PART IX – B
LABORATORY FUNCTIONAL AND TECHNICAL CRITERIA

TABLE OF CONTENTS

FUNCTIONAL CRITERIA

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>F1.</td>
<td>Typical Planning Module</td>
</tr>
<tr>
<td>F2.</td>
<td>Ceiling Height</td>
</tr>
<tr>
<td>F3.</td>
<td>Floor Loading</td>
</tr>
<tr>
<td>F4.</td>
<td>Above - Ceiling Loading</td>
</tr>
<tr>
<td>F5.</td>
<td>Structural Grid</td>
</tr>
<tr>
<td>F6.</td>
<td>Clearances</td>
</tr>
<tr>
<td>F7.</td>
<td>Personnel/Equipment Access</td>
</tr>
<tr>
<td>F8.</td>
<td>ADA / Accessibility Requirements</td>
</tr>
<tr>
<td>F9.</td>
<td>Noise</td>
</tr>
<tr>
<td>F10.</td>
<td>Architectural Finishes</td>
</tr>
<tr>
<td>F11.</td>
<td>Natural Light</td>
</tr>
<tr>
<td>F12.</td>
<td>Architectural Details</td>
</tr>
<tr>
<td>F13.</td>
<td>Laboratory Unit Hazard Classification</td>
</tr>
<tr>
<td>F14.</td>
<td>Vibration Criteria</td>
</tr>
<tr>
<td>F15.</td>
<td>Seismic / Hurricane Design</td>
</tr>
<tr>
<td>F16.</td>
<td>Validation</td>
</tr>
<tr>
<td>F17.</td>
<td>BSL3 Suite Special Functional Criteria</td>
</tr>
<tr>
<td>F18.</td>
<td>Electronic Clean Room</td>
</tr>
<tr>
<td>F19.</td>
<td>Flood Prevention</td>
</tr>
</tbody>
</table>

HEATING, VENTILATING AND AIR CONDITIONING

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>H1.</td>
<td>General</td>
</tr>
<tr>
<td>H2.</td>
<td>Space Temperature and Humidity Criteria</td>
</tr>
<tr>
<td>H3.</td>
<td>Ventilation Criteria</td>
</tr>
<tr>
<td>H4.</td>
<td>Air Change Criteria</td>
</tr>
<tr>
<td>H5.</td>
<td>Pressurization Criteria</td>
</tr>
<tr>
<td>H6.</td>
<td>Filtration/ Dedicated Exhaust Criteria</td>
</tr>
<tr>
<td>H7.</td>
<td>Building Operating Schedule</td>
</tr>
<tr>
<td>H8.</td>
<td>Flexibility Criteria</td>
</tr>
<tr>
<td>H9.</td>
<td>Watts/Square Foot</td>
</tr>
<tr>
<td>H10.</td>
<td>Noise Criteria</td>
</tr>
<tr>
<td>H11.</td>
<td>HVAC Concept</td>
</tr>
<tr>
<td>H12.</td>
<td>Fume and Exhaust Hood Criteria</td>
</tr>
<tr>
<td>H13.</td>
<td>Access to Mechanical Equipment</td>
</tr>
<tr>
<td>H14.</td>
<td>B SL3 Suite Special HVAC Criteria</td>
</tr>
<tr>
<td>H15.</td>
<td>Electronic Clean Room (Class 10,000/1,000/100/10)</td>
</tr>
<tr>
<td>H16.</td>
<td>Dehumidification</td>
</tr>
</tbody>
</table>
ELECTRICAL

E1. Primary Voltage
E2. Service Distribution
E3. Emergency (Stand-By) Power
E4. UPS System
E5. Voice/Data System
E6. Artificial Lighting
E7. Special Wiring in Hazardous Areas
E8. BSL3 Suite Special Electrical Criteria

PIPED SERVICES

P1. General
P2. Domestic Cold Water System
P3. Domestic Hot Water System
P4. Tempered Potable Water
P5. Natural Gas
P6. Specialty Gases
P7. Compressed Air System
P8. Vacuum System
P9. Type III Reagent Grade Water System
P10. Type I Reagent Grade Water
P11. Steam
P12. Chilled/Process/Condenser Water
P13. Floor Drains
P14. Silver Recovery
P15. Wash Down
P16. Laboratory Waste (Drain) System
P17. Neutralization/Monitoring
P18. Sprinkler System
P19. BSL3 Suite Special Plumbing Criteria
P20. Sea Water

SAFETY

S1. General
S2. Safety Stations
S3. Eye/Face Wash / Safety Showers
S4. Fire Extinguishers
S5. Emergency Communications
S6. Signage
S7. Safety Closet or Emergency Response Team Room
S8. Emergency Electrical Shut-off
S9. Public Safety
LABORATORY FUNCTIONAL AND TECHNICAL CRITERIA

BACKGROUND:

The National Institutes of Health at the University of the Philippines Manila is composed of ten (10) institutes, three (3) reference centers, and twenty four (24) study groups.

- Institute of Molecular Biology and Biotechnology (IMBB)
- Institute of Child Health and Human Development (ICHHD)
- Institute of Clinical Epidemiology (ICE)
- Institute of Health Policy and Development Studies (IHPDS)
- Institute of Herbal Medicine (IHM)
- Institute of Human Genetics (IHG)
- Institute of Ophthalmology (IO)
- Institute of Pharmaceutical Sciences (IPS)
- Philippine National Ear Institute (PNEI)
- Newborn Screening Reference Center (NSRC)
- National Telehealth Center (NTC)
- Newborn Hearing Screening Reference Center (NHSRC)

Interviews with representative End-Users were conducted by the UP Office of Development and Planning Initiatives (ODPI) from March-May 2013. The Schematic Design drawings developed indicate the desired adjacencies and locations for offices, laboratories, meeting rooms and auditorium. The technical criteria included in this document summarize laboratory design requirements as decided during a meeting on July 12, 2013. The document was developed without the participation of the Design and Build Contractor.

