TECHNICAL SPECIFICATIONS FOR CONSTRUCTION, TESTING, COMMISSIONING AND VALIDATION OF TB CONTAINMENT LABORATORY

SCOPE OF WORK:

The Scope of work involves' Construction, Testing, Commissioning and Validation of TB Containment Laboratory & associated works in compliance with WHO and CDC, USA guidelines as minimum and its maintenance'.

The scope of work shall include design, complete construction and establishment of TB Containment facility including minor civil works, electrical works, public health engineering works etc. complete in all respect. All the fixed equipment and systems like pass box, HVAC system and its components (including A/C plant, air handling, exhaust systems, filters, controls etc.),computers, laboratory workstations, uninterrupted power supply system, door interlocks, access control system, fire detection & alarm, system, surveillance systems CCTV with remotely placed monitor control, fire extinguishers and any other equipment/systems essentially required to meet the intent and purpose of setting up of TB Containment laboratory shall be provided and included in the scope of works. Items/equipment like scientific laboratory instruments, bio safety cabinets, autoclaves and other equipment such as freezers, refrigerator, incubators, centrifuges etc. will be available at/ procured by the site. Architectural layout of the lab will be provided (including of the TB Containment Lab and placement of equipment and power load requirement)- see Annexure 1

The scope of works shall also include:

a) Supply and laying of the required power supply cables from the existing electrical room (LT Panel room) up to the proposed TB Containment Lab for its power supply.
b) Extension of existing LT panel by providing feeder panel with switchgears of required capacities to meet the power requirements of TB Containment Lab. Dedicated earthing for the TB Containment Lab shall be installed as required by the vendor.
c) Power required for the TB Containment Laboratory shall be tapped from the existing feeder lines (through its expansion and laying of required power cablings) or panels. All necessary arrangements like extension of existing feeder/bus bars, laying of power cables etc. for tapping of required power shall be made by the contractor. Supply should be three phase and with proper earthing and required capacity of 440V for AHU Unit for TB Containment lab.
d) Extension of existing water supply lines up to the TB Containment Lab to meet its water supply requirements. Supply and erection of water tank 750-1000litres in case of inadequate or absence of water supply for emergency shower and eye wash stations.

PRE-REQUISITES for the Site to comply

1. **Power required for the TB Containment Laboratory** shall be tapped from the existing feeder lines (through its expansion and laying of required power cablings) or panels. Supply should be three phase and with proper earthing and required capacity of 440V for AHU Unit for TB Containment lab. Adequate provision for power back up in the form connection to a green source for energy back up or Diesel Generator Set of about 120-150 KVA capacity (to be re-calculated based on requirement at time of procurement/assessment) is a must to keep lab functional all time.

2. **Water supply to the TB Containment Laboratory** shall be provided through the existing Water distribution network in campus.
3. **Strength of existing building structure-** Space identified for TB lab should be strong enough to withstand local climate/ environmental hazard. The institute will require to take care of seepage issues in the building if extensive (minor issues can be taken care by vendor)

CRITICAL CONSIDERATIONS TO BE FOLLOWED IN DESIGN:

The proposed TB Containment Laboratory shall be constructed in accordance with CDC, WHO and RNTCP and other international guidelines as minimum (see later in document reference materials used). Some of the minimum essential critical considerations for construction of the proposed TB Containment Laboratory shall be as under:

1. Restricted and controlled access shall be provided for entry into the laboratory.
2. The HVAC systems shall be provided to maintain the desired inside conditions in terms of temperatures, humidity conditions, air filtration requirements. Unidirectional airflow to be achieved by appropriate negative differential pressures and a minimum of 6-12 Air changes per hour to be achieved. Air from the laboratories, shall be exhausted only after appropriate filtration (HEPA filters) as per guidelines/standards. Redundant exhaust systems shall be provided for Tb Containment lab room. Leak proof dampers with provision to prevent backflow of air shall be provided in supply and exhaust air systems of laboratory rooms for isolation of rooms/zones.
3. Interiors of the TB Containment Lab- The internal building finishes shall be monolithic, impervious, non-particle shredding, chemical resistant to phenol, hypochlorite, etc. cleaning and suitable to withstand chemical use during decontamination /fumigation. Modular false ceiling panels should be made for Clean Room application. **Flooring** inside the TB Containment lab shall be of self-levelling industrial epoxy and cleanroom compatible.
4. The door interlocks, exhaust blower of BSCs, shall be provided with online, un-interrupted power supply system with minimum 30 minutes power backup.
5. Safety measures for fire and electricity shall be provided
6. Emergency shower, Eyewash station facility will be provided to address emergency spill situations. Emergency Exit door with panic latch door from the TB Containment Laboratory shall be provided

GENERAL CONSTRUCTION

The drawings shall be submitted by the contractor for review and approval by the client/ Consultant. However some of the critical elements of the building and features are highlighted here under:

a) **Building Planning Concept**:
The proposed TB Containment laboratory building shall be constructed on primary and secondary containment barrier system concept.

b) **The Primary Barriers**:
Bio-safety cabinets (Class-IIA2) with thimble or canopy ducting, pass box, etc. shall constitute the primary containment barrier and shall be placed suitably to contain the contamination.

c) **The Secondary Barriers**:
The laboratory building, air management and control system shall provide the secondary barrier system. Sustained directional airflow from “lesser contaminated area" towards “potentially higher contaminated areas” shall be achieved through differential pressure in areas/zones.

d) **Building Construction and Finishing**:
The internal building finishing shall provide impervious and monolithic construction and all materials used for internal construction and finishing shall be non-particle shredding type and chemical resistant.

Joints like wall to wall, wall to floor and ceiling to wall shall be provided with covings for easy cleaning. All joints and penetrations in the building shall be sealed with silicon sealant. The drainage and effluent piping system from the TB Containment Lab areas shall be of chemical resistant materials.

