



Laboratory Safety Design Guidelines

The primary objective in laboratory design is to provide a safe environment for laboratory personnel in which to conduct their work. A secondary objective is to allow for the maximum flexibility for safe research use. Sustainable design principles shall be incorporated into all UMDNJ design and construction projects to the greatest extent practical, for both new construction and renovation/alteration of existing facilities. The Architect/Engineer is encouraged to inform the University of opportunities in this regard.

The goal of the UMDNJ Laboratory Safety Design Guidelines is to ensure that the safety considerations are incorporated into the design and construction of UMDNJ laboratory facilities. The criteria listed in the Guidelines are minimum design standards which shall be used on all new construction and renovation projects involving laboratories at UMDNJ.

This living document was first created in 2002 as the result of a partnering effort led by EOHSS, with input from researchers, Physical Plant and FP&C on all campuses. It incorporates lessons learned, positive and negative, from previous construction projects as well as recent trends affecting biomedical research facilities. Comments and suggestions are welcomed and should be directed to me.

It is the responsibility of the Architect/Engineer to bring deviations to the attention of the FP&C Project Manager. Deviation from these guidelines must be discussed with and approved in writing by the UMDNJ Project Manager, Department of Facilities, Planning and Construction (FP&C) as well as Physical Plant, Radiation Safety Services, or Environmental and Occupational Health and Safety Services (EOHSS), as applicable, depending upon the issue.

Renee F. Lyons

Director, EOHSS

January 2007

UMDNJ Laboratory Safety Design Guidelines
Table of Contents

Introduction: Deviations from Lab Design Guidelines.....1

1. ADA Requirements.....1

2. Architectural Finishes1

 A. Typical Laboratory1

 B. Linear Equipment Room1

 C. Glasswash.....2

 D. Photographic Dark Room2

 E. Tissue Culture Room.....2

 F. Volatile Radioisotope Laboratory.....2

 G. Core Laboratory Facilities2

3. Autoclave Areas.....3

 A. Preventing Steam Accidents3

 B. Tower-Style Autoclaves.....3

 C. Clearance.....3

 D. Dedicated Heat Removal Canopy3

 E. Backflow Preventors3

 F. Pressurized Drains4

 G. Sterilant Gas.....4

4. Back-Flow Preventors.....4

5. Biological Safety.....4

6. Biosafety Level 3 (BSL-3) Suite Special Architectural Criteria4

 A. Doors.....4

B. Autoclave	5
C. Ante Room/Air Lock/Change Space.....	4
D. View Windows.....	5
E. Architectural Finishes.....	5
F. Decontamination.....	5
G. Signage.....	5
H. BSL-3 Suite Special HVAC Criteria	5
I. BSL-3 Suite Special Electrical Criteria.....	7
J. BSL-3 Suite Special Plumbing Criteria.....	7
7. Break Rooms.....	9
8. Ceilings	9
A. Dropped Ceilings	9
B. Ceiling Heights.....	9
9. Chemical storage Areas	9
A. Chemical Fume Hood Base Cabinets	9
B. Hazardous Liquids Storage	10
10. Chemical Waste	10
A. Hazardous Waste Accumulation Room	10
B. No Laboratory Drain Chemical Waste Disposal.....	11
C. Neutralization Pit.....	11
11. Clearances	11
12. Confined Spaces	11
13. Construction Practices	11

14.	Doors	11
15.	Egress	11
	A. Corridor Storage.....	12
	B. Exit Signs	12
16.	Electrical Systems.....	12
	A. Emergency Shut Offs	12
	B. Circuit Breakers.....	12
	C. Emergency (Stand-By) Power.....	12
	D. Special Wiring in Hazardous Areas	13
	E. Ground Fault Circuit Interrupters.....	13
17.	Elevators	13
18.	Emergency Communications	13
	A. Laboratories	13
	B. Solvent Storage Areas and Chemical Waste Rooms	14
19.	Emergency Equipment.....	14
	A. Eye Washes in Laboratories.....	14
	B. Safety Showers/Eye Washes in Corridors.....	14
	C. Safety Showers/Eye Washes in Other Areas Where Hazardous Materials Are Used or Stored.....	14
	D. Compliance with ANSI 358.1	15
	E. Shower with Drain.....	15
20.	Energy Conservation.....	15
	A. Heat Recovery	15

- B. EOHSS approval of Ventilation Strategy15
- C. Green Building Laboratory Opportunities15
- D. Physical Plant Construction Standards16
- 21. Environmental (Cold 4°C and Warm 37°C) Rooms16
 - A. Ventilation of Cold and Warm Rooms16
 - B. Preventing Condensation16
 - C. Architectural Finishes of Environmental Rooms16
 - D. Viewing Panels16
- 22. Ergonomics and Physical Hazards.....16
- 23. Equipment and Furnishings17
 - A. Physical Plant Approval17
 - B. Physical Plant Energy Management System17
 - C. Furnishings17
 - D. Accessibility.....17
- 24. Fire Safety18
 - A. Flammable Liquid Quantity Limitations.....18
 - B. Fire Extinguishers19
 - C. Flammable Storage Cabinets.....19
 - D. Laboratory Safety Refrigerator19
 - E. Floor and Wall Penetrations20
- 25. Floor Drains20
- 26. Floor Loading.....20
- 27. HVAC General20

A. Codes, Regulatory Standards and ANSI Z9.5 Standard for Laboratory Ventilation	20
B. Temperature/Humidity	20
C. Filtration of Incoming Air	21
D. Dedicated Exhausts	21
E. Environmental (Cold/Warm) Rooms	21
F. Directional Airflow/ No Re-circulation of Laboratory Air	21
G. Preventing Cross Drafts in Containment Equipment	22
H. Laboratory Air Exchange Rate	22
I. Heat Loads	22
J. Air Balancing	22
K. Manifold System	22
L. Exhaust Fan Redundancy	23
M. Controls	23
N. Supply/Exhaust System	23
O. Humidification	24
P. Labeling of Ductwork and Exhaust Fan	24
Q. Internal Liners	24
R. Computational Fluid Dynamics Modeling Study	24
S. Pressurization of Ductwork	24
T. Chemical Fume Hoods	25
U. Hood Monitor/Alarm	27
V. Stacks	28

	W. Composition of Chemical Hood Exhaust Ductwork.....	28
28.	Lighting.....	29
	A. Natural Light.....	28
	B. Illumination Level.....	29
	C. Lighting Fixtures	29
29.	Natural Gas	29
	A. Biological Safety Cabinets.....	29
	B. Emergency Gas Shut Off Controls In Laboratories	29
30.	Noise	30
	A. Internal Noise.....	30
	B. External Noise.....	30
31.	Open Laboratories.....	30
32.	Operating Schedule of the Building.....	30
33.	Piped Services.....	30
34.	Planning for the Future	31
	A. HVAC Capacity	30
	B. Autoclave Capability.....	31
35.	Public Safety Issues	31
36.	Radiation Safety.....	31
	A. Security of Radioactive Materials.....	32
	B. Laboratory Radioactive Waste Storage.....	32
	C. Facility Radioactive Waste Storage Room.....	32
	D. Decontamination Requirements for Radioactive Material Use Areas	33

E. Prohibition of Food and Drink in Laboratory Areas	33
F. Chemical Fume Hoods for Volatile Radionuclides	33
37. Regulated Medical Waste.	33
38. Seismic Design.....	34
39. Signage.....	34
A. Laboratory Door Signs.....	34
B. Evacuation Signs	34
40. Silver Recovery.....	34
41. Specialty Gases	34
42. Sprinkler System.....	34
43. Storage	34
A. No Corridor Storage.....	34
B. Storage Area.....	34
44. Vacuum Systems.....	35
45. Vibration Criteria.....	35
46. Waste Storage in the Laboratory.....	35

Introduction: Deviations from Laboratory Safety Design Guidelines

The University has established the following guidelines for the purchase, design, and installation of laboratories and laboratory equipment. Deviation from these guidelines must be discussed with and approved by the UMDNJ Project Manager, Department of Facilities, Planning and Construction (FP&C), Physical Plant, Radiation Safety Services, Environmental and Occupational Health and Safety Services (EOHSS) and the end user. It is the responsibility of the Architect/Engineer to bring deviations to the attention of the FP&C Project Manager.