The preparation of the Detailed Architecture & Engineering Design drawings and specifications will be a phase in project development when the laboratory infrastructure is being designed. These technical criteria shall be revisited as the architects and engineers resolve the project’s building code requirements and budget constraints. This document should be updated and reflect communication and planning between the Design and Build Contractor and the End Users.

FUNCTIONAL CRITERIA

F1. TYPICAL PLANNING MODULE. A typical laboratory planning module is the smallest practical laboratory environment and is the basis for all other laboratory sizes. Laboratory planning modules can be combined and/or subdivided to create the appropriate sized laboratory based on head count and/or function. The planning module for this project is dimensioned as follows (*: dimension inclusive of 150mm (6") nominal partition thickness):

<table>
<thead>
<tr>
<th>Module Type</th>
<th>Width (O.C.)*</th>
<th>Depth (clear)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laboratory Module</td>
<td>3352 mm</td>
<td>7000 mm</td>
</tr>
</tbody>
</table>
F2. CEILING HEIGHT. The recommended minimum clear obstruction height is 2743mm (9’ – 0”). A hung ceiling is recommended for this facility to reduce HVAC loads (volume reduction) and dust accumulation (exposed pipes, ducts, pendant mounted lighting fixtures and spray-on fireproofing if required). A hung ceiling is not recommended in the Linear Equipment Room or Service Corridor in order to facilitate access to mechanical systems.

F3. FLOOR LOADING. The recommended live load capacity for the laboratory portion of the building is 500 kg/sq. M (100 pounds per square foot (psf)). Laboratory Support modules and Linear Equipment Room shall have an assume floor loading of 600 kg/sq. M (125 psf). For special circumstances, heavier live load may be required. Refer to room data sheets / room criteria sheets for specific information.

F4. ABOVE-CEILING LOADING. The following items are anticipated to be hung from the deck above the ceiling: overhead service carriers, optical table canopies, other. The recommended ceiling load for this facility is 25 psf.

F5. STRUCTURAL GRID. The structural grid should be coordinated with the laboratory planning module. The planning module should be offset from the structural grid to allow plumbing and electrical lines to pass through floors without impinging on floor beams. Plumbing chases, distribution and mechanical shafts will be coordinated with the structural grid during design development.

F6. CLEARANCES. For purposes of safe passage of occupants past people and equipment in aisles, as well as for an unobstructed wheelchair turning radius, the minimum recommended clearance between benches, or between a bench and a designated equipment area, is 1500mm (5'-0") in the laboratories. The recommended clear corridor width leading into a laboratory is 1800mm (6'-0") for research laboratories and 2438mm (8'-0") for teaching laboratories.

F7. PERSONNEL AND EQUIPMENT ACCESS. Provide a 1500mm (4'-6") wide door between corridor and laboratory, consisting of one 900mm (36") active door with a 450mm (18") wide inactive leaf to facilitate personnel and equipment access.

All laboratories will have at least two (2) means of egress unless the functional laboratory unit is sufficiently small (e.g.: Cold Room, Single Module Lab, etc.). Two means of egress is best practice for laboratories, especially those with fume hoods or other hazardous material usage. Applicable building codes and NFPA 45 should be consulted.

A clear path for the largest piece of anticipated equipment from the loading dock via elevator, including elevator door width and height, to any laboratory must be provided.

F8. ADA / ACCESSIBILITY REQUIREMENTS (ACCESS AND WORKSTATION). Access to and within all laboratory areas shall meet accessibility / ADA requirements.

Provide a specific number (5% or more) of ADA workstations. Workstation assembly shall be a mobile self-contained unit complete with sink, power and all available piped services. Workstation shall be capable of being located within the facility where required. Fume hood shall be capable of being modified to respond to ADA requirements.

Teaching Laboratories: Provide 5% (minimum one) ADA workstation in each teaching lab.

To meet the disabled workstation requirements, we recommend the following:

a. Counter top at standard low bench height of 31" (760mm) A.F.F.
b. Knee space at least 30" (810 mm) wide with a clear height of at least 27" (735 mm) to underside of nearest obstruction (typically front apron). Provide 6" (150mm) wide and 10" (250mm) high toe space on at least one side of workstation.

c. Service fixtures located maximum 18" (450mm) from front edge of counter top. Fixtures can be either standard or remote control type.

d. Sink drops shall occur at least 8" (200mm) from front edge of counter top and trap shall be minimum 9" (230mm) A.F.F.

e. Fume hoods modified to meet the above requirements.

F9. NOISE. Ambient noise level in the laboratories shall meet NC40 (Noise Criterion 40) in laboratories without fume hoods, not to exceed NC45 in laboratories with fume hoods. Prevent acoustic levels due to intermittent activity occurring outside the laboratory from exceeding ambient noise level by more than 5 dB. Special consideration must be given to facilities, such as clinics, clinical or human behavioral research which must meet HIPAA regulations.

SPECIAL LOW-NOISE LEVEL REQUIREMENT: The Philippine National Ear Institute (PNEI) requires construction of four STC 15 rooms for hearing tests using specialized equipment. Partitions and doors should be designed to have ante rooms and air gaps to decrease acoustic and physical vibration for ultra-quiet rooms. Attention shall be paid to the placement and specification of electrical devices, light fixtures and ventilation to be consistent with the requirement.

F10. ARCHITECTURAL FINISHES. The following is a list of recommended architectural finishes for typical laboratory areas. As a general rule, provide mold and moisture resistant gypsum wall board behind any sink assembly located against a wall.

a. Typical Laboratory

Floor: Seamless resilient sheet product with heat welded seams equal to or better than Armstrong Medintech and sustainable rubber tile product with 4" (100mm) high resilient coved base.

Wall: 5/8" (15mm) Gypsum wall board (GWG) with water-based, washable, low-lusterlatex enamel paint, low volatile organic compounds.

Ceiling: 5/8" (15mm) acoustic lay-in tile laboratory and clean room grade.

