TEFC, Squirrel cage induction motor with VFD drive and suitable for 415V  $\pm$  10%, 3 phase, 50 Hz  $\pm$  5% AC power supply.
- The motor shall be of high Efficiency IE3 class as per IS 12615 – 2011.
- Motor shall be compatible for VFD operation.
- Flexible connection fabricated of flame proof fabric attached by screws or bolts at required interval to be provided. Flexible connection to be provided with the sufficient material width to prevent interference with the free operation of the fan vibration system.
- Fan shall be factory statically and dynamically balanced as required to achieve field balance levels.
- Epoxy or PU based coating shall be provided on all the surfaces of ferrous fan housing.
- Vibration measurement shall be made in three orthogonal areas at each bearing location. Where equipment configuration precludes measurement at bearing, measurement shall be made on adjacent routine structure.
- Peak to peak displacement at the rotational frequency shall be measured. Governing displacement shall be at the rotational frequency of fan. Controlling displacements at frequencies other than the rotational frequencies are not in compliance with the balance requirements.

#### 2.2.1 COOLING COILS of RAH & RAH PRECOOLING COILS

- Cooling medium: Eco Friendly Refrigerant with Dew point of 11  $\pm$  0.5 Deg C
- Air handling quantity: Suitable to fulfil the design requirement of Fresh air load and the dehumidified load of all the clean rooms. The velocity across the coils shall not exceed 2.25 m/s.
- Pre cooling Coils shall be of seamless copper tubes with Al fins, Suitable rows deep to manage sensible and latent load of the Fresh air, with 12–13 fins/inch, with copper header, flange connection and SS 304 enclosure.
- RAH Sensible cooling Coils shall be of seamless copper tubes with Al fins, Suitable rows deep to manage sensible load of the clean room, with 12–13 fins/inch, with copper

header, flange connection and SS 304 enclosure.

- Copper tubes shall be 25 SWG and hydrostatically tested for 21 kg per sq. cm.
- Cooling coil condensate tray shall be of 20 SWG SS 304 material.
- Vertically stacked Cooling coils shall have SS 304 drip trays between them and SS pipe drain connection left at the drain tray and finally connected to drain point with suitable trap to check ingress of outside air.
- Accessories: Frame, support, inlet and outlet header.

### 2.2.2 FILTERS

- There will be three stages of filtration for overall capacity of AHU and one stage filtration for Pre cooling coil capacity.
- Pre cooling coil stage: The pre-filters for pre cooling coils shall be of G4 grade as per EN 779, non-woven synthetic material sandwiched between HDPE mesh on both sides and suitable for minimum 2000 CFM with an initial pressure drop of 5 mm WG or less, suitable for cleaning with dry air or water jet.
- First stage: The pre-filters shall be of G4 grade as per EN 779, non-woven synthetic material sandwiched between HDPE mesh on both sides and suitable for minimum 2000 CFM with an initial pressure drop of 5 mm WG or less, suitable for cleaning with dry air or water jet.
- Second stage: Fine filters shall be of F7 grade as per EN779, non-woven synthetic material sandwiched between HDPE mesh on both sides and suitable for minimum 2000 CFM with an initial pressure drop of 6–8 mm WG or less, suitable for cleaning with dry air or water jet.
- Third Stage: Fine filters shall be of H14 grade as per EN779, with efficiency of 99.995% down to 0.3 micron. Filter Media shall be made up Micro fibre glass it shall have Anodised Al frame with a module size of 600mm x 600mm and media shall be epoxy/PU bonded to the filter casing.
- Filters face velocity shall not exceed 2.5 m/sec.
- Filter mounting frame shall be made out of extruded aluminium material. The frame shall be strong enough to withstand the weight of two persons which may climb the frame during the filters replacement.
- Between Filter sections, minimum spacing of 600mm shall be maintained.

- Filters shall be having a quick release mechanism and sealing gasket.
- The filters shall have Al frame with a module size of 600mm x 600mm (preferably).

### 2.2.3 SMOKE FIRE DAMPER

Motorized damper with smoke and fire sensor, complete with frame, supports, actuators, limit switch and other standard accessories, shall be provided at the outlet of RAH. The damper will get closed automatically with the sense of smoke of fire in the duct as well as operated manually during maintenance of the RAH.

### 2.2.4 Heaters

Tubular/strip heaters section with sufficient capacity to maintain the temperature and Dew point of the fresh air.