1. ADA Requirements (Access and Workstation)

Access to and within all laboratory areas shall meet ADA requirements. Facility will be modified in the future on an “as needed” basis.

2. Architectural Finishes

The following is a list of recommended architectural finishes for typical laboratory areas. As a general rule, provide waterproof Gypsum Wall Board (GWB), or an equivalent product, approved by Physical Plant, in wet areas and behind any sink assembly located against a wall. See also section 35C, “Decontamination Requirements for Radioactive Material Use Areas.”

A. Typical Laboratory

Floor: Seamless vinyl with 4” high vinyl cove molding shall be provided to prevent the seepage of liquid into the space between walls and floors.

Wall: 5/8” Gypsum Wall Board (GWB) with water-based, washable, low-luster paint.

Ceiling: 5/8” vinyl coated acoustical lay-in tile. Ceiling tiles shall have appropriate fire rating and be washable.

Casework: Phenolic cabinets with epoxy resin or phenolic counter top.

B. Linear Equipment Room

Floor: VCT with 4” high vinyl cove molding shall be provided to prevent the seepage of liquid into the space between walls and floors.

Walls: 5/8” GWB with water-based, washable, low-luster paint, corner protection and white marker boards (these must not conceal electric panels and must maintain the clearance required by code).

Ceiling: None. Maintain 8’-0” AFF unobstructed clearance plan.

C. Glasswash

Floor: Seamless vinyl with welded seams equal to Armstrong Medintech with integral 4" high 1/8" radius cove based.
Wall: 5/8" waterproof GWB with water-based epoxy paint and insulation. Extend partitions to underside of structural slab.
Ceiling: 5/8" waterproof GWB with water-based epoxy paint and insulation.
Casework: Phenolic cabinets with type 316L stainless steel counter top and sink.

D. Photographic Dark Room

Floor: Gray seamless vinyl with heat welded seams equal to Armstrong Medintech with integral 4" high, 1/2" radius cove base.
Wall: 5/8" water-proof GWB with water based flat gray epoxy paint.
Ceiling: 5/8" waterproof GWB with water-based flat gray epoxy paint.
Casework: Phenolic cabinets with gray epoxy resin counter top.
Processing sinks should be molded fiberglass equal to Kreonite.

E. Tissue Culture Room

Floor: VCT with 4" high vinyl cove molding
Wall: 5/8" GWB with water-based, washable, low-luster paint.
Ceiling: 5/8" vinyl coated acoustic lay-in-tile. Ceiling tile shall have the appropriate fire rating and be washable.
Casework Phenolic cabinets with epoxy resin counter top and sink.

F. Volatile Radioisotope Laboratory

Floor: Seamless vinyl with welded seams equal to Armstrong Medintech with integral 4" high 1/2" radius cove base.
Wall: 5/8" GWB with water-based epoxy paint. Ceiling tile shall have the appropriate fire rating and be washable.
Casework: Phenolic cabinets with stainless steel counter top and sink.

G. Core Laboratory Facilities

Floor: Seamless vinyl with welded seams equal to Armstrong Medintech with integral 4" high 1/2" radius cove base.
Wall: 5/8" GWB with water-based, washable, low luster paint.
Ceiling: 5/8" vinyl coated acoustic lay-in tile. Ceiling tiles shall have appropriate fire rating and shall be washable.
Casework: Phenolic cabinets with epoxy resin or phenolic countertop and sink.

3. Autoclave Areas

A. Preventing Steam Accidents

Compressors for autoclaves shall be located in an area that is not normally occupied or shall be sufficiently enclosed to prevent personnel from being splashed during a steam release. Provisions shall be made so that steam which escapes from the safety relief valve during an over-pressure condition is plumbed/exhausted according to the plumbing code to prevent steam from filling the area or injuring any personnel.

One steam generator shall not be stacked upon another.

Care shall be taken to ensure that equipment is located to prevent condensate or other water sources from dripping onto electrical controls.

Equipment shall be located to ensure that in the event of a steam release, the egress route from the area is minimally blocked or obstructed by equipment or released steam.

B. Tower-Style Autoclaves

Tower-style autoclaves where one autoclave is stacked upon another are prohibited.

C. Clearance

There shall be at least a four foot clearance between the front of the autoclave and the opposing wall or any other obstruction.

D. Dedicated Heat Removal Canopy

Special exhaust ventilation (such as canopies for heat removal for autoclaves) will not be connected to re-circulating ventilation systems. Enclosed equipment area for sterilizer should be highly ventilated to prevent build-up of heat, moisture and odors. Steam-catching canopies shall be stainless steel or stainless steel lined sheetrock and shall be connected to a dedicated stainless steel system.

E. Backflow Preventors

Backflow preventors must be provided in all locations as required by code.

F. Pressurized Drains

Sterilizers shall be equipped with an integral effluent sterilization system with an open air gap connection employed at the floor drain for cooling hot condensate.

G. Sterilant Gas

Special ventilation or exhaust systems should be provided to accommodate equipment using sterilant gases. Fans should be at the end of runs for both cylinder storage and equipment areas. Ductwork and fans should be labeled indicating the type of gas exhausted.

4. Back-Flow Preventors

Back-flow preventors must be provided in all locations as required by code. Back-flow preventors should be installed on all sinks or equipment connected to potable water sources.

5. Biological Safety

The latest version of the NIH/CDC guidelines, "Biological Safety in Microbiological and Biomedical Laboratories," shall be complied with to ensure appropriate containment of biohazardous work. Biological safety levels 1 – 4 have been designated, with BSL-1 being the least hazardous. All laboratories at UMDNJ will meet the design requirements for a BSL-2 or higher laboratory.

6. Biosafety Level 3 (BSL-3) Suite Special Architectural Criteria

All provisions in the most recent version of the CDC Guidelines entitled, "Biosafety in Microbiological and Biomedical Laboratories," as well as other relevant CDC Guidelines shall be followed, including methods of monitoring and alarming. The following criteria are specific to this area:

A. Doors

Regulations require passage through two sets of doors for entry into the suite from an unrestricted corridor. (This may also include a clothes-change room and shower). Doors with appropriate vision panels shall be provided with automatic closers, closed cell neoprene gaskets on all three sides, and a surface-mounted automatic drop seal to facilitate gas decontamination procedures.

B. Autoclave

A double-door (pass-through), high vacuum sterilizer shall be specified with cross-contamination seal and integral effluent decontamination. Enclosed equipment area for sterilizer should be highly ventilated to prevent build-up of heat, moisture and odor.

C. Ante Room/Air Lock/Change Space

Provide ante room/ air lock between suite and corridor consisting of two sets of doors. Provide another change space on the "dirty side" for clothes. A shower is not currently required by regulations.

D. View Windows

View windows shall be closed and silicone-sealed.

E. Architectural Finishes

Floor: Seamless vinyl with welded seams equal to Armstrong Medintech with integral 4" high 1/2" radius cove base.