Casework: Powder coated steel with epoxy resin countertop in BSL-2 and BSL-3 laboratories

Stainless steel with stainless steel countertops in animal areas and certain US Pharmacopeia (USP) 797-compliant sterile compounding laboratories.
b. **Linear Equipment Corridor / Service Corridor**

   **Floor:** Seamless resilient sheet product with heat welded seams equal to or better than Armstrong Medintech and sustainable rubber tile product with 4" (100mm) high resilient coved base.

   **Wall:** 5/8" (15mm) GWB with water-based, washable, low-luster latex enamel paint, corner protection

   **Ceiling:** 5/8" (15mm) laboratory and cleanroom grade acoustic lay-in tile.

c. **Teaching Laboratory for Surgery and Pathology**

   PNEI TEMPORAL BONE LABORATORY - Cadaver temporal bone is drilled and suctioned and deep sink is required to clean instruments. Instructor and 40 students participate and observe procedures.

   **Floor:** Epoxy resin system with 4" (100mm) integral epoxy resin coved base.

   **Wall:** 5/8" (15mm) GWB with water-based, washable, low-luster latex enamel paint, corner protection and concealed painted metal electric panels / access panels.

   **Ceiling:** 5/8" (15mm) laboratory and cleanroom grade acoustic lay-in tile.

d. **Hearing Test Rooms**

   PNEI needs sound proof rooms for hearing tests at different sound pressure levels. Sound level of the walls, floor and ceiling should be 15 STC. Children and adult outpatients stay in the room from 30 to 45 minutes. Typical construction to achieve the level of quiet required has a room-within-a-room design. Room size is 1/4th laboratory module. There will be up to four rooms of this type. Equipment needs earth grounded power.

<table>
<thead>
<tr>
<th>Instrument settings</th>
<th>Audible Frequency</th>
<th>Sound Pressure Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>125 hertz</td>
<td>39 SPL</td>
<td>Rhythm frequencies</td>
</tr>
<tr>
<td>2</td>
<td>250 hertz</td>
<td>25 SPL</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>500 hertz</td>
<td>21 SPL</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>1000 hertz</td>
<td>26 SPL</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>2000 hertz</td>
<td>34 SPL</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>4000 hertz</td>
<td>37 SPL</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>8000 hertz</td>
<td>37 SPL</td>
<td></td>
</tr>
</tbody>
</table>
Floor: Commercial, anti-microbial carpet tile with dense insulated back, with 4" (100mm) resilient coved base.

Wall: 5/8" (15mm) GWB with water-based, washable, low-luster latex enamel paint, corner protection and white marker boards (concealing electric panels). Provide STC 15 certified wall panel system with painted fiber board or fabric wrapped high density board.

Ceiling: 5/8" (15mm) laboratory and cleanroom grade acoustic lay-in tile, provide 25mm sound blanket insulation above ceiling tiles to increase sound separation.

e. Chemical Storage Room – to be part of Chemical Management Procedure

Floor: Epoxy resin system with 4" (100mm) integral epoxy resin coved base.

Wall: 5/8" (15mm) GWB with water-based, washable, low-luster latex enamel paint, corner protection and concealed painted metal electric panels / access panels.

Ceiling: None

e. Tissue Culture/Procedure Room/Microscopy – coordinate with decontamination procedures

Floor: Seamless resilient product with heat welded seams equal to or better than Armstrong Medintech or Nora Linoleum with 4" (100mm) high vinyl coved base.

Wall: 5/8" (15mm) GWB with water-based, washable, low-luster latex enamel paint.

Ceiling: 5/8" (15mm) vinyl coated acoustic lay-in tile.

Casework: Metal (powder coated steel) cabinets with gray epoxy resin counter top and sink.

g. Environmental Room (4° C)

These rooms will be prefabricated and will be specified as fixed laboratory equipment.

Floor: Prefabricated 4" (100mm) thick metal clad insulated panels with seamless vinyl and integral 4" (100mm) high "A" (12mm) radius coved base. Depress structural floor slab 4" (100mm) for recessed installation.

Wall: Prefabricated 4" (100mm) thick metal clad insulated panels with baked-on white polyester finish on galvanized steel.

Ceiling: Prefabricated 4" (100mm) thick metal clad insulated panels with baked-on white polyester finish on galvanized steel.

Casework: Stainless steel counter top, sink and adjustable shelving. Shelving should be corrosion resistant wire to facilitate air flow.
h. Core Laboratory Facilities (Protein & Peptide Structure, Proteomics, Genomics, Flow Cytometry, Research Stockroom, Mass Spectrometry, Nucleic Acid)

Floor: Seamless resilient sheet rubber, VCT 4” (100mm) high vinyl coved base.

Wall: 5/8” (15mm) GWB with water-based, washable, low-luster paint. Ceiling:5/8” (15mm) vinyl coated acoustic lay-in tile.

Ceiling: 5/8” (15mm) laboratory and cleanroom grade vinyl coated acoustic lay-in tile.

Casework: Metal cabinets with gray epoxy resin counter top and sink.

F11. NATURAL LIGHT. Laboratories shall have direct access to natural light. Window treatment (shades) shall be provided where appropriate to vary the amount of natural light entering the laboratory or office. Darkrooms, Microscopy and Imaging Rooms, Behavioral Rooms, Cold Rooms and Warm Rooms shall avoid access to natural light.

F12. ARCHITECTURAL DETAILS.

A. The potential to add or remove partitions within the laboratory will require the following special architectural details to be developed:

1. Demountable partitions with modular structural casework solutions in biosafety level 2 laboratories.

2. Animal areas and containment space shall not have removable partitions.

B. Ceiling penetrations by exhaust devices and light fixtures

1. Details shall be provided for joints between acoustic ceiling types and ceiling mounted elements including exhaust devices (canopy hoods and fume extractors), fire sprinklers, and light fixtures.

2. Details shall be provided for wall and ceiling penetrations in special areas such as the containment areas for biosafety level 3 (BSL-3) and animal biosafety level 3 (ABSL-3), and hard ceilings in animal biosafety level 2 (ABSL-2) areas.

F13. LABORATORY UNIT HAZARD CLASSIFICATION.