DETAILED SPECIFICATIONS

1. **Restricted and controlled access** shall be provided for entry into the laboratory.
   - Access control system for entry / exits should be provided. 20 numbers of card to be provided to each lab.

2. **HEATING VENTILATION & AIR-CONDITIONING (HVAC) SYSTEM:**

i. The entire laboratory shall be air-conditioned. The HVAC systems shall be provided to maintain the desired inside conditions in terms of temperatures, humidity conditions, air filtration requirements, room/zone pressure requirements and air change rate.

ii. Housing/Casing of AHU unit: Air Handling Units shall be of sectionalized constructions with an under frame of extruded heavy aluminium profiles. The under frame shall be mechanically strong and shall take double skinned insulated panels. The powder coated panels shall consist of 0.8 mm galvanized iron outer skin and 0.63 mm galvanized iron inner skin with 13 mm thick injected PUF insulation in between two panels. The AHUs shall be with true thermal break. There should not be any projections inside the AHUs and the covings has to flush with the side panels. Air tight access panel with suitable neoprene gaskets shall be provided in the fan section, coil and filter section. Similar gaskets should be used at all other joints of the AHU and its ducting. Units meant for indoor locations shall be specially designed to meet the arduous and corrosive atmosphere.

iii. Platform for AHU: In places where firm, even and concrete surface not available, the same will have to be constructed (masonary work) for the entire surface area which will be enclosed within AHU shed.

iv. There would be independent supply and exhaust system with unidirectional inward airflow and 100% exhaust.

v. **Supply Unit:**

a. Air Conditioning Plant: The Air-Conditioning plant (of suitable capacity based on requirements of the lab's AHU) shall be with Direct Extension (DX system). The condenser unit shall have multiple compressors such that at least one compressor shall be as standby. The AHU shall comprise of Cooling Coil Section with 8 row deep DX coil, necessary component, 18 gauge SS 304 drain pan with 13 mm thick closed cell self-sticking polyethylene insulation, having slope at one side, drain connection from other side. Inlet and outlet coil nipples shall be sealed against unit casing by means of neoprene gaskets. Alternately, the cold air from the existing Central Air-Conditioning plant may be taken.

b. The laboratory rooms will be supplied with pre-conditioned (heating, cooling) fresh air by a mechanical ventilation system. Temperature inside the lab shall be maintained at 22°C±2.

c. The air will be cooled to 12ºC - 13ºC then reheated with an electric duct coil to maintain required space conditions. This is required to maintain proper humidity conditions in the lab and humidity level should be maintained at 60±10%. To heat the air in the winter, an electrical heater unit (of adequate capacity) would be planned. This heater will be the same heater that will function as dehumidifier unit in summer.

d. Design of Supply air system: One variable speed supply fan of Gebhardt/ Krugger/ Nicotra or equivalent reputed OEM (Original Equipment Manufacturer) should be installed. Fan is designed for the whole required supply air amount (100% Redundancy). The fan shall be backward (or forward) curved centrifugal double inlet multi blade with optimized selection for low noise and high efficiency. Fans shall be statically and dynamically balanced for vibration free operation. Fans shall be enclosed in galvanized steel scroll cases and shall be driven by a variable frequency drive (VFD). The VFD should be pre-set programme for five different varying fan speed with selector switch for user operation. Fan and motor assembly shall be mounted on vibration isolators eliminating the need for external vibration isolators. Provision shall be made for belt tensioning. Motor should be of required capacity of Crompton Greaves/ Siemens/ ABB or equivalent of reputed OEM make. The fan should not exceed noise level of 75 db (A) from 1 m distance. A spare motor shall be provided in case

of any burn out/breakdown for immediate repair/replacement. 4-5 spare fan belts shall also be provided which can be used for replacement in case of wear/tear.

e. Volume Control Dampers: The distribution of air is planned via air inlets in the laboratory rooms. To control the air volume flow variable volume boxes in the supply air ducts are planned (at mouth of supply, after blower and after fine filter). The housing for these dampers (in fact all) will be of extruded aluminium, Low Leakage Aerofoil design. A constant volume mechanical control damper valve will be installed which will also be easily accessible for corrective purposes. The supply air needs to be constant to maintain the proper air change rate.

f. A wire mesh screen to prevent entry of rodents/birds/insects, etc. will be placed in front of the damper at the mouth of supply.

g. Filters:

- There will be three sets of filters- coarse filters at mouth of supply and fine filter after blower motor of supply unit and HEPA filter housing in the supply ducting at a distance of about 500mm from fine filter unit.
- Coarse filter will be in outside fresh air pre-filter section and will be G4 washable filter (50 mm deep) class having average arrestance of 85-98% for 10 microns size as per EN779 2002, after damper at mouth of supply (as mentioned in volume control damper).
- Fine filters will be F7 filter (300 mm deep) Average Efficiency 85-95% for 1 micron size as per EN 779 2002 standards and placed after coarse filter before air goes into DX system.
- F-7 filter to be provided with test port elbows (pre and post) to put in magnehelic gauges tubing for measure differential pressure across it. These test port elbows will remain sealed/closed in routine condition.
- The HEPA filter plenums (Containment Housing) shall be made in SS 304 (14 gauge) with air tight and leak proof construction. The HEPA filter plenums shall be provided Isolation dampers at Inlet and Outlet and shall have provisions and facility to carry out on site HEPA filter scanning, testing and validation, magnehelic pressure gauge to monitor pressure drop across the HEPA filter, fumigation ports to allow IN-SITU decontamination of HEPA filters and Bag-In-Bag-Out facility for change/replacement of filters. The quantity of HEPA filter should be provided on the basis of supply air room volume, length of duct.

h. Ducting: Ventilation ducting shall be made out of minimum 24 gauge GI sheet, all the ventilation ducting shall be leak proof and with thermal insulation (the colour of insulation material will not be black). This insulation is made of nitrile rubber or glass wool. The GI duct should be fabricated as per SMACNA standards. To prevent air leakage, all the lateral joints and flanged joints of GI ducting should be sealed using silicone sealant.