- The Ambient conditions shall be considered as mentioned in above section to calculate the thermal load
- The heaters shall complete with mounting frame, Thermostat in redundant arrangement, air stat etc.

### 2.2.5 INSTRUMENTATION AND CONTROL

- Temperature and RH sensor to measure the temperature and humidity of the respective areas. Accuracy levels: Temperature: + 0.2 Deg C or better, RH: + 1% or better.
- Positive pressure sensor to measure the positive pressure of the clean room,
- Differential pressure sensor across pre filters, fine filters and HEPA filters.
- Motorised supply and return air damper – interlocked with a smoke sensor and fans with a manual over ride.
- VFDs for RAH fans.
- Dew point, DBT, WBT temperature sensor cum transmitter at outlet of RAH precooling side
- Flow sensor and transmitter at the outlet of the RAH/RAH precooling side.
- DBT, WBT and RH temperature sensor cum transmitter at inlet of RAH Precooling side.
- Differential pressure sensor and transmitter across all the filter banks
- Smoke/fire sensor in the outlet duct of AHU

### 2.2.6 CONTROL PHILOSOPHY

- The temperature of the clean room is to be controlled using electronically operated expansion valve along with RAH / AHU KIT as per the VRF OEM recommendation.
- The motorised return air damper will open when the start command to RAH is communicated. If RAH is off, damper will remain close.
- When the smoke sensor will detect smoke, it will switch off the RAH and will close the motorised return air damper.
- One fan of the RAH system will come online and in continuation to that Pre cooling coil fan will come online.
- With switch-on the system, one fan, VRF system, one heaters will come into line.
- The required value of the dew point of the air at the outlet of RAH will be provided by the Relative Humidity sensors inside the clean rooms based on the on-going RH levels. The Electronic expansion valve of RAH sensible coil / heater steps will be modulated / controlled to achieve the required dew point as under:
- If dew point is above the required value, the Electronic expansion valve in medium temp coil will open/close accordingly.
- The heater steps will be modulated to maintain the DBT of the air at the outlet of RAH dew point of 10 to 12 Deg c.
- Differential pressure (DP) sensor across each filter set will give alarm in case the DP value is more than the set point.
- Flow meter in the main outlet duct will provide the online flow value. In case flow falls below the set value, it will generate an alarm.

### 2.2.7 Ducting and Insulation

- Scope covers design, detailed engineering and SITC of following duct works:
- From the RAHs/ AHUs (Return Air Handlers / Air Handling Units) up to the Plenum space over the clean room ceiling and Return air(dehumidified air) to the AHU/RAH.
- Vanes for mixing of treated Dehumidified air from AHU and Recirculated air from clean room.
- The detailed specifications for the duct work are as under:
- The duct work shall be of GI as per SMACNA and material shall confirm to IS 737.
- Ducts shall be made from GI sheet of lock forming quality.
- The ducts shall be designed for pressure levels with a minimum sheet thickness as per

the SMACNA standards.

- The ducts will be used for clean room environments to meet this requirement, the sheet for manufacturing the ducts shall be totally oil free.
- Velocity for Supply Air shall not exceed 1500 fpm and return air shall not exceed 1000 fpm.
- Ducting shall be complete with dampers, vanes, anchor fasteners, supports, access doors, neoprene rubber gaskets etc.
- All duct reinforcement shall be of GI.
- All the dampers shall be Al construction.
- The duct sections shall be joined with MS Angle flange joints.
- All the edges with minor leaks should be sealed with silicon sealant.
- All the ducts shall be supported with the building structure with GI threaded rods of 10mm dia. and spring isolators of GI or coated suitable for clean rooms.
- Duct inspection window in GI construction to be provided in the main ducts and plenum boxes. The inspection windows shall be leak proof, easy to open/close.
- The ducts fabrication work shall be carried out and installed without dust.
- Tentative air distribution duct layout and duct design is shown in the enclosed drawing.
- Selected vendor shall carry out design, detailed engineering (based on the design parameters viz., Flow, Static Pressure) to work out actual duct sizes and duct routing layout, and submit the drawings including shop floor drawings to IITM for approval before commencement of the duct work fabrication and installation work. The drawing shall be co-ordinated with other services in the area.
- The supply air duct exposed to the atmosphere condition requires to be insulated using
- Aluminium faced Closed Cell Nitrile rubber, Class 'O' fire rating, 25 mm thick with a density not less than 50 Kg/m<sup>3</sup> with UV protection. All the joints shall be sealed with 50mm thick Al tape
- Plenum shall be closed using 50 mm thickness PIR Sandwich panels made of an insulating component in rigid polyurethane foam and laminated on one side with re-inforced Aluminium foil and the other side Aluminium foil embossed. Standard length of panel should be 4000mm and width of 1200 mm. Fire properties with Class 0.