Laboratories will be Class C: Low Hazard as per the US standard National Fire Protection Association (NFPA) 45 and quantities of flammable or Liquid Class I, II and IIA combustible liquids shall not exceed 8 gallons (30 liters) per 100 square feet (9 sq meters) of laboratory unit or 400 gallons (1500 liters) in a sprinklered laboratory unit. A typical 36” (900mm) wide flammable storage cabinet located under fume hoods can hold up to 22 gallons (80 liters). According to NFPA 45, Class C laboratory doors do not have to swing in the direction of egress and laboratory partitions do not have to be fire rated.

F14. VIBRATION CRITERIA. Limit center bay vibration velocity to 2000 microinches / second (50 micrometers/second) due to building resonances and footfall induced vibration including slow (50 steps/minute) walking speed in workstation aisles, moderate (75 steps / minute in laboratory interior / ghost corridors, and fast (100 steps/ minute) walking speeds in adjacent corridors. Regions within 5 feet (2 meters) of columns shall be restricted to a vibration velocity of 600 microinches / second (15 micrometers/second) with inducer located at center of bay. This will provide a laboratory environment where approximately 45% of the lab is between 500 and 1000 microinches/ second (12-25 micrometers/second); approximately 10% is between 1000 and 1500 microinches/second (25 and 37.5 micrometers/second); and only 20% is between 1500 and 2000 microinches/second (37.5 and 50 micrometers/second).
For vibrations induced by mechanical equipment, structural slabs between lab and mechanical spaces shall be constructed to a minimum mass of 350 Kg/M² in order to provide an appropriate base for equipment isolators to work against. The design approach will then provide equipment isolation to preclude vibrations from being transferred into the structure.

The following table is provided for reference.

**Vibration Criteria:** The following table should serve as a basis for deciding the appropriate vibration criteria for the building.

### DESIGN CRITERIA FOR SENSITIVE INSTRUMENTATION AND EQUIPMENT NOT OTHERWISE VIBRATION-ISOLATED

Criterion Curve is the ISO nomenclature.

Max. Level ($V_{rms}$) is measured in μin/s.

Velocity Level is measure in dB with Ref: 1μin/s.

Detail Size is measured in μm.

- **Workshop (ISO):** 32,000 μin/s, 90dB, NA; Distinctly felt vibration. Appropriate to facility workshops and non-sensitive areas.

- **Office (ISO):** 16,000 μin/s, 84dB, NA; Felt vibration. Appropriate to offices and non-sensitive areas.

- **Residential Day (ISO):** 8,000 μin/s, 78 dB, 75μm; Barely felt vibration. Sleep areas in most instances. Probably adequate for computer equipment, probe test equipment and low-power microscopes (to 20X). Adequate for animal facilities.

- **Op. Theatre (ISO):** 4,000 μin/s, 72dB, 25μm; Vibration not felt. Suitable for sensitive sleeping areas. Suitable in most instances for microscopes to 100X and for other equipment of low sensitivity (this includes most inverted, fluorescence and confocal microscopes).

- **VC-A:** 2,000 μin/s, 66dB, 8μm; General laboratory criteria in NIH 2008 guidelines. Adequate in most instances for optical microscopes to 100X, microbalances, optical balances, proximity and projection aligners, etc. Animal holding and rodent behavioral rooms.

- **VC-B:** 1,000 μin/s, 60dB, 3μm; Optical microscopes up to 400x on benches and tables, and greater than 400x installed on isolation tables. Optical equipment on isolation tables, inspection and lithography equipment (including steppers) to 3 micron-meter line widths. Surgical spaces. Microscopy core (EM laser).

- **VC-C:** 500 μin/s, 54dB, 1μm; Electron microscopes up to 30,000x. A good standard for most inspection equipment and lithography to 1 micron micron-meter detail size. Laser-based optical systems.

**Detail Size column** expresses the minimum width of fabrication details or size of research particles that could be handled at a specific criterion value.

The US National Institutes of Health Design Requirements Manual 2008 (DRM 2008) guidelines call for MRI, NMR, and “super microscopes” to be located on slab on grade.
F15.  **SEISMIC / HURRICANE DESIGN.** Structural engineer to identify seismic / hurricane requirements. Provide shelving, cabinet and equipment and liquid nitrogen dewar restraints/tie downs as required.

F16.  **VALIDATION.** Design team should be aware that this facility will be validated to meet cGMP requirements and therefore P & I Drawings are required for all Engineering. IHM and IPS have this requirement. Validations for cGLP will be conducted for animal labs, IHM lab, IMPB molecular biology.


F18.  **FLOOD PREVENTION.** Allow for water to flow down stair and elevator shafts by requiring all slab penetrations to have a 2” (50mm) above floor slab sealed sleeve and automatic sump pumps in elevator wells. Provide minimum 2” curbs at all shaft openings (except stairs and elevators) in laboratory floors, and in floors above laboratories (e.g. mechanical rooms and mechanical penthouse).

**HEATING, VENTILATING AND AIR CONDITIONING**

H1.  **GENERAL.** The mechanical design shall be developed to meet the requirements of the United States Occupational Safety and Health Act (OSHA) Laboratory standards, American Society of Heating Refrigeration and Air Conditioning Engineers (ASHRAE) guidelines for directional air flow and the use of pressure differential for control and the American National Standards Institute (ANSI) Laboratory Ventilation Standard Z9.5. It should be noted that the National Building Code of the Philippines 2005 IRR contains ventilation standards which state normative values for room air changes per hour in offices, laboratories and assembly spaces. A review of the design requirements should be made and the more stringent requirements should be compared to address safety concerns and budgetary decisions.

H2.  **SPACE TEMPERATURE AND HUMIDITY CRITERIA.** The following inside design temperature (degrees Dry Bulb) and humidity (% Relative Humidity) conditions are recommended for all laboratory areas. Provide one thermostat per laboratory.