i. Ducting design will be submitted by the vendor along with details of bends, dimensions of the duct at various places from AHU to the TB Containment Lab, number of inlets/outlets planned, etc. which would be suitable from the lab being upgraded. It will have to be consulted with lab design expert and the lab i/c and approved before construction is carried out.

j. Noise Reduction: To avoid the allowed noise level, sound absorber will be installed on the housing of the AHU.

vi. **Exhaust System**

a. Design of Exhaust Air System: One variable speed exhaust fan of Gebhardt/ Krugger/ Nicotra or equivalent reputed OEM (Original Equipment Manufacturer) should be installed. The fan shall be backward (or forward) curved centrifugal double inlet multi blade with optimized selection for low noise and high efficiency. Fans shall be statically and dynamically balanced for vibration free operation. Fans shall be enclosed in galvanized steel scroll cases and shall be driven by a variable frequency drive (VFD). The VFD should be pre-set programme for five different varying fan speed with selector switch for user operation. Fan and motor assembly shall be mounted on vibration isolators eliminating the need for external vibration isolators. Provision shall be made for belt tensioning. Motor should be of required capacity of Crompton Greaves/ Siemens/ ABB or equivalent of reputed OEM make. The fan should not exceed noise level of 75 db(A) from 1 m distance. A spare motor shall be provided in case of any burn out/breakdown for immediate repair/replacement which can be done by local engineer. 4-5 spare fan belts shall also be provided which can be replaced by local engineer in case of wear/tear.

b. Exhaust Air System will be designed such that it ensures directional air flow by differential pressure gradient across different rooms and maintains minimum 6-12-fold air change per hour in the lab area (including separate exhaust ducting for BSCs installed).
c. Ducting: Exhaust ducting (like supply) shall be made out of minimum 24 gauge GI sheet. The GI duct should be fabricated as per SMACNA standards. To prevent air leakage, all the lateral joints and flanged joints of GI ducting should be sealed using silicone sealant. All the ventilation ducting shall be leak proof and with thermal insulation (the colour of insulation material will not be black). This insulation is made of nitrile rubber or glass wool
d. Air Filtration: The exhaust air filter handling systems shall be provided with HEPA Filters such that it protects the maintenance staff from acquiring any infections while handling/replacing the filters -Bag in Bag out system (BIBO). It is essential that the maintenance person wears PPE while doing so. The HEPA filters will be located prior to exhaust unit at a place which is easily accessible and has adequate space for BIBO to function effectively. The HEPA filter housed in BIBO should have efficiency of H13 or H14 tested as per EN1822 at MPPS (Maximum Penetrating Particle Size). The HEPA filter plenums (Containment Housing) shall be made in SS 304 (14 gauge) with air tight and leak proof construction. The HEPA filter plenums shall be provided Isolation dampers at Inlet and Outlet and shall have provisions and facility to carry out on site HEPA filter scanning, testing and validation, magnehelic pressure gauge to monitor pressure drop across the HEPA filter, fumigation ports to allow IN-SITU decontamination of HEPA filters and Bag-In-Bag-Out facility for change/replacement of filters. HEPA Filters of 99.99% efficiency would be used in all exhaust. All the HEPA filters should have 0.3µm filtration.
e. Supply Air system to be electrically interlocked (fans, dampers, electrical) with exhaust air system, to prevent sustained positive pressurization.

vii. **Appropriate negative differential pressures** (for e.g. the negative pressure room where bio safety cabinets are placed shall be -12.5 Pa (-0.05" WG) relative to the anteroom, anteroom shall be -12.5 Pa (-0.05" WG) relative to change room if planned, and the change room shall be -12.5Pa (-0.05" WG) relative to the outside atmospheric pressure. Manual differential pressure gauges shall be placed outside Change Room, Ante room and main lab. Pressure balancing system to maintain room/zone pressures within specified set limits shall be provided which should be done through manual control. Magnehelic gauges used will be of DYWER/ WAREE/ WIKA or equivalent reputed OEM (Range -50 to 0 to +50 Pascals) with supporting SS Hardware with Top plate & suitable Box SS 304 including tubing & suitable fitting & accessories in wall panel.

viii. **Fire Dampers for supply and exhaust air:** As a safety feature, fire dampers shall be provided in both supply as well as exhaust duct. In supply system it will be in between variable damper and inlet (but at an accessible point from outside). In the exhaust system it will be located in exhaust ducting coming out of the building and prior to BIBO assembly at an accessible point from outside. These dampers are curtain type made of SS interlocking blades with fusible link which melts at 74°C

ix. **Leak proof dampers** with provision to prevent backflow of air shall be provided in supply unit (after blower motor and before volume control damper) and in exhaust unit (in between blower motor and volume control damper). It is made of SS blades with neoprene gasket

x. **AHU SHED:** It will be required at sites where AHU is installed on roof/ outside the lab building. AHU shed with provision for fencing, door with lock-key arrangement.
a. Framework vertically made of M S Square Pipe frame: 2 Inches X 2 Inches, 16 Gauge
b. M S Fencing with wire mesh: ½ inch X ½ inch
c. Supporting Structure M S Angle: 50 X 5 mm
d. GI pre-coated corrugated profile roof sheet: 0.5 mm thick duly supported with J Hook.
e. 10 SWG with provision of door with lock and key

AHU Shed with fencing should be duly enamel painted and with anti-rust coating from both sides. The height covered shall be at least 8 feet. There should be no gap between roof sheet and wire mesh, if any angle creates gap, it should be covered with iron bars and wire mesh in between.