Wall: 5/8" GWB with water-based epoxy paint and minimum 1/2" radius coved corners.

Ceiling: 5/8" GWB with water-based epoxy and minimum 1/2" radius coved corners.

Casework: Phenolic with epoxy resin countertop and sink.

F. Decontamination

Penetrations in walls, floors and ceilings shall be silicone sealed or capable of being sealed to facilitate decontamination. Premium room construction with specific consideration given to all joints, finishes, and penetrations to meet Federal Standard 209B (established by NASA and adopted by FDA) for pressure level of containment at 0.05" WC.

G. Signage

Provide appropriate signage (universal biohazard symbol and biosafety level) at doors leading into BSL-3 facilities.

H. BSL-3 Suite Special HVAC Criteria

The following is specific to this area:

i. Directional Airflow

System for suite shall create directional airflow that draws air into the laboratory through the entry area. Personnel must be able to verify that the direction of airflow is proper before opening a door. Controls to maintain pressure gradients should be active in this area. Relative pressure shall be maintained as follows:

1) Ante Room/Air Lock: Negative to Linear Equipment Room and positive to BSL-3 laboratories.

2) BSL-3 Laboratories: Negative to Ante Room/ Air Lock

ii. Exhaust Criteria

Dedicated exhaust system with 100% redundancy.

iii. Filtration Criteria

Current regulations allow exhaust air from the laboratory room and HEPA-filtered air from Class II biological safety cabinets to be discharged through a non-recirculating (100% exhaust) building exhaust system without additional filtration prior to discharge to atmosphere. A dedicated exhaust is not required.

Consider a dedicated exhaust system for the BSL-3 suite designed to accommodate a future 100% redundant HEPA filtration system (including, but not limited to bag-in/bag out cabinets and fan, sized for additional static load generated by HEPA filter) to accommodate potential regulation changes. Location of the future HEPA filter shall be carefully selected and dedicated to facilitate in-place filter decontamination, replacement and general maintenance.

iv. Monitors and Alarms

Monitors and alarms shall be installed as follows:

- Audible alarms shall be installed to notify personnel of HVAC system failure.
- An appropriate visual pressure monitoring device that indicates and confirms the pressure differential of the cabinet room shall be provided and located at the entry to the clean change room.
- The differential pressure/direction airflow between adjacent areas shall be monitored and alarmed to indicate any system malfunction.

- An appropriate visual pressure monitoring device that indicates and confirms the pressure differential of the suite area must be provided and located at the entry to the clean change room. The airflow in the supply and exhaust components is monitored and an HVAC control system is installed to prevent positive pressurization of the laboratory.

I. BSL-3 Suite Special Electrical Criteria

The following criteria are specific to this area.

i. Doors

Card readers and electronically interlocked doors shall be provided at ante room/air lock to prevent contamination.

ii. Electrical Fixtures

All electrical fixtures (electrical receptacles, data, telephone jacks, lighting fixtures, light switches, etc) shall be recessed mounted, sealed and designed for "wash down/wipe down" with gasketed cover plates.

iii. HVAC on Emergency Power

HVAC supply and exhaust systems for BSL-3 laboratories shall be placed on emergency power.

J. BSL-3 Suite Special Plumbing Criteria

The following criteria are specific to this area:

i. Sinks

Foot or automatic hand wash sink shall be located near the laboratory exit door. Automatic (infrared proximity) controls with thermal mixing valves and manual overrides are recommended.

ii. Hot/Cold Water

Hot and cold potable water should be supplied through a double check valve, anti-siphon.

iii. Atmospheric Drains

The atmospheric contained drain system typically services sink and floor drains. Regulations require that drain traps are always filled with water or a suitable liquid disinfectant. Traps within this system should have extra depth, a total of 2" WG greater than the maximum static pressure generated by the HVAC supply or exhaust, to prevent the trap from being cleared in the event of HVAC /exhaust system malfunctions. Drain vents should be HEPA filtered and piping labeled/identified.

iv. Pressurized Drains for Sterilizer

Sterilizer shall be equipped with an integral effluent sterilization system with an air gap connection employed at the floor drain for hot condensate.

v. Laboratory Vacuum

Provide a dedicated local vacuum system for this area. Regulations require HEPA filters and liquid disinfectant traps on vacuum lines. Provide local HEPA filters and liquid disinfectant traps for all vacuum outlets to avoid line contamination. Locate HEPA filters upstream of liquid disinfectant traps to avoid getting filter wet. A disposable HEPA filter should be installed on the vacuum line just prior to the vacuum pump.

vi. Effluent Sterilization System

Current regulations do not require effluent sterilization (heat or chemical kill tank) for waste discharged into the sanitary sewer from BSL-3 facilities. High vacuum steam sterilizers should be specified with integral effluent sterilization systems.

vii. Specialty Gas Manifold

Provide dedicated specialty gas manifold outside of this area, if necessary, to eliminate the need to bring cylinders into the BSL-3 laboratory.

viii. Piped Services

All piped services shall penetrate the room and terminate with a cap and valve assembly. Penetrations shall be silicone sealed.

7. Break Rooms

At least one room, located outside of any laboratory, suitable for coffee or lunch breaks will be provided on each floor containing more than four research laboratories. This room must be accessible from hallways or non-laboratory space, and must be large enough to accommodate one sixth of the floor's work force (both laboratory and non-laboratory) at any one time.

8. Ceilings

A. Dropped Ceilings

5/8" vinyl coated acoustic lay-in tile. Ceiling tiles should have the appropriate fire rating and be washable. Open ceilings are acceptable in the linear equipment room, provided minimal ducting and piping are present, all exposed surfaces are cleanable, and all Engineering systems (ductwork, piping, wiring, cable trays) have finishes identifying the service and providing a finished appearance.

B. Ceiling Heights

The recommended minimum clear obstruction height is 10'-0". A hung ceiling is recommended 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. To allow for efficient sprinkler operation, all storage must allow for 18" clearance below the ceiling.

9. Chemical Storage Areas

A. Chemical Fume Hood Base Cabinets

Chemical hoods shall have ventilated base cabinets that comply with NFPA 30, with a built-in partition for separation of incompatible chemicals. Except in ADA hoods, the cabinet shall be able to hold four liter sized bottles on both the top and bottom shelves.

B. Hazardous Liquid Storage

Appropriate storage cabinets must be provided for hazardous liquids so they do not need to be stored on open shelves. Hazardous chemicals shall not be stored in laboratory rooms that are not equipped with a ducted chemical fume hood unless approved by EOHSS.

10. Chemical Waste

A. Hazardous Waste Accumulation Room:

This area will be used to collect, store, segregate, package and ship chemical waste for disposal. The size and features of the room will be dependent upon the number and type of laboratories in the new/renovated facility. Because federal EPA regulates this type of facility under RCRA law, the room must meet certain criteria. The room must be designed, constructed and maintained to protect against fire, explosion, and accidental release of hazardous substances.

EOHSS shall be consulted regarding the need for the features listed below.

- i. General ventilation with a minimum of 12 air changes per hour, with dedicated exhaust directly vented to outdoors. Exhaust grill shall be 12" from the floor.
- ii. Local exhaust, directly exhausted to the outdoors (either a trunk with bulking capabilities and/or a chemical hood)
- iii. Impervious flooring
- iv. Fire alarm (tied into facility)
- v. Fire suppression (sprinkler)
- vi. Portable fire extinguisher (located in room or just outside of room)
- vii. Polycoated storage shelves (number to be determined on case by case basis)
- viii. Flammable storage cabinets (number to be determined on case by case basis)
- ix. Lab bench with sink and storage cabinets above and below countertop.
- x. Door sweep / saddle bump
- xi. Eye wash / safety shower
- xii. Telephone, intrinsically safe - location to be determined by EOHSS
- xiii. Sufficient space for chemical spill clean-up equipment and supplies.
- xv. Bonding and grounding equipment for bulking of flammable liquids

B. No Laboratory Drain Chemical Waste Disposal

Chemical wastes will be disposed of through local "in-lab" safety containers and will not be poured down the drain.