Thermal Conductivity of 0.021 w/mk. Density of 48 +/- 3 kg/m3.

- The PIR panels shall cover the beams, columns, True ceiling and other utilities in the plenum.

### **SECTION 3: ELECTRICAL SYSTEMS**

#### General Design Consideration

##### a) System configuration

- I. Voltage Supply: 415V +/- 10%
- II. Frequency :50Hz +/- 5%
- III. No of Phase and grounding: 3 Phase & Solidly ground earth
- IV. Power Distribution: A.C., 3 Phase 4 wire for 3 Phase system, 1 Phase 3 wire system

##### b) Code & Standards

All electrical equipment and accessories to be furnished, installed and commissioned under scope of these specifications shall be designed, manufactured, tested and installed in accordance with relevant Indian Standard Specifications (ISS), Indian electricity rules and any other applicable regulations.

#### 3.1 Scope of Supply

Contractor must design the electrical system to meet the requirement of clean room loads and load of the utilities. Design of electrical system must be submitted as a part of technical bid and presentation.

Following equipment must be included in the scope of electrical package

- a. Electrical panels(MCC) / MCB DB's
- b. Cables / Wires: FRLS grade cable for power and lighting distribution
- c. GI Conduits, earthing materials, double/single compression brass cable glands and cable lugs (Al & Cu as required), cable ties, cable/wire identification tags required for installation and maintenance of trouble free operation of the system and accessories.
- d. Lighting fixtures for clean room, grey area and other areas as per the lux level specified above.
- e. Trunking and raceways for power and LAN cables with accessories
- f. All relevant drawing, data, catalogues with instruction and trouble shoot manuals,

#### 3.2 Scope of Service:

- a. Providing skilled & unskilled Labor, experienced and qualified engineers and supervisor, erection tools & tackles, testing tools & equipment, supplies, consumables and hardware and transport for Installation, testing and commissioning of all supplied materials in a timely and efficient manner complying with the technical specifications including drawings.
- b. Following drawing /documents shall be submitted at the time of acceptance of the system.

- I. Electrical single line diagrams for complete electrical system starting from electrical panel power and lighting DBs which includes Illumination system, Power Distribution system, Fire Detection system, Network System, telephone and paging system.
- II. Foundation drawing of all floor mounted equipment (Electrical panels, Network Racks etc), Ceiling mounting details for lighting fixture/speakers/detector etc and any other relevant drawing requires for repair & Maintenance.
- III. Layout drawing with dimension of all electrical equipment under the bidder's scope.
- IV. Make, type and catalogue of lighting fixture, speakers, detector, raceways, Trunking and related accessories along with technical leaflets, data sheets, polar curve etc to be provided by the vendor. The contractor shall offer recommended makes mentioned in this document.
- V. Equipment data sheets furnishing guaranteed performance figure for each type of equipment.
- VI. Test certificates, test results for each type of equipment.
- VII. Checks list and test to be conduct during erection, testing & commissioning of the individual equipment.
- VIII. Wiring diagram for Lighting, power, Fire Detection system and LAN.

### **3.3 Technical Specification of Major Items:**

#### **MCC Panel**

Technical scope of the work includes Design, Fabrication, Supply, Installation, Testing and Commissioning of electrical panel. As a part of technical scope, contractor must submit SLD for approval and system must be made as per approved SLD and panel drawings.

- a. Panel shall be indoor or outdoor as per space availability, metal clad, air insulated floor mounted extendable to side, single front construction, front wired, front connected.
- b. Minimum thickness of sheet metal used shall be 2 mm and panel shall conform to IP54 protection.
- c. The working height of the Panel shall be limited as per standard engineering practices.
- d. The design should be fully compartmentalized with metal partitions between compartments. All doors shall be gasketed. Each vertical section shall have removable back cover.
- e. All switches, indicating lamps, push buttons, measuring instruments shall be flush mounted.
- f. A full height vertical cable chamber with cable supports shall be provided in each section to facilitate unit wiring. Cable chamber shall be sized to accommodate all cable and shall have removable covers. A horizontal wire way extending the entire length shall be provided at the top of panel for inter panel wiring.
- g. Panel shall be with minimum 75mm high base MS channel frame.
- h. Lifting hook shall be provided at each section for easy transportation.