3. **Electricals:**
   i. The electrical power requirement (power matrix) for the TB Containment laboratory should be calculated and provided by the lab.
   ii. Supply should be three phase supply with proper earthing and required 440 V capacity to support the functioning of AHU Unit.
   iii. **Earthing**: If earthing is not adequate, the vendor will do the necessary grounding work to ensure entire TB C&DST Lab has adequate earthing.
   iv. All the required electrical panels, cabling, switchgears, surge and spike protection system and arrangements, etc. for the purpose of energizing the TB Containment Laboratory facility shall be carried out by the contractor.
   v. All the electrical fittings and fixtures in the laboratories areas on the walls shall be sealed (all conduits, outlets shall be sealed with silicon sealant), leak proof and capable to withstand chemical exposures during fumigation.
   vi. Lighting should be on ceiling and surface mounted, LED of reputable manufacturer, suitable capacity (~18W) and arranged as per the layout provided. Light fixtures inside shall be with gasket or otherwise sealed with silicon.
   vii. The electrical power distribution scheme shall be provided to provide back-up power supply to the critical components and equipment through a UPS (to prevent any disruption of work) and through Diesel power generator set for the entire lab.
   viii. Every workbench should have at least one socket which received electrical input through UPS of TB Containment lab. Extractor fans of BSC' ducting should also receive electrical input through this online UPS of the TB Containment Lab.
   ix. Power sockets with lid (15-20 in each room) should be provided for equipment (as per the layout provided). Modular type, power sockets with lid of 5A/15A are to be provided at various locations on the wall as per discretion and strategic arrangements /provisions for lab equipment. The Sockets meant for UPS should be screen printed as (UPS) for ease of operation and identification marked wires and cables used shall be copper wire of standard make (ISI Marked) and manufacturer.
   x. AHU Control panel:
      - Cabling from the panel to individual AHUs and control wiring will be in the scope of HVAC contractor. However cabling up to the electrical panel will be provided by site. Termination will be done by HVAC contractor. In case of power failure, the alternate power through Main Diesel Generator Set of the Hospital Supply to be used. The Panel is to be design accordingly.
      - Housing of the AHU panel shall be GI 16 gauge powder coated, with cable inlet and outlet going through grommet and with earthing connection arrangement.
      - Multi-function meter displaying voltage, load and power factor for electricity supply to AHU panel should be present.
      - LED indicator for ON/OFF will be provided for RBY phase, AHU supply, AHU exhaust, Standby exhaust, Condensation unit, Heating Coil of Supply Unit
      - DOL Starter Switch to be provided for AHU exhaust, AHU Supply and Condensation Unit (in the order)
      - All electrical equipment used should be high quality of reputed manufacturers like VFD may be Allen Bradley, Siemens make or equivalent, MCCB may be of Havells, Legrant, Anchor, Siemens, L&T or equivalent, wiring of Havells, Polycab or equivalent make, etc.
      - Control panel should show simple instructions for starting the AHU
      - Diagrams of electric circuit should be displayed on the backside of door of panel.
      - Control panel should have its lock and key (for controlled access)
      - SOP for lab condition for operating VFD with selector switch for manual operation of AHU
   xi. MCCB panel suggesting supply and safety mechanism for different sections of the lab should be provided at adequate place near AHU control panel.

4. **Fire Safety:** Fire detection and alarm system (FDA System) and fire extinguishers of Type ABC (2kg) shall be provided at strategic locations (TB Containment Room, Ante Room and outside at entrance of TB

Containment Lab and near control panel, near AHU and should overall comply with fire safety guidelines). Training will be provided for its operation.

5. Emergency Preparedness:

a. One emergency shower and one eye wash station for each site shall be provided at strategic location in compliance with ANSI / ISEA Z358.1. The water supply for emergency shower shall be sufficient to supply at least 3 GPM for 10 minutes. Shower shall be hands free and stay open valve type. The water supply for eye wash shall be sufficient to supply 0.4 GPM (1.5 litres) for 10 minutes in low velocity flow.

b. Emergency Exit door with panic latch door from the TB Containment Laboratory shall be provided wherever mentioned for personnel exit in case of an emergency and can also be used for equipment placement inside lab. Door should be equipped with hooter/audible alarm every time it is opened.

c. UNINTERRUPTED POWER SUPPLY SYSTEM (UPS): A central UPS console shall be provided to cater to the extreme essential power requirement of the laboratory. All critical components like lights, Door Interlocks, exhaust blowers of BSCs and critical equipment shall be provided with uninterrupted power supply. UPS for adequate load to support the AHU for 30 minute shall be provided by vendor. Cabling and installation shall be done by contractors end.

d. Fire and electrical safety is described in the relevant sections.

6. Interiors of the TB Containment Lab:

i. Modular walls**:** The internal building finishes shall be monolithic, impervious, non-particle shredding, chemical resistant especially to Hypochlorite cleaning and suitable to withstand chemical use during decontamination/ fumigation. Modular wall should be made for Clean Room application, pre-engineered 60 mm thick PUF panels with GPSP Sheets with PUF insulation of minimum 38-40 kg/m^3. Both surfaces should be 0.8 mm thick GPSP sheet and has to be installed along the outer walls, partitions and false ceiling to create an impervious shell which is fully sealed. The panels on either side will be coated with Epoxy painted. These panels must have good aesthetic appeal as well and have to be easily maintainable. The height of wall shall be minimum 9 feet (to accommodate BSC with its thimble and damper).

ii. Modular false ceiling: The internal building finishes shall be monolithic, impervious, non-particle shredding, chemical resistant especially to Hypochlorite cleaning and suitable to withstand chemical use during decontamination/ fumigation. Modular false ceiling panels should be made for Clean Room application, pre-engineered 60 mm thick PUF panels with GPSP Sheets with PUF insulation of minimum 38-40 kg/m^3. Both surfaces should be 0.8 mm thick GPSP sheet and has to be installed along the ceiling, to create an impervious shell which is fully sealed. The panels on inner side will be coated with Epoxy painted and powder coated on outer side. These panels must have good aesthetic appeal as well and have to be easily maintainable. The construction of false ceiling shall be strong to allow 1 person weighing 50-60 kg to easily walk/crawl above it for necessary work. Service window will be provided for access above false ceiling preferably outside TB containment lab.