C. Neutralization Pit

Neutralization pits are not permitted except where required by the local water municipal authority. The A/E shall provide documentation to EOHSS and Physical Plant that the pits are properly sized. Neutralization pits shall not be located in a permit-required confined space. Neutralization pits that are located in a confined space must be approved by Physical Plant.

11. Clearances

For purposes of safe passage of occupants past people and equipment in aisles, the minimum recommended clearance between benches, or between a bench and a designated equipment area, is 5'-0" in the laboratories. The recommended clear corridor width leading into a laboratory is 6'-0".

12. Confined Spaces

Permit-required confined spaces shall not be created without the written permission of EOHSS and Physical Plant.

13. Construction Practices

Compliance with UMDNJ Physical Plant Construction Standards is required for construction practices as well as material selection. Standards must be developed for any materials included in the document for which Physical Plant has yet to develop a standard.

14. Doors

Provide a 48" wide door between corridor and laboratory, one 36" active door with a 12" wide inactive leaf to facilitate personnel and equipment access. Each laboratory door will have a viewing panel which does not reduce the required fire protection rating. Laboratory doors shall be recessed and swing outward in the direction of egress depending upon the code requirement.

15. Egress

A. Corridor Storage

Corridors and public spaces shall not be designated or used for storage. Under no circumstances shall any hazardous materials be stored in corridors or public spaces.

B. Exit Signs

All egress doors shall be identified using LED type exit signs.

16. Electrical Systems

All electrical features must comply with current National Electric Code standards as published by NFPA.

A. Emergency Shut Off

It shall be determined during the planning stage whether any specific electrical equipment shall have emergency shut-off features.

B. Circuit Breakers

Each double module laboratory shall have an individual circuit breaker panel. Each panel shall have at least 25% spare breaker capacity above initial requirements.

C. Emergency (Stand-By) Power

The following items shall be placed on emergency (stand-by) power, and shall not be confused with Life Safety requirements.

i. Laboratory Manifold Exhaust Systems

Laboratory manifold exhaust system to maintain relative negative pressure of laboratories, exhaust from chemical fume hoods, vented base cabinets under the hood and thimble exhaust above biological safety cabinets.

ii. Biological Safety Cabinets

iii. Chemical fume hood and biological safety cabinet airflow monitor/audible-visual alarm.

iv. Dedicated exhaust from radiochemical fume hoods and perchloric acid fume hoods and Class II B2 100% exhaust biological safety cabinets.

v. Environmental Rooms (Warm, Cold)

vi. DDC Panels

vii. Heating System, including pump and fans.

viii. Computer Servers in dedicated computer rooms.

D. 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), explosive venting per local code:

- 1) Solvent Storage Room
- 2) Chemical Waste Storage Room

E. Ground Fault Circuit Interrupters near Sinks

Electrical service shall be provided through ground fault circuit interrupter (GFCI) devices where required under the National Electric Code, where circuits are within six (6) feet of water supplies or where users can form a ground with energized equipment.

17. Elevators

If the building design includes an elevator, provisions shall be made to include a stop at the location of Mechanical/Electrical/Plumbing equipment, including the roof.

18. Emergency Communications

A. Laboratories

A telephone should be located every 40 meters in open laboratories and outside of the open laboratory (in an area which would be uncontaminated in the event of a chemical spill) to summon help. There should be a telephone in each traditional laboratory room.

B. Solvent Storage Areas and Chemical Waste Storage Rooms

A phone shall be provided in these areas. If bulking of chemicals is planned the phone shall be explosion-proof.

19. Emergency Equipment

The number of eyewash and shower units and their specific locations shall meet all applicable national codes and local regulations.

A. Eye Washes in Laboratories

A counter top mounted eye and face and body wash/drench hose which complies with the latest ANSI eyewash requirements shall be provided at every laboratory sink (except cup sinks) unless another arrangement is approved by EOHSS. Laboratory areas which are not equipped with a sink shall also be provided with at least one plumbed eye wash. EOHSS shall approve the type to be used.

In open laboratory design areas there shall be at least one or more dual headed eyewash units located in an area that is unlikely to become cluttered with laboratory supplies, and a safety shower unit in a central location within 22 meters from any point in the laboratory. Eyewashes must not splash water on the floor when activated.

B. Safety Showers/ Eye Washes in Corridors

Provide a safety station, consisting of a deluge shower and eye/face wash in each laboratory corridor within 10 seconds travel distance of any laboratory. Eye/face wash to operate independently of the deluge shower. Height of eye/face wash basin, deluge shower pull ring and deluge shower head shall meet ANSI requirements. Deluge shower shall have the capacity to be "turned off" by the building occupants.

Electrical apparatus, telephones, thermostats, or power outlets should not be located within 18 inches of either side of the emergency shower or emergency eyewash facility (i.e., a 36-inch clearance zone).

C. Safety Shower/Eyewashes in Other Areas Where Hazardous Chemicals Are Used

EOHSS shall be consulted about the placement of eyewashes/safety showers in non-laboratory areas where hazardous materials are used or stored including, but not limited to mechanical rooms, print shops, medical, chemical, chemotherapeutic, radioactive waste areas, animal handling areas, shipping and receiving, anatomy labs, media, general stores. The need for sinks to ensure hygiene shall also be determined by EOHSS.

D. Compliance with ANSI

Only those showers and eye washes manufactured in accordance with the most recent version of ANSI Standard 358.1 "American National Standard for Emergency Eyewash and Shower Equipment" shall be used. They must provide tempered water and be installed to provide water flow consistent with requirements of this standard.

E. Shower with drain

There shall be a hot and cold running shower with a drain in at least one men's bathroom and at least one women's bathroom in each laboratory building.

20. Energy Conservation

A. Heat Recovery

Heat recovery is acceptable for laboratory air as long as a non-contact heat exchange unit, which has been approved by Physical Plant is utilized. Heat wheels and other heat recovery technologies that allow the return of potentially contaminated systems to the supply air are prohibited unless expressly approved by EOHSS.

B. EOHSS Approval of Occupied/Unoccupied Strategy

EOHSS must expressly approve the strategy by which laboratories will go from full ventilation (occupied mode) to reduced flow (unoccupied) mode.

C. Green Building/Laboratory Opportunities

The architect/ engineer/lab planner shall notify the project team of opportunities for energy efficiency, and the use of renewable energy resources at all phases of the design and construction process. Provide life cycle cost analysis as a basis for energy investment decisions. Provide examples of criteria from the EPA Labs 21 Environmental Performance Criteria <http://labs21.lbl.gov/EPC/intro.htm> and Best Practice Design Guides (<http://www.epa.gov/labs21century/index.htm>). EOHSS approval is required for energy conservation measures that can have an impact on health and safety, such as on air quality, the spread of contaminants and fire safety.

D. Physical Plant Construction Standards

Compliance with UMDNJ Physical Plant Construction Standards is required for construction practices as well as material selection. Standards must be developed for any materials for which Physical Plant has yet to develop a standard.

21. Environmental (Cold (4°C) and Warm (37°C) Rooms)

A. Ventilation of Cold and Warm Rooms

Environmental rooms shall be ventilated at 0.5 CFM/square foot.