- i. Different compartments of the panel shall be provided with explosion vents or similar safety arrangements in the panels to let out gases under pressure generated during event of any fault inside the panel.

### **Bus and Bus Taps**

- a. The main bus and connections shall be of high connectivity Aluminium/ Aluminium alloy, sized for specified current ratings with maximum temperature limited to 85 C. i.e. 35 C rise and ambient 50.
- b. Neutral Bus shall be of the same size as of the main bus.
- c. Separate vertical bus bars shall be provided for each vertical panel.
- d. All bus connections shall be silver plated. Adequate contact pressure shall be ensured at bus connections by means of two bolt connections with plain and spring washers and lock nuts.
- e. Bus bar and connections shall be fully insulated for working voltages with adequate phase/ground clearances. Insulating sleeves heat shrink type for bus bar and shrouds, removable moulded type joints shall be provided. Bus insulators shall be flame retardant.
- f. Bus bar shall be color coded for easy identification and so located that the sequence R-Y-B shall be from left to right, top to bottom or front to rear when viewed from the front of the assembly.
- g. All buses and connections shall be supported and braced to withstand the stresses due to maximum short-circuit current and to also take care of thermal expansion.
- h. Bus Bar should be connected in such a way that it can be dismantle/assemble while separating different section of the panel.
- i. Shrouds of transparent sheet on the exposed bus in cable alleys, for adequate safety measure.

### **Control Module**

- a. Fixed type control module shall house the control components for a circuit.
- b. The equipment layout shall provide sufficient working space in between the components and subject to SCL approval.
- c. Each control module shall be equipped with Relays. Contractors etc. for operation of Drives from local, remote and FCMS.
- d. Vendor to provide the potential free contact to facilitate remote and local operation, each drive module shall have auto/ manual selector switch and each drive module shall be wired up to the terminal block for local/auto selection, ON, OFF, trip feedback to SCL's control station and ON/OFF command to provide potential free contacts on terminal block.

### **MCCB**

- a. The MCCBs should be extra current limiting type with trip time of less than 10 msec under short circuit conditions. The current limiting action should be achieved with repulsion principle. The MCCBs should preferably have an anti-reclosing feature.
- b. The MCCBs should be 3 P + N.
- c. The Incomer MCCBs should have Microprocessor release having adjustable overload and Short circuit protection with Service short circuit breaking capacity (Ics) of not less than 50kA rms at 415 Volts 50Hz AC. The service breaking capacity should be equal to ultimate breaking capacities (Icu) (i.e. Ics= Icu=100%).

- d. The outgoing MCCBs should have a Service short circuit breaking capacity (Ics) of not less than 50 kA rms at 415 Volts 50Hz AC. The service breaking capacity should be equal to ultimate breaking capacities (Icu) (i.e. Ics= Icu=100%). The release should be thermal magnetic having adjustable overload and short circuit.
- e. MCCBs shall be with rotatory drive kit and spreader terminals.

**Fuses**

- a. Fuses shall be HRC, preferably link type.
- b. Fuses shall be complete with fuse bases and fittings of such design so as to permit easy and safe replacement of fuse element.

**Contactors**

- a. The contactor shall be 3 pole, air break type with non-bouncing silver/ silver alloy contacts.
- b. Contactor shall be provided with adequate auxiliary contacts rated for 10Amps @ 240VAC for interfacing with control scheme.

**Control and Indications**

- a. Push buttons will be heavy duty, oil tight, and push to actuate type with integral plate marked with its function
- b. Each push button shall be provided with 2NO+2NC contacts rated for 10Amps @ 240VAC.
- c. Lamps shall be LED type rated for 240V AC. Lens and lamps shall be replaceable from the front.

**Meters**

- a. All indicating instruments shall be digital, Switchboard type with accuracy class +/- 2% full scale.
- b. Voltmeter 0-500V AC shall be provided before the incomer switch and shall be protected through control fuses.
- c. Ammeter of suitable range shall be provided at incomer.
- d. Selector switches shall be furnished for metering as per SLD.