iii. Flooring shall be of 5 mm (3 mm + 2mm) of self-levelling industrial epoxy including screed compound for adhesion, 3 mm semisolid cladding of EPOXY will be applied over a uniform cemented flooring and 2 mm semi-liquid epoxy over 3 mm hardened surface with bubble free perfect smooth finishing completed in three steps: Cementing (Uniform Flooring), Hardening (3 mm epoxy) and smoothening (2mm epoxy). Epoxy used for this application will be self-levelling and clean room compatible. Flooring outside the TB Containment facility where required for aesthetic purpose will be covered with vinyl flooring.

iv. Doors:

i. Flush Door finishes shall be 45mm thick with chemical resistant, anti-fungal and anti-bacterial properties.1.2mm thick GPSP sheet suitable to fix on 60 mm thick wall panel with provisions for double glazing glass for all door and hardware like push plates and handle on both side, lock and key, etc. PUF Panels will be with GPSP Sheets, epoxy painted on both sides and PUF insulation of minimum 38-40 kg/m3. Concealed hardware for fixing of door frames, TS-71 door closure, SS hinges, SS Door handle, SS ball bearing butt hinges, concealed tower bolt for the double door, both sides lock and key arrangement. Suitable neoprene “Y seal” type gaskets may be used between the door jam and door stop.

ii. Door interlocking systems shall be complete with controller module, push button stations with LED indication, electromagnetic locks. To take care of malfunctioning of interlocking, alternative electrical switch to manually open the doors should be provided.

iii. Vision Glass for doors shall be fixed type vaccumised and insulated type with 6 mm toughened glass and shall be installed for natural lightening flushed with surfaces of the door. Fixed flush to both faces of the door / wall panels to provide ease of cleaning and maintenance. No crevices / joints / sloped profiles are used for fixing the glass. This will avoid particle contamination and dust accumulation.

v. Covings: Extruded aluminium anodized R75 clip-on type (Male & Female connectors) covings for entire wall to floor, wall to wall & wall to ceiling joints. Extruded aluminium double cove integrated with top track of the partition panels. Corner internal & external cove joining pieces in aluminium anodized finish. Having similar construction and finish as the walls and properly sealed with silicon sealant with wall & ceiling. Covings used in construction shall include Wall to Wall Coving -R-75, Wall to Ceiling Coving-R-75, 90°Corner, 3-D Corner,2-D Corner

vi. All penetrations through walls, ceiling & floors will be sealed using a suitable caulking. Caulking shall be applied around pipes and conduit. The interior of electrical and cable conduit shall also be caulked.

vii. **Pass Box:** Pass Box (Static type) shall be provided at strategic / required locations for transfer of samples, chemicals and materials to and from the Laboratories (as indicated in the design submitted). In case of two pass box, one will be to receive the sample within and second will be for sample discard to autoclave room or for disinfected waste collection. It shall be made of SS 304, with inbuilt UVGI system, with interlocking in such a way that both doors cannot be opened simultaneously, panel mounted, with buzzer to indicate open status for any door, fixed at a height of 750 mm from floor in sandwich panel, with dimension of 610 mm (L) X 610 MM (W) X 610 MM (D), with load bearing capacity of 40 Kg, door make-Single door in each side, with glass and air tight gasket, with door latch for one door(door opening outside), with handle of superior quality, with viewing glass made of polycarbonate or 10 mm thick tempered glass, hinges made of SS304, with one LED lamp inside pass box, chemical resistant especially to Hypochlorite solution, alcohol, etc., flange to seal pass-box and sandwich panel, with indicating lamps in both sides to show status-On/OFF switches for all lamps. A SOP must be developed for pass-box decontamination.

7. Furniture inside the lab:

a. **Laboratory work stations** (numbers as per the Lab design)**-** Frame shall be made up of SS 304, with nylon cushion/bushing for the legs, non-particle shredding material and shall be chemical resistant to allow chemical disinfection. It should be strong to hold the granite top/workbench as well as equipment places on the workbench. There shall be no drawers or safe in the workstation and shall have arrangement for placing the UPS below the work bench.

b. **Garment Storage Cabinet**- One garment storage cabinet that can be locked shall be provided in the Change room/Ante Room. It shall be of SS 304 with two compartments and shelves for storage of clean items of suitably large dimension to fit in the Ante/ Change Room (size to be consulted with site i/c)

c. **Coat hangers** 8-10 individual hangers made of SS30, in group of 4-5 each, will be provide to hang gowns/ aprons in Ante Room and change room (in consultation with site i/c)

d. **Shoe rack** (one)- It should be made of SS 304 with 5 shelves, open type and wide enough to hold two pairs of shoes in each shelf and shall be able to fit in available space as per design.

e. **Wash Basin** (two): Modular standalone hand washing sinks made of SS 304 with elbow or foot operated mechanism shall be provided as per design inside lab and in change or ante room. Wall hanging soap dispenser to be provided along with each wash basin unit. A Tissue paper rack with a mechanism to pull out tissue papers, will be provided near the wash basin to dry hands. Water lines that penetrate the TB Containment space shall be equipped with back-flow prevention devices. Outlet pipes should be made of PVC with closure outside lab made of SS plate.

f. **Laboratory Stools** (five): Laboratory grade hydraulic SS stools with back support, foot rest, rotating type with castor wheels at the base, shall be provided by contractor.

g. **Trolleys**: Two tier trolleys (two quantity) made of SS 304, size 2'x1'6" with side walls to prevent fall of items from sides and wheels at bottom for smooth movement, shall be provided. **Plus,** one similar trolley will be

provided for each BSC. One of the trolleys for transportation of material from lab to the Autoclave room shall be provided with a lid to prevent direct exposure of material to outside.