<table>
<thead>
<tr>
<th>Room Type</th>
<th>Summer Temp</th>
<th>Summer Humidity</th>
<th>Winter Temp</th>
<th>Winter Humidity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typical Laboratory</td>
<td>72° ±2 (22°C)</td>
<td>50% ±10</td>
<td>72° ±2 (22°C)</td>
<td>30% ±10</td>
</tr>
<tr>
<td>Linear Equipment Rm</td>
<td>72° ±2 (22°C)</td>
<td>50% ±10</td>
<td>72° ±2 (22°C)</td>
<td>30% ±10</td>
</tr>
<tr>
<td>Tissue Culture / Procedure Room</td>
<td>70° ±2 (21°C)</td>
<td>50% ±10</td>
<td>70° ±2 (21°C)</td>
<td>30% ±10</td>
</tr>
<tr>
<td>Core Lab</td>
<td>70° ±2 (21°C)</td>
<td>50% ±10</td>
<td>70° ±2 (21°C)</td>
<td>30% ±10</td>
</tr>
<tr>
<td>BSL3 Lab</td>
<td>70° ±2 (21°C)</td>
<td>50% ±10</td>
<td>70° ±2 (21°C)</td>
<td>30% ±10</td>
</tr>
<tr>
<td>Office / Amenity</td>
<td>72° ±2 (22°C)</td>
<td>50% ±10</td>
<td>72° ±2 (22°C)</td>
<td>30% ±10</td>
</tr>
</tbody>
</table>

H3.  **VENTILATION CRITERIA.** One hundred percent of the air supplied to the laboratory areas shall be exhausted. There shall be no recirculating of laboratory air. Supply air quantities shall be based upon heat loads, minimum dilution/ventilation requirements, and/or required make-up air for exhaust systems, whichever is greatest.

H4.  **AIR CHANGE CRITERIA.** While occupied, a minimum level of effective air changes per hour (ACPH) for dilution and/or removal of odors in laboratories shall be provided. Engineer shall calculate actual ACPH requirements based on exhaust device requirements and heat loads generated by equipment, people, lighting, and solar heat gain. While unoccupied, the minimum ACPH in laboratories can be reduced to 4 if acceptable environmental (temperature and humidity) parameters can be maintained.
H5. PRESSURIZATION CRITERIA. All laboratories shall be negative with respect to the corridor or adjacent space, unless otherwise noted, assuming that all doors are kept closed. The overall building shall be positive to atmosphere to avoid infiltration. The level of pressure differential shall be established by the Engineer.

H6. FILTRATION/DEDICATED EXHAUST CRITERIA. All laboratory areas shall be supplied with air through 30% ASHRAE (atmospheric dust spot efficiency) efficient pre-filters and 95% ASHRAE efficient final filters. Laboratories or equipment which require dedicated and/or special filtration of supply or exhaust air are listed below:

a. Biosafety Level 3 (BSL-3) laboratories require dedicated high efficiency particulate exhaust (HEPA) and design for reliable ventilation that will not cause reversal of air flow during emergencies.

b. Animal biosafety level 2 (ABSL-2) rooms that require clean conditions (barrier) will be provided with dedicated HEPA filtered air supply and HEPA exhaust. Air locks shall be design to

c. Animal rooms requiring containment for infection control and safety will require

H7. BUILDING OPERATING SCHEDULE. All laboratory M.E.P. systems shall be operable 24 hours, 7 days a week with varying degrees of occupancy in a 24 hour period. Some areas will be mainly 8-5 office hours. Building areas will be managed to have low use periods.

H8. FLEXIBILITY CRITERIA. Air distribution systems shall be designed to afford flexibility for future redesign, primarily by providing accessibility to the duct systems throughout the facilities and, where feasible, by applying a modular layout of air distribution devices and by providing symmetry and uniformity to the branch duct layout. Initial infrastructure should provide capacity for up to [25%] [50%][or other %] beyond initial capacity.

H9. WATTS/SQUARE FOOT. The HVAC system shall be sized to compensate for the following equipment heat loads (not including lights or people):

<table>
<thead>
<tr>
<th>Space</th>
<th>Watts/SF</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Typical Laboratory</td>
<td>8</td>
</tr>
<tr>
<td>b. Equipment Room*</td>
<td>40*</td>
</tr>
<tr>
<td>c. Linear Eqmt Room</td>
<td>16</td>
</tr>
<tr>
<td>d. Tissue Culture / Procedure Room</td>
<td>16</td>
</tr>
<tr>
<td>e. Analytical Laboratory</td>
<td>40</td>
</tr>
</tbody>
</table>

(* this value has been verified by two different HVAC engineers)

Note: Any room exceeding these values will be serviced with a local chilled water fan coil unit that will recirculate and cool the room air.

H10. NOISE CRITERIA. Ambient noise level in the laboratories shall meet NC40 (Noise Criterion 40) in laboratories without fume hoods, not to exceed NC45 in laboratories with fume hoods. Special consideration must be given to facilities such as clinics, clinical or human behavioral research which must meet HIPAA regulations.
H11. HVAC CONCEPT. The following HVAC concept is proposed for this facility:

a. Supply Location. Supply air diffusers shall be located so as not to create drafts or turbulence at fume hoods or biological safety cabinets.

b. Exhaust Location. Each module shall be exhausted at a common location in the laboratory and can accommodate an initial or future 1200 mm fume hood, biological safety cabinet or room exhaust register rated for approximately 650 CFM.

c. Manifold System. All laboratory exhaust shall be exhausted through a common exhaust duct, also referred to as a manifold system. Only specialty hoods (radio-chemical, perchloric or Class II Type B2 biological safety cabinet) or equipment that requires direct venting will have a dedicated exhaust and fan.

d. Thimble Connection. Class II, Type A2 biological safety cabinets (30% exhaust) if noted to be ducted shall be connected to the manifold system with a thimble connection.

e. Exhaust Fan Redundancy. Manifolded exhaust system shall be on multiple fans, minimum two, each rated for 60-75% of the total load to compensate for maintenance or partial system failure.

f. Controls. All controls shall be DDC with electronic [or pneumatic] actuators. The potential to employ PLC's (programmable logic controllers) and industrial grade components (not commercial grade) should be evaluated.