B. Preventing Condensation

Dehumidify supplied air to ensure that the final Relative Humidity in cold rooms is between 25-40% at all times. Penetrations including plumbing and electrical lines running through the room must have adequate insulation and be sealed to prevent condensation.

C. Architectural Finish of Environmental Room

Floor: Prefabricated 2" [or 4"] thick metal clad insulated panels with seamless vinyl and integral 4" high ½" radius cove base. Depress structural floor slab 2" [or 4"] for recessed installation.

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

Ceiling: Prefabricated 4" thick clad insulated panels with baked on white polyester finish on galvanized steel.

Casework: Stainless steel or phenolic cabinets, stainless steel counter top, sink and adjustable shelving.

D. Viewing Panel

Environmental rooms shall have a viewing panel in the door.

22. Ergonomics and Physical Hazards

Laboratory equipment purchase decisions must include ergonomic considerations such as ensuring thigh clearance and room for the operator's legs. EOHSS should be involved in the furniture selection decision-making. Equipment will be configured with knee space to allow operator to sit comfortably if the operator will be using the equipment for an extended period of time. Chairs and stools shall be purchased to conform as closely as possible to PEOSH ergonomic guidelines.

To allow for better movement in the laboratory, and to reduce trips and bumps, furniture and cabinets/counters shall be designed to be as vertically flush as possible. Knee-hole space shall be provided for multiple waste containers.

23. Equipment and Furnishings

A. Physical Plant Approval

UMDNJ Policy 00-01-70-55-00, Major Equipment Purchases, requires that the purchase and installation of major pieces of equipment which use or draw from any utility system (water, electric, HVAC, medical air, vacuum, etc.) shall be reviewed, analyzed and authorized by Physical Plant so that the overall impact can be monitored and properly controlled.

B. Physical Plant Energy Management System

All Building Service equipment such as HVAC equipment, pumps, compressors, chillers, etc., which is modified and/or added shall be connected to the Physical Plant Energy Management System for proper operation and monitoring. Compliance with UMDNJ Physical Plant Construction standards and material selection standards are required. Standards must be developed for any materials included in the document for which Physical Plant has yet to develop a standard.

C. Furnishings

Furnishings and decorations including any item of upholstered furniture, mattresses, wardrobe, wastebaskets, curtains, draperies, surface coverings (carpet, wall and ceiling), acoustical and other materials used for decoration shall be documented to be non-combustible or flame resistant (capable of restricting the spread of flame) in accordance with the appropriate NFPA or other equivalent standard. The University's Purchasing Department shall ensure, by including in all Vendor Agreements, that the vendors comply with CAL TB 117 for all upholstered furniture, including sofas and mattresses, CAL TV 133 for furnishings and furniture to be used in general assembly areas, and NFPA 701 for all other decorative materials. If a building is fully sprinklered, compliance with CAL TB 117 shall be considered adequate for the furniture in general assembly areas. All such purchases shall be made with the approval of the Department of Purchasing.

D. Accessibility

All HVAC equipment must be accessible for preventive maintenance.

All new/upgraded labs shall comply with the following lab design and construction requirements:

- The UMDNJ Fire and Life Safety Policy which can be found at: http://www.umdnj.edu/oppmweb/Policies/HTML/HealthSafety/00-01-45-60_00.html.
- Fully comply with the applicable State UCC as a minimum.
- Follow the appropriate guidelines of the latest edition of NFPA 45, Laboratory Safety Standard, when more stringent than the UCC.
- Use the following approach to determine the most appropriate lab design and construction criteria as specified in NFPA 45:
 - * Determine intended use of each laboratory.
 - * Determine space requirement for each lab work area.
 - * Determine the probable lab unit fire hazard class.
 - * Determine allowable area and construction requirements specified in NFPA 45.

Note: Where intended use and quantities cannot be determined, the lab must be designed to the most stringent standard.

Ensure that all new laboratory designs consider features that facilitate full compliance with the applicable fire prevention and protection requirements specified in Exhibit A, B and C of the UMDNJ Fire and Life Safety Policy.

In particular, designers shall pay attention to the following:

- * Hazardous Materials Requirements (Exhibit A.I.6)
- * Compressed Gases and Cryogenic Liquids (Exhibit A.I.7)
- * Electrical Safety Requirements (Exhibits A.I.8 and Exhibit C)
- * Furniture and decorative requirements (Exhibit A.I.9, 10)
- * Special Purpose Door Alarms and Locking Devices (Exhibit | A.II.5)
- * Electrical Equipment Use and Restrictions (Exhibit C)

All existing labs shall also comply with the UFC and UMDNJ Fire and Life Safety Policy.

Considerations for Hazard Class B (moderate hazard) labs:

Class B laboratories allow storage of higher quantities of hazardous chemicals than Class C (low hazard) laboratories. Most UMDNJ laboratories are Class C. Where Class B laboratories are considered, the design shall comply with all requirements of the NFPA 45. Basic requirements of Class B laboratories include:

- * Maximum area per lab unit: 10,000 sq. feet
- * Fire separation: 1 hour
- * Doors: must swing outward in the direction of egress

A. Flammable Liquid Quantity Limitations

The Architect will inform the project manager in writing about limitations of the quantities of flammable liquids which are allowed to be stored, based upon current building/fire codes and on the laboratory class designations. The number of control areas and the amount of flammable liquids permitted is based upon the floor level. Therefore, chemical-intensive areas should be constructed on lower floors as much as possible. The Designer shall also consider requirements of the University's Current Fire and Life Safety Policy (Exhibit A, section 1.6) which is posted at which allows for 10 gallons of flammable liquids in each laboratory room. The Architect/Engineer shall notify EOHSS and the Project Manager if code compliance for a proposed design would allow less than 10 gallons of flammable liquids in a laboratory room.

B. Fire Extinguishers

A 10 pound ABC fire extinguisher (or other appropriate size and type of extinguisher, approved by EOHSS) should be located in each laboratory or within 15 feet of the laboratory, and at every other bench in open laboratories at a height consistent with NFPA 10. Class "A" fire extinguishers shall be located in corridors outside laboratories in locations designated by EOHSS. In addition, a carbon dioxide or other clean agent fire extinguisher (type, size and rating approved by EOHSS) will be provided in areas where it is necessary to protect costly equipment which can be damaged by ABC extinguishers.

C. Flammable Storage Cabinets

Provide vented flammable storage cabinets which conform to NFPA 30 in terms of material and construction detail, as part of the chemical hood base cabinets and in other locations if all flammable liquids will not be able to fit in the flammable base cabinets.

D. Laboratory Safe Refrigerator

A "laboratory safe" refrigerator (no internal ignition sources) shall be provided for locations where flammable liquids need to be kept cold.

E. Floor and Wall Penetrations

Wall and floor penetrations in laboratory areas shall be avoided. All penetrations shall use raised sleeved openings, and be sealed and caulked to prevent leakage and maintain the fire rating of the slab.

25. Floor Drains

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). Environmental room condensate will drain into an internal counter top sink or floor drain located exterior to room and easily accessible. Consult EOHSS about providing floor drains at safety showers.

26. Floor Loading

The structural Engineer shall determine, and Physical Plant must approve the live load capacities to be utilized in the building. The applicable codes shall govern the minimum design live load selection for the building.

27. HVAC General

A. Codes, Regulatory Standards, and ANSI Z9.5 Standard for Laboratory Ventilation

The mechanical design shall be developed to meet the requirements of ASHRAE guidelines for directional air flow, the use of pressure differential for control and the requirements of the most recent ANSI Z9.5 Standard for Laboratory Ventilation. Laboratory ventilation systems must also be designed to meet all applicable codes and regulatory standards.