8. **Monitoring Mechanism:** Monitoring of crucial parameters will be made available in the lab for the following:
   a. Visual display of Room Pressure, Relative humidity and temperature in the TB Containment Lab
   b. Differential pressure through Magnehelic gauges in Ante-room, Change Room (where available) and outside TB Containment Lab
   c. In the Control Panel- Multi-function meter displaying voltage, load and power factor for electricity supply to AHU panel and LED indicator for ON/OFF will be provided for RBY phase, AHU supply, AHU exhaust, Standby exhaust, Condensation unit, Heating Coil of Supply Unit
   d. CCTV footage from the various sections in the Microbiologist's room
   e. Hooter/alarm when the emergency exit door is opened as well as when fire detection system is activated in incidence of fire.

9. **Connectivity:**
   a. LAN wiring for internet access inside the lab with sockets to be provided at strategic locations (near work benches) in TB Containment Room.
   b. A suitable EPABX System shall be provided for the laboratory. Telephone instrument with line will be kept in Microbiologist room, Staff room and TB containment room and any other place as suggested by Site i/c. Telephone with speaker for hands free operation will be provided inside TB Containment Room.

10. **SPECIALIZED LABORATORY SUPPORT EQUIPMENTS AND SYSTEMS**
   a. **Split AC for MGIT:** Two wall mounted split air conditioners (of suitable tonnage according to the area of the TB Containment Lab) should be installed near to MGIT. These will be inverter ACs (minimum three star) of Hitachi/ Bluestar/ Carrier/ Lloyd/ Godrej or equivalent OEM. The outdoor unit will be suitably placed outside the lab with easy access and adequate protection from theft. Drainage pipe of ACs will be adequately long and connected into the drainage system of the institute. Both the Split ACs should be connected with alternator (Timer Control cut-off and start) for changeover every 4 hours between them so that load is distributed between both the ACs. These will be used at the end of the day when main HVAC system is not operating to provide ambient temperature for MGIT.

   b. **Biological Safety Cabinets**: Biological Safety Cabinets (BSC) will be installed, commissioned and validated inside the TB Containment Lab at the required location as per the plan. BSCs should be placed away from doors, air supply vents or other things which may disrupt the cabinet airflow. The Biological Safety Cabinets that are being procured shall be Class II A2 type. Lab upgradation agency shall coordinate/liaise with BSC Manufacturer for installation, ducting, commissioning and calibration of BSC if under warranty or newly supplied (else it shall be done by vendor). The exhaust from the Biological Safety Cabinets shall be thimble connected and individually ducted out. The external extraction fan installed at the end of the ducting should exceed the volumetric flow rate of each BSC by 30–50%, and should be controllable, provided with easily accessible dampers and connected to an uninterrupted power supply. The air from the BSC should be ducted with ventilation pipes that have a diameter exceed 20 cm.

   c. **CCTV Monitoring Devices:** Camera to continuously monitor the activities inside and outside the TB Containment Lab by providing Central CCTV Monitor. Five/Six Camera unit should be installed(one/two outside the TB Containment lab covering the entry and corridor area, one in ante room and two inside TB Containment Room and one covering AHU Area). Supply, installation, testing and commissioning of the following shall be done:
      - Color Camera 1/3" CCD, IR type, dome shaped, 480 TV lines resolution which work in low light.
      - 6 Channel standalone / Network version DVR Make: DAHUA /equivalent reputed OEM
      - Hard Disk with 1 TB (TERA byte) Capacity -Make -Seagate or equivalent reputed OEM
      - 6 Channel Power Supply of reputed Make
      - Supply Laying of Co-axial Cable with necessary Accessories

- Wall mounted monitor (at least 20 inch LED/LCD) located in Microbiologist room or as suggested by site i/c.

11. Civil works and Plumbing:

a. Ensure water proofing of the roof (if required) is done prior to carrying out the work. Levelling of the floor where required will be carried out the vendor. Civil works to create new door arrangement/ closure of exiting openings, sealing of the existing windows, etc. will be carried out by the vendor.
b. Drain: All the liquid drain coming out from the laboratory shall be connected to a single drain with back flow prevention, which would be further connected to existing local ETP plant in the hospital campus if available. All drains shall be equipped with "p traps". Penetrations made in walls and floors must be properly sealed.
c. Water connections for the emergency shower and eye wash and wash basins to be appropriate provided.
d. Ensure that pipes and connections are leak proof to avoid flooding behind modular walls.

12. Labelling to be done as per following details:

a. Biohazard label should be placed outside the laboratory.
b. Labels for all switches (to be provided) including in the MCCB panels, LT Panel and AHU Control panel
c. Labelling of the TB Containment Lab and Ante Room/ Change room including Emergency exist.
d. TB Containment laboratory layout should be provided at the entrance of Lab

13. **Final performance and capacity testing and validation:** All the certification and validation parameters for TB Containment Lab must be done in accordance in with NIH certification requirement. BSCs will be validated and calibrated as per NSF 49and EN 12469 standards.

a) There will be periodic mid-term assessment of the project (after plumbing, electrical works, ducting and AHU installation, construction of interiors and dry run) by identified technical people and Site i/c to assess the timely and proper execution of the project.
b) After completion of the construction and installations, the entire laboratory facility, all the equipment, systems and services shall be validated by the contractor under supervision of a committee of the consultants / client or lab i/c as follows:
    i. For Bio Safety Cabinet:
        - Validation of BSC: Particle count test, PAO (Filter Integrity test for pre-filters, filters ULPA filter/ HEPA filters), Air in-flow velocity and down-flow velocity test as per NSF 49and EN 12469 standards with devices traceable to National/International Standards, UV and Fluorescent light intensity
        - Maintenance of the BSC to be carried out if existing one to be used (and not covered under warranty) i.e. complete and thorough cleaning of working Area of cabinet, cleaning of exhaust filter from the top to eliminate and external clogging or disturbance and inspection of ducting, cleaning and oiling of sliding sash movement system, checking of switches, tube lights and UV light fittings, checking of airflow and exhaust system, calibration and validation of Magnehelic Gauges if existing, etc.