g. Energy Conservation.
   1. Low velocity / high performance fume hoods and/or horizontal/vertical restricted sash fume hoods shall be utilized to reduce overall building exhaust requirements and provide a safer work environment by reducing the sash opening (50% vs. 100%). Automatic sash positioners will be provided.
   2. Heat Recovery. Heat recovery is encouraged and should be investigated.

h. Supply/Exhaust System.
   1. [Option 1] Constant Volume. The supply and exhaust system shall be constant volume. No method of reducing volume during unoccupied periods will be provided.
   2. [Option 2] Two-Position Constant Volume. The supply and exhaust system shall be constant volume with a reduced constant volume when the laboratory is unoccupied. For planning purposes the unoccupied reduced volume shall be 50% with thermostat override. The primary components of this system are two-position constant volume boxes on the supply and exhaust from the laboratory module and fans connected to the manifolded system that can respond to an infinitely variable air flow.
   3. [Option 3] Variable Air Volume (VAV): The supply and exhaust system shall be variable air volume with minimum air change criteria established for occupied and unoccupied times. During occupied and unoccupied times, the air volume should be thermostat controlled and provide at least the minimum air change criteria. The primary components of this system are VAV boxes on the supply and exhaust from the laboratory module and fans connected to the manifolded system that can respond to an infinitely variable air flow.

Exhaust Fans. The exhaust fans should have a minimum exhaust stack discharge velocity of 3,000 fpm (15 meters/sec).
Fume Hood VAV/Alarm Control System. Fume hood through-the-wall pressure sensing devices (hot wire technology) shall be employed, not sash tracking.

H12. FUME AND EXHAUST HOOD CRITERIA.

Chemical fume hoods shall typically be 4'-0" (1200mm) bench type with horizontal/vertical restricted sashes, one 36" (600mm) wide corrosive acid base cabinet and one 12" (300mm) wide base cabinet to conceal cup sink waste piping. Corrosives cabinets will be vented behind the fume hood baffle and 12"(300mm) above the counter top. Fume hoods shall have an average face velocity of 80 feet per minute (.5m/sec). Fume hoods and biological safety cabinets will be equipped with an airflow monitor/audible-visual alarm. The following criteria have been provided for mechanical system planning:

Description

a. CFH72  4'-0" (1800 mm) restricted sash bench hood
b. IIA-6   6'-0" (1800mm) class II, type A2 (30% exhaust) biological safety cabinet
c. IIA-4   4'-0" (1200mm) class II, type A2 (30% exhaust) biological safety cabinet
d. X-1     Point Exhaust / Fume Extraction point: 1 indicates base size: typically 4" (100mm) 75 cfm. FX – 2 would denote a second type.
e. CAN-x   Canopy Hood. Formula for calculations as follows: 30 liters/ minute
f. DOWN   Downdraft surfaces: 100 cfm / sf (1100 cfm / sqM) downdraft velocity at table surface for 100% smoke capture at 12" (300 mm) above table.

H13. ACCESS TO MECHANICAL EQUIPMENT. If building design includes an elevator, provisions shall be made to include a stop at the location of MEP equipment.

H14. BSL3 SUITE SPECIAL HVAC CRITERIA. There are very specific criteria specific to this area; refer to the Containment Criteria Narrative.

H15. DEHUMIDIFICATION:

1. Provide central dehumidification in summer conditions if criteria warrants
2. Provide 25-30%RH, 55°F supply air to any environmental or cold room that requires mechanical ventilation to avoid condensation on the walls. Engineer to determine which method is appropriate for the application.
ELECTRICAL

E1. PRIMARY VOLTAGE. Laboratory areas will require 208/120 volt, 3-phase 220 volt, 50 cycle, 2 phase, 3 wire service for receptacles, small appliances and small (1/3 horsepower or less) motors. Elevators shall incorporate "Soft" starters to minimize any adverse effect on the power source.

E2. SERVICE DISTRIBUTION.

Each laboratory shall have an individual circuit breaker panel or panels as the size of the lab warrants. Each panel shall have at least 25% spare breaker capacity above initial requirements. Each 120V/20A (220 volt) circuit shall not exceed four (4) receptacles.

Alternate circuiting of adjacent duplex receptacles is recommended to minimize outages. It is recommended that electrical distribution be via surface mounted twin compartment (electrical and data; similar to Isoduct or Wiremold) raceways at wall benches and peninsula benches.

Duplex outlets shall be provided at a maximum of 2'-0" O.C. (600mm), unless otherwise noted.

Ground fault protection will be provided for outlets within 4'-0" (1200mm) (distance to be confirmed by electrical engineer based on local codes) of a sink edge.

Special attention shall be paid to the unusual number of dedicated circuits and outlets that will be required in specialized laboratories such as analytical laboratories.

E3. EMERGENCY (STAND-BY) POWER.

It is recommended that the following items be placed on emergency (stand-by) power, and this shall not be confused with Life Safety requirements:

a. Laboratory manifold exhaust system (at least one fan) to maintain relative negative pressure of labs, exhaust from fume hoods (sash shall be completely closed in a power outage), vented base cabinets (acid and flammable) under the hood and thimble exhaust above biological safety cabinets.

b. Fume hood and biological safety cabinet air flow monitor/audible-visual alarm.

c. Environmental rooms (Cold).

d. DDC panels

e. Air conditioning system including pumps and fans.

f. Computer servers in dedicated computer rooms.

g. Although specific laboratory equipment cannot be identified at this time, assume the following:

1) Typical Laboratory: two (2) 120V (220v) duplex receptacles per module (one per benchside).

2) Equipment Rooms: two (2) 120V (220v) duplex receptacles per module

3) Tissue Culture Room: one (1) 120V (220v) duplex receptacle per room.

4) Procedure Rooms: two (2) 120V (220v) duplex receptacles per room
5) Linear Equipment Room: 120V, 20A (220v) duplex receptacle nominally 5'-0" (1500mm) on center on both sides of room.

6) Outlets on standby power will be red. Where special outlets not available with red bodies are required, the cover plate will be red.