B. Temperature/Humidity

FP&C will provide inside design temperature (degrees Dry Bulb) and humidity (% Relative Humidity) conditions. Provide one thermostat in each office and a minimum of one per laboratory in standard laboratories. In open laboratory designs, provide a minimum of one thermostat per 40 linear feet along the longest wall.

C. Filtration of Incoming Air

As a minimum, supply air for these areas should pass through a prefilter and filter on the upstream side with efficiencies of 30 percent and 95 percent respectively, based on ASHRAE Standard 52.1-92 (or the most recent standard) atmospheric dust-spot test efficiency. Special areas may require greater filtration on both the supply and the exhaust sides. The

requirements for additional exhaust filtration shall be coordinated with the EOHSS and the Radiation Safety Officer where specific hazardous program functions occur.

D. Dedicated Exhausts

The following equipment need dedicated exhausts:

i. Perchloric Acid Fume Hoods.

These require a dedicated exhaust (recommended material: welded type 316 stainless steel, joints welded and smoothed down, no organic materials used) with cold-water wash down capability (straight vertical riser with minimal horizontal run to facilitate wash down). Special attention should be given to avoid cold water line/head freezing.

ii. Class II, Type B2 Biological Safety Cabinets (100% exhaust)

These may require a dedicated exhaust (thimble connection) due to high static pressure of 1.4-2.0" WC for 6 ft unit or 1.0-1.4" WC for a 4 ft unit.

iii. Hazardous Exhaust Systems, as required by code.

E. Environmental (Cold/Warm) Rooms

Cold and warm rooms will be ventilated at .5 CFM/square foot.

F. Directional Airflow / No Recirculation of Laboratory Air

Single pass air shall be supplied in the laboratories directed from clean areas to potentially contaminated areas and from low hazard to high hazard areas. All laboratories shall be negative with respect to the corridor or adjacent space (unless otherwise noted) assuming that all doors are kept closed. The airflow velocity through any opening (i.e. the slot beneath the door) shall be a minimum of 50 fpm and a preferred velocity of 100 fpm in the desired direction. The overall building shall be positive to atmosphere to avoid infiltration. The level of pressure differential shall be established by the Engineer.

One hundred percent of air supplied to the laboratory areas shall be exhausted. There shall be no recirculation 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).

G. Preventing Cross Drafts in Containment Equipment

Hoods shall be located in a room so that air currents generated in the room will not interfere with the hood's ability to capture and eliminate vapors, mists and airborne particles. Therefore, hoods must be located as far away as possible from doors, air supply diffusers, windows which can be opened, heavy traffic areas and other local exhaust ventilation devices. Air supply diffusers must be located and configured to prevent cross drafts at the face of containment equipment such as chemical hoods and biological safety cabinets, which can cause leakage of contaminated air.

H. Laboratory Air Exchange Rate

The Laboratory Air Exchange Rate strategy must be provided in writing to both EOHSS and Physical Plant. Approval must be obtained by EOHSS and Physical Plant.

I. Heat Loads

The HVAC system shall be sized to compensate for equipment heat loads.

J. Air Balancing

All laboratory air balancing companies will be hired by the University, rather than by the Architect, Engineer, or other contractors. The company should be an independent air balancing company, certified by the Associated Air Balancing Council.

K. Manifold System

As allowed by code, all laboratory exhaust (fume hoods, Class II A1 and A2 biological safety cabinets and registers) shall be exhausted through a common exhaust duct, also referred to as a manifold system. Ducted AII biological safety cabinets must have a canopy (thimble) connection unless prohibited. Only specialty hoods (perchloric, or Class II Type B1 and B2 biological safety cabinets) or equipment that require direct venting will have a dedicated exhaust and fan. If B2 biological safety cabinets are placed on a manifolded system the set-up must comply with NSF/ANSI 49-2002 (or more recent) as well as the manufacturers installation specifications. Phoenix valves are recommended for this application.

L. Exhaust Fan Redundancy

Manifolded exhaust systems shall be on multiple fans (minimum two) each rated for 100% of the total load to compensate for maintenance or partial system failure.

M. Controls

All controls shall be direct digital controls (DDC) with electronic (or pneumatic) actuators. The potential to employ programmable logic controllers (PLCs) and industrial grade components (not commercial grade) shall be evaluated.

N. Supply/Exhaust System

i. Variable Air Volume (VAV)

The supply and exhaust system shall be variable air volume with minimum air change criteria approved by EOHSS and Physical Plant established for occupied and unoccupied times. 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 airflow without affecting lab pressure relationships to adjacent areas.

There must be a means for increasing the air exchange rate in a laboratory remotely in the event of a spill. Following a spill, the air exchange rate shall only go back to “normal operation” when EOHSS directs Physical Plant that it is safe to do so.

Use of Phoenix Control systems are recommended for variable air volume systems.

ii. Exhaust Fans

The exhaust fans should have a static pressure control modulating a raw air bypass damper; a static pressure control modulating a fan damper; follow the fan curve to maintain a minimum exhaust stack discharge velocity of 3,000 fpm. The fume hood exhaust fan and air duct should be constructed of material selected to resist corrosion and non-combustibility, such as stainless steel, or as required to meet the standards for the intended use of the hood. Exhaust fans serving chemical fume hoods shall be located on the roof, not part of the unit, to eliminate the presence of contaminated air in pressurized ductwork.

iii. Room Control Sequence

EOHSS shall have input, along with the building occupants regarding the room control sequence. Physical Plant shall be able to monitor the air exchange rate and hood exhaust rate through the building automation system to confirm that the room control sequence is working as designed.

O. Humidification

Clean steam (generated with potable water and free of all boiler additives) should be used for all humidification applications.

P. Labeling of ductwork and exhaust fan

All ductwork and exhaust fans shall be labeled.

Q. Internal Liners

Use of internal liners is prohibited in all ductwork.

R. CFD Modeling Study

The mechanical engineer shall recommend whether a computational fluid dynamics (CFD) modeling study is needed to determine optional airflow characteristics in laboratories.

S. Pressurization of Ductwork

No positive pressurized segment of any laboratory exhaust system should be located in any occupied zones including mechanical rooms. Offices within the mechanical rooms are classified as occupied zones. The design should permit the installation of exhaust fans at the end of exhaust lines and as close as possible to the final point of discharge to avoid or minimize leakage to the space, particularly mechanical areas. The positive pressure segment of an exhaust system should be constructed per the SMACNA standard for 1 494 Pa water-gauge positive pressure. A leak test should be performed to verify the SMACNA allowable leakage rate as defined in the HVAC Systems Duct Design Standard, Third Edition, Chapter 5. All ductwork shall be SMACNA seal Class A.

T. Chemical Fume Hoods

i. Type of Hood

The make and model number of hood to be utilized must be approved by EOHSS.

ii. Chemical Fume Hood Features

Chemical fume hoods shall typically be 5'-0" bench type with one 30" wide flammable base cabinet and one 30" wide corrosive acid base cabinet. A 12" wide section of the base cabinet is necessary to conceal cup sink waste piping if a cup sink is provided (Cup sinks are not recommended. If users decide that cup sinks **are** necessary, the acid base cabinet will be 18" wide.) Base cabinets will be vented behind the fume hood baffle and 12" above the counter top. Fume hoods will be equipped with an airflow monitor/audible-visual alarm which has been approved by EOHSS. The criteria listed below have been provided for mechanical system planning. Deviations must be approved by EOHSS.