    ii. For TB Containment Lab- The installation as a whole shall be balanced, tested and validated upon completion, and all relevant information, including the following shall be submitted to the Institution
        - Pressure in each room/zone as per the design, differential pressure readings including across filters.
        - Air inflow velocity and outflow velocity test across all inlets and outlets to measure/derive air change rate per hour (minimum 6-12 ACH) and as per design
        - Smoke pattern test for directional airflow should be performed during validation including for Passbox.
        - Temperature shall be maintained at 22°C±2 and humidity level should be maintained at 60±10%
        - HEPA Filter (in BIBO) integrity test based on PAO test and manufacturer's certifications
        - Electrical current readings, in amperes on full load work, average running, and on starting, Testing of power cabling, earthling, AHU control panel, MCCB panel and LT panels

- Containment room -the walls, floors, ceilings, penetrations, and other containment barrier features have adequate integrity
- Operational performance testing for
    - HVAC including Blower motors in the Supply, exhaust including emergency, extractor of BSC ducting and condensation unit
    - Ducting for any potential leakages and insulation breakage
    - Dampers including variable control, leak proof and fire control (only verification)
    - Magnehelic Gauges
    - Temperature control sensors; pressures control sensors,
    - Passbox
    - Split ACs
    - Fire Detection system
    - EPABX System
    - Access Control System
    - CCTV System
    - UPS Back up system
    - Emergency Shower and eye wash station
    - Interlocking of supply blower motor and exhaust blower motor

c) Prior to validation, the contractor shall prepare and submit a detailed 'Validation Document' for approval.
   i. The Validation Document shall provide the detailed procedure for validation, parameters for validation, validation schemes and formats for recording the validation details.
   ii. The contractor shall arrange to do a mandatory third party validation
   iii. The contractor shall arrange for all the instruments, tools, manpower etc. required for the validation. The validation results shall be recorded and documented and shared with the site and hiring/funding agency.

d) The above validation tests shall be performed Annually during the warranty as well as maintenance period

In addition to the above validation tests, preventive maintenance servicing of all installations, operational performance testing as listed above shall be carried out on a quarterly basis during the maintenance as well as defects liability period.

14. **Maintenance Services**: After the completion of defect liability and warranty period of two years, it will be appropriate to have a longer term maintenance of the upgraded lab for a period of at least three years through the same agency who upgraded the lab. Apart from annual validation and quarterly preventive maintenance servicing as described above, it should include attending breakdown maintenance calls as and when required, repair/replacement of compressors, refrigerant gas charging of condensing units, besides replacement of spares required (due to wear and tear) at pre-fixed rates.

15. Training of personnel: Institution personnel to be trained over 2 days for:
   a. Operation of HVAC Plant and all other equipment and systems.
   b. Adjustments of settings for controls and protective devices
   c. Servicing and Preventive maintenance
   d. Emergency response training.

16. Guidelines & Standards for reference:
   a. *Bio safety in Microbiological and Biomedical Laboratories, 5th edition, 2007 (CDC/NIH BMBSL).*This guideline recommends minimum facility and operational requirements for laboratories working with biological hazards. Primary Containment for Biohazards: Selection, Installation and Use of Biological Safety Cabinets,
   b. Canadian Tuberculosis Standards 6th Edition

c. American Society of Heating, Refrigeration and Air-Conditioning Engineers, Inc. *Laboratory Design Guide - 2001*
d. NIH Design Policy and Guidelines, 2008
e. American National Standards Institute (ANSI)
f. NIH BSL 3 Certification requirement, 2006
g. WHO TB Containment Lab Biosafety Manual, 2012

17. **Submission of specialized systems and services layout schemes prior to initiation of the work:** Conceptual layout plans and schematic drawings of various specialized services and utilities showing tentative locations of equipment and furniture such as to be submitted before initiating work at site for approval to hiring agency and site i/c
    a. HVAC system
    b. Air filtration system
    c. Pressure control system including differential pressure zones
    d. Fire Detection and Alarm system
    e. Air distribution System including ACH
    f. Electrical distribution system
    g. Monitoring system including CCTV and three important parameter monitoring (pressure, temp and humidity)
    h. Water supply and drainage system
    i. AHU Control Panel System with VFD controls and SOP for lab condition for operating VFD with selector switch for manual operation of AHU
    j. Chart for defining the AHU fan and its speed for air quantity being delivered by supply and exhaust blower at different speed
    k. Un-interrupted Power Supply system
    l. Specialized laboratory support equipment/ primary containment barriers such as
        - Pass boxes
        - Entry exit protocols

18. **Documents for final submission: The following documents are required to be submitted after Final assessment and validation of TB Containment Lab for verification and approval to hiring agency and to the lab within 15 days of completion of successful validation.**
    a. The drawings and layout of each final commissioned TB Containment laboratory should be shared with site and hiring/funding agency (both in soft and hard copy) for verification.
    b. All Test Certificates / Maintenance manuals / As Built drawings / Spare Part List should be submitted to site and hiring/funding agency after validation within one week.
    c. Detailed document on Laboratory Validation Procedures and to include as per table;

Submission of validation documents as per followings.
Design Qualification
Installation Qualification
Performance Qualification
Operational Qualification
All Test Certificates / Maintenance manuals/ As Built drawings / Spare Part List.