E4. UPS SYSTEM. A central UPS system is not recommended for this building. Users will be responsible to provide local UPS systems for equipment requiring this service. Emergency generator will accept load transfer within 10 seconds. Selected labs will need this.

E5. VOICE/DATA SYSTEM. Voice/data outlets shall be provided every 8'-0" (2000mm) O.C. in the twin compartment electrical raceway in laboratory and one outlet at each work station and lab office. Provide cable tray in central corridor and linear equipment room. The Analytical or Core Laboratories may require additional outlets. Provide phone jacks outside the doors of each laboratory suite for safety.

E6. ARTIFICIAL LIGHTING. The recommended illumination level to be achieved in all laboratory areas at the work surface (37" A.F.F (900mm)) is 80 foot-candles (800 lumens/ sq meter). Fluorescent lighting with T8 electronic ballasts and light emitting diodes (LED) will be acceptable in all laboratory areas as long as light levels are maintained. It is preferable to have dimmer capability in Computer Rooms. Direct/indirect lighting fixtures are preferred in the laboratories. Lighting design will consider energy efficiency, economy of construction and ease of maintenance. Combinations of lighting strategies where daylighting is available will be employed.

E7. SPECIAL WIRING IN HAZARDOUS AREAS. Hazardous areas and equipment shall be equipped with explosion-proof lighting fixtures, power outlets and switches as follows (provide grounding as necessary to prevent static build-up):

   a. Chemical Solvent Storage Room.
   b. Solvent dispensing fume hood located in Chemical Solvent Storage Room.

E8. BSL3 SUITE SPECIAL ELECTRICAL CRITERIA. There are very specific criteria specific to this area; refer to the Containment Criteria Narrative.

PIPED SERVICES

P1. GENERAL. Subject to review and consideration by the Plumbing Engineer, piped services shall be available for potential distribution to all individual laboratories through a perimeter distribution system located at the inside face of the exterior wall. Piped services shall be distributed within the lab via a horizontal service chase within the laboratory bench. This shall be furnished as part of the laboratory casework and shall be independent of the partitions. System sizing and diversity factor to be determined by Engineer. Vacuum breakers will be furnished on all domestic water fixtures including eye/face drench hose where potable water is used.

P2. COLD WATER SYSTEM. A potable cold water system shall be provided to laboratory sinks, cup sinks, safety stations (combination safety shower and eye/face wash), safety showers and eye/face wash stations. Capacity will be based on one sink outlet (3 gpm/35-40 psig (.2 liter/sec at 240-275 kPa)) and one cup sink outlet (1 gpm/35-40 psig (.2 liter/sec at 240-275 kPa)) per laboratory module. Usage factor (% of total demand): 20%.
P3. HOT WATER SYSTEM.

a. Unless noted otherwise, laboratory sinks and hose bibbs for washdown areas shall have hot water from a local electric instantaneous water heater.

P4. TEMPERED POTABLE WATER. A tempered potable water system is required to support the operation of the eye wash and safety showers.

P56. SPECIALTY GASES. Laboratory gases (i.e. N2, H2, He, Instrument Air, NO2, CO2, etc.) require all piping components (Copper tubing for nonflammable gases and stainless steel tubing for oxidizers and flammables is recommended). Outlet pressure shall be 150 psig (1380 kPa) with line pressure not to exceed 200 psig (1840 kPa). Gas cylinders shall be located outside the laboratories in convenient shared gas cylinder closets.

Laboratory gases anticipated on this project include:
AR: Argon
CO2: Carbon Dioxide
H2: Hydrogen
He: Helium
NO2: Nitrous Oxide
N2: Nitrogen
O2: Oxygen

The list shall be updated prior to delivery of Design Development documents.

Fixtures to be: lubricated, cleaned, capped, protected, and delivered certified for "Oxygen" service and shall be supplied as follows:

a. BSL-3 and ABSL-2, ABSL-3 areas: gases delivered, handled and distributed from cylinders and manifolded to the point of use (fixture or equipment) on a local basis. Owner will furnish and install all piping, regulators, gauges, cylinders, alarms, control valves, etc.

b. BSL-2 areas: gases will be delivered from cylinders locally positioned in the laboratory. All components will be owner furnished. Cylinder restraints will be located in the laboratory as part of the casework system.

c. CO2 will be delivered from a central point on each floor and manifolded to the point of use terminating at a quick disconnect (Q/D). Bulk containers or multiple cylinders, alarms, automated change-overs will be furnished by Owner/Vendor. Although specific requirements cannot be identified at this time, assume the following:

   o Four (4) Q/D's per Tissue Culture Alcove.

   o Eight (8) Q/D's per Procedure Room.

P7. COMPRESSED AIR SYSTEM. (TBD)

1. **CDA**—Clean Dry Air: for critical applications like cleanrooms (-100 to -40 °F dewpoint, less than 3 micron particulate, less than 0.1 PPM hydrocarbons)

2. **LA**—Laboratory Air: for general laboratory applications, including scientific instrumentation (-40 to +10 °F dewpoint, 3 micron particulate, less than 1 PPM hydrocarbons). Oil free, compressed air shall be available to each laboratory at 60 psig (415kPa). Capacity will be based on four (4) outlets per laboratory module (1 scfm/outlet). No special filtration is anticipated (filter on intake is standard). Usage factor (% of total demand): 20%
3. **CA**—Compressed Air: for shop or plant compressed air (above +10 °F dewpoint, greater than 3 micron particulate, more than 1 PPM hydrocarbons)

**P8. VACUUM SYSTEM.**

a. **VAC:** Local vacuum pumps shall be furnished and installed by Owner in vented vacuum pump cabinets provided as part of the laboratory casework.

b. **BSL-3 and ABSL-3 vacuum shall be HEPA filtered and used inside biosafety cabinets.**