<u>Symbol</u>	<u>Description/Exhaust Requirement</u>
FUM 5	5'-0" bench hood: with appropriate flow rate to ensure a full open sash face velocity of 80 fpm for constant volume hoods and 100 fpm for variable air volume hoods.
BSC 6	6'-0" Class II, type B3 (30% exhaust) biological safety cabinet: 587 CFM minimum @ 0.22" WC with thimble connection.
BSC-4	4'-0" Class II, type B3 (30% exhaust) biological safety cabinet: 322 CFM minimum @ 0.1 WC with thimble connection.
BSC6X	6'-0" Class II, type B2 (100% exhaust) biological safety cabinet: 1,148 CFM +/- 5% @ 1.4" WC.
PE4	4" point exhaust: 100-150 CFM
CNPY	Canopy Hood: 100 FPM/SF depending upon application

Down Downdraft surfaces: 100 CFM/SF down draft velocity at table surface for 100% smoke capture 12" above the table.

iii. Minimum Chemical Fume Hood Face Velocity

Unless otherwise approved by EOHSS, the minimum face velocity requirements for Constant Volume (CV) Chemical fume Hoods is 100 FPM with 14" high sash opening.

Unless otherwise approved by EOHSS, the face velocity for variable air volume hoods shall be 100 fpm. There must be infollow of air even when the sash is closed.

iv. Sash Stops

There will be a sash stop at 14" above the work surface to encourage hood users to keep the sash at a safe working height.

v. Sash Closers

The use of automatic sash closers for variable air volume hoods must be approved by EOHSS.

vi. ASHRAE 110 Documentation

Before the final hood selection is made, the Architect/ Engineer must obtain documentation from the chemical hood manufacturer or vendor that the chemical hood model which will be used has passed the most recent version of the ASHRAE 110 "as manufactured" test at the same flow rate and conditions which will be utilized at UMDNJ. If the 1995 ASHRAE 110 test is used, a sulfur hexafluoride release rate of 4 liters per minute will be employed. The average of point measurements for each hood must be below .05 ppm with no point exceeding 0.1 ppm.

The A/E shall also provide documentation that the hood model has attained an ASHRAE 110 rating of 4.0 AU .1 under similar conditions.

vii. ASHRAE 110 "As Installed" Test

The Architect/Engineer shall include as part of the specification that "as installed" testing shall be performed on all hoods in

accordance with ANSI/ASHRAE Standard 110 – 1995 or more current version, after installation but before acceptance by the construction project team. The ASHRAE 110 vendor must be approved by UMDNJ-EOHSS. EOHSS personnel must be present when the testing takes place. The standard consists of three tests: face velocity, smoke visualization and tracer gas. The Architect/Engineer is responsible for identifying causes of failure in hoods which do not pass and making recommendations to correct the problems so that hoods pass satisfactorily.

- a. The hood's face velocity shall be measured as described in the ASHRAE 110 Standard, before the flow visualization and tracer gas testing is performed. For the face velocity test the chemical fume hood must achieve a minimum face velocity of 80 FPM with a uniform face velocity profile of +/- 20% of the average velocity with the sash fully open.
- b. After the hood has passed the face velocity test, a smoke tube, smoke candle, and/or a theatrical fog generator shall be utilized for the flow visualization tests. This test is a visualization of a hood's ability to contain vapors. The test consists of both a small local challenge and a gross challenge to the hood and is outlined in the ASHRAE 110 standard. The test shall be performed at the "operating height" of 14 inches above work surface.
- c. Unless otherwise specified by ASHRAE, the sulfur hexafluoride release rate of 4 liters per minute shall be used with all point measurement averages at or below .1 ppm for the tracer gas test.

viii. Ductless Hoods Prohibited

The purchase of ductless chemical hoods is prohibited.

U. Hood Monitor/Alarm

a. Constant Volume Hood Monitors

Each newly purchased hood shall have a visual and audible low face velocity indicator/alarm. The model shall indicate the face velocity and shall also provide an LED indicating the performance of the hood, for example, green, yellow or red. EOHSS shall approve the hood monitor model before it is selected and shall determine the alarm set-points.

Vendors who set and perform the initial calibration of the hood monitors shall submit a written report to the University, indicating how each hood monitor was set and if any problems were encountered.

b. Variable Air Volume Hood Monitors

EOHSS and Physical Plant shall be provided with the instruction manual of the device to be used.

V. Stacks

The stacks from the chemical hood exhaust fans will be of a height and discharge velocity consistent with the latest applicable ASHRAE standard and shall be labeled with the labs they serve. The stack shall be in a vertical up direction at least 10 feet above the adjacent roof-line and so located with respect to openings and air intakes to avoid reentry. China caps are not permitted. Chemical hood exhaust stacks shall have a discharge velocity of at least 3500 fpm unless otherwise approved by EOHSS. The discharged air must be at least 25 feet away from any air intakes or building openings.

Aesthetic considerations concerning external appearance of the building shall not be allowed to overcome the requirements of this section. In case these requirements conflict, the conflict shall be resolved in a manner that preserves the intent of this section. Some acceptable solutions are:

- * architectural structures that mask the unwanted appearance of the stack as long as the stack extends vertically one stack diameter or more above the masking structure and otherwise meets the requirements of this section.
- * the use of a fan (such as Strobic Air) able to provide protection from exhaust re-entrainment requirements consistent with this section when used with a lower stack.

W. Composition of Chemical Hood Exhaust Ductwork

Ductwork from chemical hoods shall be seamless, welded, 316 type stainless steel.

28. Lighting

A. Natural Light

Laboratories shall have direct access to natural light where possible. Window treatment (shades or blinds) shall be provided where appropriate to vary the amount of natural light entering the laboratory or office. Darkrooms, tissue culture rooms, cold rooms and warm rooms shall avoid access to natural light.

B. Illumination Level

The minimum required illumination level to be achieved in all laboratory areas at the work surface (37" A.F.F.) is 90 foot-candles. Provide plug-in or hard-wired task lights at all desks. Fluorescent lighting with T8 electronic ballasts will be acceptable in all laboratory areas except dark rooms (incandescent). It is preferable to have dimmer capability in computer rooms. Direct/indirect lighting fixtures are preferred in the laboratories.

C. Lighting Fixtures

In the laboratories, light fixtures shall be suspended from the ceiling, parallel to the lab bench and shall be positioned to reduce the need for task lighting. If there will be less than one lighting fixture per side of the bench, than an illumination consultant must be consulted to ensure that illumination will be adequate and approval must be obtained from the end users.

29. Natural Gas

A. Biological Safety Cabinets

Natural gas will not be provided to any biological safety cabinet which has an integral motor unless approved by the EOHSS and the campus Laboratory Safety Committee. If gas is to be provided, it will be installed by Physical Plant after completion of the building

B. Emergency Gas Shut Off Valves in Laboratories

If emergency gas shut off units are provided in laboratories (in addition to gas shut-offs required by code) a valve type unit is recommended to prevent accidental activation. It shall not be tied in to the fire alarm system. It shall only control the gas in the room that it is in. It should be placed near the laboratory exit . Lab personnel and EOHSS shall be

consulted about the placement of these devices so they do not interfere with laboratory operations.

30. Noise

A. Internal Noise Sources

Ambient noise level in the laboratories shall meet RC40 (Room Criterion 40) not to exceed RC45. Quality Assessment Index (QAI) shall not exceed 5 dB. Prevent acoustic levels due to intermittent activity occurring outside the laboratory, from exceeding ambient noise level by more than 5 dB.