DOCUMENTS TO BE SUBMITTED BY THE BIDDER ALONG WITH THEIR BIDS FOR TECHNICAL QUALIFICATION AND EVALUATION

Project Implementation Methodology including

- Past experiences of developing labs including TB Containment labs (with contact details of at least 5 such)

- Team (members and their qualifications) which will be building the TB Lab (including designing, HVAC and ducting team, electrical, plumbing, civil works team, interiors developing team, etc.)
- Architectural layout plans- including any comments/ concerns about the design provided
- Men & Materials movement layout plans- Conceptual layout plans showing movement of men & materials into and within the Laboratory areas clearly highlighting the measures/ preventions for control of spread of infection/contamination into and within the Laboratory
- Schematic Diagram of HVAC system for each lab should be mentioned and submitted for the labs quoted
- Detail specification of HVAC components lab should be mentioned and submitted for the labs quoted
- AHU Calculation for each lab should be mentioned and submitted for the labs quoted
- Zoning plans: Plans indicating details of zoning and separation/isolation of different classified, non- classified and contaminated areas/zones, relative pressurization, Air change rates, air re-circulation rates and sterility requirements, decontamination control, services etc. for different areas/zones.
- Total Power requirement and heat load including buffer of 20-25% for each lab should be mentioned and submitted
- List of Construction Material and Equipment Proposed for construction of the laboratory along with specifications including manufacturers (OEM) along with warranty period (as specified by Manufacturer) should be clearly mentioned and submitted as per table (Annexure 2) given below for the labs quoted. Any additional material proposed for construction by bidder may also be specified in the same table.
- Certificates complying to refer standard for filters and HEPA filters should be mentioned and submitted.
- Services & Utilities schemes
    - Power supply and distribution system
    - Water supply and distribution system
    - Internal/external communication system
    - Disinfection/decontamination system
- Laboratory Validation Procedures and Details including design qualification, installation qualification, performance and operational qualification
- GANTT Chart informing timelines for executing the various stages of work

Annexure 1

Layout of the lab and details of the Sites for TB Containment Laboratory Infrastructure Establishment and list of equipment to be placed in TB Containment Lab

Layout of the lab- see attached

Sl. No.	Name of the Site	Total Area	Area of TB Containment Lab	Area of Ante room	Area of Change room (if planned)	No. of BSC to be installed	Capacity of split AC *
1							
2							

* Back up split AC for after work hours support for MGIT

Power Load for Equipment planned for TB Containment Lab:

Sl. No.	Equipment	Quantity	Dimension (cm) W X H X D	Weight (Kg)	Power Requirement (Watts)	Remarks	Placement
1							
2							
3							
4							

Note: Dimensions and Power requirements are approximate values and may vary Power requirements mentioned here are standby loads, the peak values may be 120% the stand by load.

All UPS should be placed in a common electrical panel room (where possible) with connections for various equipment.

Annexure –2

Technical Compliance sheet along with proposed specifications / make / manufacturer to be submitted by Bidder

- List of Construction Material and Equipment Proposed for Construction of the Laboratory along with specifications including manufacturers (OEM) along with warranty period (as specified by Manufacturer) should be clearly mentioned and submitted with ITB as per table given below. Any additional material proposed for construction by bidder may also be specified in the same table.

S.N	Item description	Manufacturer	Specifications with capacity (wherever applicable) and warranty as specified by Manufacturer	Proposed Makes / Manufactures
1	Thermal Insulation			
2	HEPA Filter H14			
3	Diffusers , Grilles			
4	Airtight and Gastight Isolation Dampers			
5	VAV Dampers & Leak dampers			
6	Fire Damper			
7	Magnehelic Gauge			
8	Containment HEPA filter housing with Filter			
9	BIBO Indigenous			
10	AHU and Ventilation units			
11	AHU Plenum Filters G4 , F7			
12	AHU Blower- Supply & Exhaust			
13	AHU Motor-Supply & Exhaust			
14	Condensing unit			
15	HVAC Control valves			
16	Modular Material for Ceiling and Walls			
17	GI Sheets			
18	Epoxy Flooring Material			
19	Distribution Boards			
20	LT Switchgear (ACB, MCCB, MCB,ELCB, RCCB, Contactors, SFUs)			
21	FUSE			
22	VFD			
23	Timers			
24	Protection Relays			
25	Selector Switches			
26	Change Over Switch			

S.N	Item description	Manufacturer	Specifications with capacity (wherever applicable) and warranty as specified by Manufacturer	Proposed Makes / Manufactures
27	Ammeters, Voltmeters,			
28	Indication Lamps (LED Type)			
29	Push Buttons			
30	PF Meters			
31	Energy Meter			
32	Electrical Multi-function Meters			
33	Load Managers			
34	Current Transformers (Cast Resin)			
35	Telephone Tag Box			
36	Industrial type Metallic plug sockets			
37	Modular switches, socket outlets, LED ceiling lights			
38	PVC Conduits, Accessories			
39	MS Structural's			
40	Copper wires			
41	XLPE insulated, armoured,			
42	Aluminium conductor cables			
43	Telephone, Co-axial wires & Cables			
44	Data Cables (CAT 5e, 6)			
45	CONTROL JUNCTION BOXES			
46	Network Switches			
47	CCTV & CAMERAS			
48	UPS			
49	LED Monitor			
50	Door Interlock and Access control System			
51	Smoke Detectors			
52	Addressable analogue main panel			
53	FIRE ALARM SYSTEM			
54	Differential Pressure Switch			
55	Temperature sensor			
56	Temperature transmitter			
57	Temperature display			

S.N	Item description	Manufacturer	Specifications with capacity (wherever applicable) and warranty as specified by Manufacturer	Proposed Makes / Manufactures
58	Humidity sensor			
59	Humidity transmitter			
60	Humidity display			
61	Pressure sensor			
62	Pressure transmitter			
63	Pressure display			
64	3-Channel Monitor display with Audio-visual alarm system, wiring & accessories			
65	Vinyl Flooring for Passage/Corridor			

Note:

i. Attach separate sheets for specifications and manufacturers catalogues/brochures for construction materials and equipment proposed.
ii. Use separate table as above for each Schedule, if required.