**P9. TYPE III REAGENT GRADE WATER SYSTEM.** A centralized water system with a continuous loop design to the tip of the faucet, capable of providing type III reagent grade water (CAP/NCCCLS or ASTM), is recommended for this facility. Capacity will be based on one outlet per laboratory (.5 gal per hour (2 liters per hour) /outlet at 25-60 psig (200-400 kPa)) plus specific equipment consumption rates (glassware washers and local water polishers). Polypropylene pipe with fused joints is recommended. Local in-laboratory polishing units will be utilized to increase the quality of the type III reagent grade water to type I. Fixtures that recirculate to the outlet will be specified to eliminate dead-legs. The diversity of consumption criteria shall be 50% for faucets and 100% for hard connected equipment. Type III reagent grade water basic specifications:

<table>
<thead>
<tr>
<th>Professional Association:</th>
<th>CAP/NCCCLS</th>
<th>ASTM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resistivity (megohms/cm):</td>
<td>0.1</td>
<td>1.0*</td>
</tr>
<tr>
<td>Conductivity (microhm/cm):</td>
<td>10.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Silicate (microg/L):</td>
<td>1000</td>
<td>500</td>
</tr>
<tr>
<td>Total Organic Carbon (microg/L):</td>
<td>N/A</td>
<td>200</td>
</tr>
<tr>
<td>Sodium (microg/L):</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Chlorides (microg/L):</td>
<td></td>
<td>10</td>
</tr>
</tbody>
</table>

* We acknowledge that the current ASTM standard for Type III water is 4. However this lower criteria was established to minimize the equipment's life cycle cost.

**P10. TYPE I REAGENT GRADE WATER.** A type I reagent grade water system, centrally distributed as a building system, shall not be provided. Type I reagent grade water will be delivered via Owner furnished and installed local polishing units fed by the type III reagent grade water system. These units are typically located in shared areas for certain lab floors.

**P11. STEAM.**

a. Process Steam: High pressure (60 PSI (420 kPa)) process steam shall be provided to glassware washers and other equipment with built-in steam-fired hot water temperature boosters. A local electric steam generator shall be provided where required.

b. Clean steam. High pressure (60 PSI (420 kPa)) clean steam (generated with potable water and free of all boiler additives) shall be provided to cGLP or cGMP sterilizers through the use of a steam fired boiler. A local electric clean steam generator shall be required.
P12. **CHILLED/PROCESS/CONDENSER WATER.**
   
a. Chilled water required for all water-cooled Environmental Room condensing units and for specific laboratory equipment identified by owner, chilled water will be provided by local chillers and mechanical space for the footprint of these chillers will be considered in the design.

P13. **FLOOR DRAINS.** Floor drains at safety showers shall not be provided.
   
   Floor drains shall not be provided in laboratory areas except in Glass Wash Rooms, and at specific equipment locations (i.e.: sterilizers, glassware washers, ice machines). Controlled Environmental Room condensate will drain into floor drain located exterior to room and easily accessible.

P14. **LABORATORY WASTE (DRAIN) SYSTEM.** Policy and procedure will be to segregate and dispose of any toxic, radioactive or high concentration wastes through local "in-lab" safety containers, without the use of a piped waste system. Polypropylene is recommended for all branches.

P15. **NEUTRALIZATION/MONITORING.**
   
   Provide local neutralization capability at all laboratory sinks.

P16. **SPRINKLER SYSTEM.** All laboratory areas shall be provided with automatic wet sprinkler system protection. The system shall be designed with provisions that permit replacement of sprinkled areas with specialized local systems such as pre-action as warranted by special requirements. If a dry system is required, provide an FM 200 system.

P17. **BSL3 SUITE SPECIAL PLUMBING CRITERIA.** There are very specific criteria specific to this area; refer to the Containment Criteria Narrative.

**SAFETY**

S1. **GENERAL.** It is recommended that the following safety features be provided in or accessible to each laboratory and meet OSHA and/or ANSI requirements for configuration, operation and location.

S2. **SAFETY STATIONS.** Provide a minimum of two (2) safety stations, consisting of a deluge shower and eye/face wash, in each laboratory corridor within 10 seconds travel distance of any laboratory. The specific number should be driven by building configuration, code or owner's standard, whichever is more stringent. Eye/face wash to operate independently of deluge shower. Height of eye/face wash basin, deluge shower pull ring and deluge shower head should meet ADA and ANSI requirements.

S3. **EYE/FACE WASH / SAFETY SHOWERS.** A hand-held, counter top mounted eye, face and body wash/drench hose unit should be provided at every laboratory sink. All stand alone safety showers, eye washes, and combination eye wash/ safety showers shall be supported with a source of tempered potable water. The number of units and their specific location shall meet all national codes and local regulations or client standards whichever is more stringent.

S4. **FIRE EXTINGUISHERS.** Fire extinguisher cabinets should be located in corridor at laboratory doorway. Extinguishers shall be provided by Owner. The specific number should be driven either by code or owner's standard, whichever is more stringent.
S5. **EMERGENCY COMMUNICATIONS.** A telephone should be located in each laboratory to summon appropriate safety personnel or emergency aid.

S6. **SIGNAGE.** Appropriate signage indicating, but not limited to, Radioisotope, Flammable, Corrosive, Microwave or Biological Hazard, should be posted on each appropriate laboratory entry door. Signage to be furnished by Owner or accommodated in the wall mounted room name/occupants signage system.

S7. **SAFETY CLOSET OR EMERGENCY RESPONSE TEAM ROOM.** Owner to determine whether a safety closet on each floor in each laboratory wing or a central Emergency Response Team (ERT) Room will be provided. Equipment will be furnished by Owner and typically consists of the following:
   a. Decontamination Equipment
   b. HEPA filtered, explosion proof, wet/ dry vacuum
   c. Spill Control Equipment
   d. Drawings and diagrams of the building and alarm systems

S8. **EMERGENCY ELECTRICAL SHUT-OFF.** An emergency electrical shutoff may be provided for laboratories. Local circuit breakers shall be provided wherever equipment manufacturers require.

S9. **PUBLIC SAFETY ISSUES.** The following security options shall be incorporated into project.
   a. Entry card access
   b. Doorway alarms
   c. CATV coverage on building exterior
   d. Exterior lighting
   e. Communication link to monitoring station.

**END OF PART IX-B**