B. External Noise

The engineer shall inform the Project Manager whether the ventilation system of a building is likely to be heard in the community surrounding the facility. If so, an acoustical engineer should be retained to provide recommendations to ensure that the arrangement of equipment and stacks do not cause unacceptable noise in the area surrounding the facility.

31. Open Laboratories

Unrelated research groups shall each have their own chemical fume hood. There shall be capability in the exhaust system for the addition of 50% more chemical fume hoods in the future.

Dedicated space for hazardous waste storage will be provided to minimize storage of hazardous waste in chemical fume hoods.

The storage needs of the end users must be considered early in the design phase.

32. Operating Schedule of the Building

All laboratory Mechanical/Electrical/Plumbing systems shall be operable 24 hours, 7 days per week with varying degrees of occupancy in a 24 hour period.

33. Piped Services

No non-potable water shall be supplied to laboratory sinks. Vacuum breakers will be furnished on all domestic water fixtures including eye/face drench hoses. A tempered potable water system is required to support the operation of eyewashes and safety showers. Service shut-off valves for gases and hydraulic piping/services should be provided, labeled and accessible. A valve plumbing chart indicating services and locations of water and gas systems should be

provided. Check with end users about the necessity of having cup sinks on lab benches or in lab hoods.

34. Planning for the Future

A. HVAC Capacity

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. Provisions shall be made to allow connection of one (1) chemical fume hood or biological safety cabinet (Class II, B3) per laboratory module. It is anticipated that up to 20% of the lab modules will require the equivalent of two fume hoods during the life of the building and the HVAC system will be designed for this contingency.

B. Autoclave Capability

For maximum flexibility, all new construction consisting of more than 1,000 square feet of contiguous research space, there shall include an area large enough to accommodate the necessary connections (steam and water lines, exhaust duct work for heat removal) for one autoclave per every two laboratory units (a laboratory unit being defined as 500 square feet).

35. Public Safety Issues

UMDNJ Public Safety will determine which security options are incorporated into the project.

36. Radiation Safety

The Radiation Safety Officer for each school or unit shall participate in decisions related to radiation safety in new or renovated laboratories.

The Nuclear Regulatory Commission issues materials, equipment and human use licenses to the schools and hospitals associated with UMDNJ. Use of radioactive materials and equipment producing radiation is strictly governed by federal and state-issued regulations. Non-volatile radionuclides are used throughout UMDNJ laboratories, although volatile radionuclides are generally used only in designated laboratories. The following facility design considerations where radioactive materials will be used, are either required or will significantly facilitate compliance with NRC regulations.

A. Security of Radioactive Materials

All radioactive materials stored at any UMDNJ facility must be secured in accordance with NRC and NJDEP regulations. All laboratories must have the ability to be locked against unauthorized access. Design specifications for radioactive materials shall include provisions (e.g., locks as part of the integrated system) to secure this equipment.

B. Radioactive Waste Storage in Laboratories

All laboratory modules shall be designed for the safe storage of radioactive waste. The volume of radioactive waste generated by a laboratory is a function of the type of work being performed there. In many cases the radioactive waste storage area will have to accommodate multiple containers plus appropriate shielding materials as segregation of different radionuclides (and of different waste streams) is required. Thus, the size of the space dedicated to storage of the containers should be tailored to the volume and type of radioactive waste expected. The Radiation Safety Officer (RSO) and faculty expected to occupy the space should be consulted for more specific requirements. The five waste streams include:

- Liquids
 - aqueous waste
 - solvents/other hazardous chemical constituents (mixed waste)
- Dry or solid waste (dry active waste)
 - disposable labware
 - sharps
- Liquid scintillation vials and/or bulk liquid scintillation media
- Animal Carcasses and /or tissues
- Animal bedding and/or solid excreta

C. Facility Radioactive Waste Room

The school/unit Radiation Safety Officer shall be consulted to determine if there is a need for a facility radioactive waste storage room as well as the required features of the room.

D. Decontamination Requirements for Radioactive Material Use Areas

Surface materials utilized in laboratory facilities where radioactive materials will be used should be compatible with decontamination requirements as follows:

- Epoxy coatings, laminates, floor coverings and protective coatings shall be utilized for ease of decontamination and to provide a protective coating which can be readily removed without extensive damage to the existing facility and surfaces.
- Sinks shall be either plastic composite, or coated with epoxy of the equivalent or manufactured of stainless steel, to aid in the decontamination of surfaces. Soapstone shall not be used for sinks.

E. Prohibition of Food and Drink in Laboratory Areas

The NRC strictly enforces regulations prohibiting drinking or eating in laboratory areas authorized for use of radioactive materials. The University is at serious risk for fines and other enforcement actions from the NRC if there are no convenient spaces adjacent to laboratory areas available for eating or drinking. Practical considerations dictate that 1) office, conference room, library or lunchroom areas should be close by, and 2) access to these rooms should not be solely through laboratory areas.

F. Chemical Hoods for Volatile Radionuclides.

The Radiation Safety Officer should be consulted for specific requirements.

37. Regulated Medical Waste Storage

The needed size and features of the regulated medical waste room will be determined by Physical Plant. The room ventilation system shall ensure at least 10 air changes per hour shall be maintained under negative pressure and shall not recirculate air to other parts of the building. A sink and eyewash shall be located to allow personnel to wash their hands when they are leaving the facility.

38. Seismic Design

The Architect/Engineer shall determine the seismic requirements for the building.

39. Signage

A. Laboratory Door Signs

Signage for laboratory doors to be furnished by the University. All signage should be approved by EOHSS and approved and ordered by Facilities Planning and Construction.

B. Evacuation Signs

Evacuation signs showing emergency egress routes shall be posted at elevator lobbies and in other locations specified by EOHSS. This should include stairwell egress routes posted on each stairwell floor landing.

40. Silver Recovery

A drain that is compatible for a local silver recovery system must be provided for automated processors and processing sinks in all dark rooms.

41. Specialty Gases

The Architect/Engineer shall consult EOHSS about the type of tubing to be used for specialty gases.

42. Sprinkler System

All laboratory areas shall be provided with automatic wet sprinkler system protection. NMR suite and hazardous waste storage room to have special agent system which must be approved by UMDNJ-EOHSS>

43. Storage

A. No Corridor Storage

Corridors and public space shall not be designated or used for hazardous material storage. Equipment such as refrigerators, file cabinets and freezers shall not be designated to be stored in these areas.

B. Storage Area

The Architect/Engineer shall verify with the end user the need for a storage area physically separated by fire-rated construction from the laboratory work area. The area would be used for the storage

of non-hazardous, non-flammable materials and laboratory materials that are typically purchased in bulk (e.g. petri dishes, pipettes) that would otherwise consume laboratory work space. No electrical equipment would be allowed and therefore storage rooms would not have electric outlets. Materials are not allowed to be stored within 18 inches of the ceiling in sprinklered rooms.

44. Vacuum Systems

Vacuum pump systems will be designed in a manner which will ensure the release of vapor to the outside of the building, and not into a mechanical space. Provisions must be made to provide capability to drain and clean the vacuum collection tank.

45. Vibration Criteria

Vibration criteria must be specified by the Architect/Engineer and approved by Physical Plant.

46. Waste Storage in Laboratories

In the laboratory, waste boxes (garbage cans) must be located near the exit door and shall be easily accessible. Space must be allocated in each laboratory for waste box storage. Trash cans must be UL approved and have the appropriate fire rating.

The following waste baskets are utilized in UMDNJ laboratories:

- Trash
- Regulated Medical Waste (this may include several large, 20 gallon containers as well as sharps containers)
- Glass
- Radionuclides

end