Approved List of makes for Electrical System:

MCCB	L&T/Siemens/Schneider
Push button	Siemens
Selector Switch	Salzer
Fuse	L&T/Schneider/Siemens
Timer	L&T/ Siemens/Schneider
Control Transformer	AE/IMP/Indcoil
Terminal Block	Elmex
Meters	Schneider/Conzerv
CTs & PTs	Kappa/Alpha
Contactors	L&T/ Schneider/Siemens
Indications	Indications Siemens
Relays	Relays:

	Schneider/Siemens/PLA
MCB	L&T/Schneider/Siemens
Cooling Fan	REX/Sunon
VFDs	Allen Bradley
Thyristor module	DYDAC
Cooling Fan for MCC	REX/Sunon

**Any deviations from above recommended makes should be discussed with IITM and mutually agreed upon.**

#### **SECTION 04: SAFETY AND FIRE FIGHTING SYSTEM**

**1. All the clean room zones must be equipped with Oxygen depletion sensors and monitoring system. Oxygen level monitoring system must include following units:**

- a) Oxygen depletion sensors inside each clean room zones
- b) Alarm hooter inside the clean room and in the corridor
- c) Visual display unit inside and outside the clean room
- d) Must be connected to BMS and other necessary interlocks

#### **2. Fire Fighting & Smoke Detection System**

Fire/Smoke detection and fire suppression system for complete facility should be provided:

- a) Automatic fire detection and suppression system to be installed in the class 100, class 1000, class 10000 and service bays for A, B and C class of fire.
- b) The system should consist of automatic control and display panels, audio and visual alarms, smoke and heat detectors, UV-IR detectors, Clean room compatible suppressant system.
- c) The suppressant should be a clean agent and have a short environment lifetime and zero ozone depleting potential. The material should also be ISO certified. Please mention the discharge time of the suppressant.
- d) Provision of manual trigger of suppressants to be present.
- e) The system should be designed for modular and/or manifold use.
- f) Fire panel should be sub-divided into zone system.
- g) The design/installation/commissioning/testing of the fire detection and suppression system should be as per NFPA standards.
- h) Pipes and manifolds should be of mild steel, duly painted, should have no particulate material and pressure tested. The spray nozzles in the yellow and non-yellow rooms should be of appropriate clean room compatible material.
- i) The contractor should show a free live demonstration of gas flooding by simulation.

#### **SECTION 05: Building Management System**

A complete BMS control system (with both auto and manual operation facilities) should be provided for control to HVAC, Fire detection and suppression system, Safety System, HVAC Chiller. It must be able to monitor all major areas of cleanroom, service bays and the utilities.

## **SECTION 06: Access Control, CCTV, Public Addressing System, LAN**

1. **Access Control:** A networkable access control system must be provided and installed. Requisite number of card readers for accessing the main entrance, entry to service bay and exit doors of the cleanroom should be provided. For data logging, the card readers should be interfaced with BMS system. Requisite number of card readers, hardware and software (for creation of accounts and access control) must be provided with the system. At least 50 access cards must be supplied during commissioning
2. **CCTV:** The CCTV system should be IP based system with 10 monitoring cameras units coupled to a low voltage weatherproof external PIR motion detector designed to simultaneously or individually control switchers and video recorders. It must have the following features:
  - a) Should enable 360 degree view of all areas of cleanroom as well as the service bay
  - b) Should enable locating incident video easily, and then transfer the same to external storage via USB/LAN
  - c) Should be capable of displaying live view or playback video HDTV or monitor via HDMI/VGA connector
  - d) DVR Input: 10 channels
  - e) DVR output: HDMI, VGA
  - f) Display resolution: 1080p
  - g) Recording mode: Manual/Motion/Schedule
  - h) Camera: Viewing angle better than 62 o , Night vision distance better than 100 ft; IR filters are necessary
  - i) Frame rate: Up-to real-time 24 fps or better
  - j) Compression H.264
  - k) The components (viz. Monitors, cables, HDD, computer, etc.) necessary for stand-alone operation of the CCTV system are within the scope of the bidder. System must be capable of storing incident video for upto 2 weeks or better
3. **Public Addressing System:** A public address system must be provided within the facility with speakers in appropriate locations so as to enable clear and audible announcements in all areas of cleanroom including service areas. The public address announcements can be made from a common location.
4. **LAN:** Upto 20 LAN ports and 2 Wi-Fi Access Points must be provided within the cleanroom. The network cables and switches for LAN/Wi-Fi must be included by contractor.

## **SECTION 07: Warrantee:**

Comprehensive warrantee for a period of Three (3) years for all equipment and system supplied and workmanship.