Introduction

Washington University in St. Louis (WUSTL) Project Manager Guideline serves to assist University Project Managers apply Environmental Health and Safety (EHS) requirements and best practices during demolition, renovation, utility, roofing and new construction projects. This guideline also supports Project Managers in the planning and design process.

Due to the complexity and variety of projects, this guideline does not address all possible Environmental Health and Safety issues and is to be used as a guide in conjunction with an EH&S review of the scope of the project.

Project Managers are expected to be familiar with and meet all local, state and federal codes and requirements.
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Roles and Responsibilities

Environmental Health and Safety (EH&S)

EH&S provides technical guidance and advice; prepares and implements institutional policies and procedures to ensure Federal, State and Local laws related to safety, health and the environment are followed; provides advice in accordance with relevant outside agencies to address proper handling, transfer, and disposal of biological, chemical and radiological materials and waste; and, offers advice regarding decontamination of surfaces found in laboratories so the space will be prepared for re-occupancy or for full or partial renovation projects.

EH&S also reviews designs for projects for environmental health and safety and regulatory compliance; provides design comments to project managers; reviews final construction documents to ensure all EH&S requirements have been addressed; and communicates changes and provides guidance to Project Managers.

Project Managers (Capital Projects)

Project Managers must communicate with EH&S during all phases of design and construction to ensure applicable regulatory requirements, performance standards and University policies are being incorporated into the project.
## EH&S Contacts

<table>
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<tr>
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<th>Contact Info.</th>
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<tr>
<td>Biological &amp; Chemical Safety</td>
<td>Laboratory close-outs/decommissioning, General laboratory Design, Biosafety Level 3 (BSL3) laboratory and animal facility design</td>
<td>Susan Cook, 747-0309</td>
</tr>
<tr>
<td>Environmental Compliance</td>
<td>Air Permitting; Metropolitan Sewer District (MSD) permits and sampling; Hazardous waste permits and licenses; Spill Prevention Control and Countermeasure (SPCC) permits; Chemical and Biological waste disposal; regulated equipment, Universal Waste, electronics and fluorescent bulb and ballast recycling and disposal; Property Phase I and Phase II environmental assessments and sampling; Underground Storage Tank (UST) and Aboveground Storage Tank (AST) requirements; Oil and hydraulic oil testing and leak requirements</td>
<td>Linda Vishino, 935-7864</td>
</tr>
<tr>
<td>Occupational Safety</td>
<td>Provides technical assistance on building safety hazards (asbestos, lead, PCB’s), fire safety, fire and life safety codes, construction site safety, indoor air quality (IAQ), mold, ergonomic equipment purchases, hot work permits, red tag permits, lock out/tag out requirements, fall protection, building flood and fire follow-up, and hazard communication (HazCom)</td>
<td>Brad King, 935-9262</td>
</tr>
<tr>
<td>Radiation Safety</td>
<td>Lab close-outs/decommissioning of areas and equipment that were used for radioactive materials, including cyclotron and linear accelerator locations; tritium exit lights; lab duct, surfaces and sink plumbing testing for radioactive material contamination; NRC decommissioning requirements; building and property assessment for radioactive material contamination; research magnet, laser, ultra violet (UV) and extremely low frequency (ELF) safety. Typically need to contract out for decommissioning and cell phone tower microwave safety assistance.</td>
<td>Mickey Croyle, 362-2997</td>
</tr>
</tbody>
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Project Initiation

At the beginning of a project, there are several EH&S planning considerations that need to be reviewed to ensure compliance with federal, state and local regulations. The type of construction (new or renovation), and the scope of work will determine what guidelines need to be followed.

The following checklist will provide assistance in determining which EH&S standards and requirements need to be included in new construction and renovation projects. Although the checklist covers many EH&S requirements, it’s impractical to list all requirements; therefore, it is important to send the checklist to EH&S for review prior to the start of the project to try and verify all EH&S requirements are being included in the project.

Guidance by Topic Checklist:
The following EH&S protocols provide guidance information for all projects that involve new construction, renovation and demolition. Any relevant supporting policies, regulations, etc., should also be referenced in further detail, if appropriate.

Asbestos Management

- The following four steps shall take place prior to any project that involves removal or demolition of building materials:
  1) Contact one of the University-approved Continuing Service Agreement (CSA) asbestos environmental consultant companies (see below) to conduct an Environmental Protection Agency (EPA) asbestos survey.
     a. Existing asbestos building surveys can be used to get an idea if there is asbestos containing material in a space, however, the building surveys are non-invasive and do not include all building materials, particularly those hidden from view (e.g. whether asbestos containing material is behind walls, in joint compound, in floor tiles and mastic under flooring, etc.).
     b. If demolition will occur, then surveys should be invasive to determine proper scope.
  2) If asbestos containing material is found in building materials, then an approved third party environmental consultant company (see below), shall be used.
     a. An asbestos consultant is certified to perform accredited testing for asbestos (including conduct air monitoring, as necessary).
  3) In addition, an approved abatement company (see below), will need to be hired to remove the asbestos.
  4) Send a copy of the abatement close-out documents to Brad King via e-mail at kingb@wustl.edu or via campus mail (Campus Box 1010).

- Continuing Service Agreement Contractors:
  o For Abatement: Cardinal Environmental Operations (314) 890-2088 or Midwest Service Group (636) 926-7800
  o For Third-Party Monitoring/Consulting: Farmer Environmental Services, LLC (618) 656-6988 or Professional Service Industries (PSI) (314) 432-8073
• Click here for Washington University’s Asbestos Operations and Maintenance Plan.

**Biosafety Level 3 (BSL3) Laboratories**

• Biosafety Level 3 facilities are required for agents designated as risk group 3 by the NIH and CDC. These facilities have extensive architectural and HVAC requirements that differ depending on the specific agents in use. A representative from the Biological & Chemical Safety Division of EH&S must be present during design meetings for any BSL3 facility (new or remodel).

**Compressed Gases**

• Following are the minimum design requirements for compressed gases. Additional requirements may be required for compressed gases and manifolds usage and storage.

  **Flammable Gases:**
  - Flammable gas cylinder use is not permitted in any laboratory unit where the floor is located below grade.
  - Flammable gases must be stored in storage rooms which are located at, or above, grade level.
  - Flammable gases must be separated from corrosives (acids and bases), chemicals, oxidizers and oxidizing gases.
  - Follow NFPA and local Building and Fire Code requirements.

  **Cryogenics:**
  - Cryogenics are not permitted to be stored at or near entrances or exits.
  - Space must be allocated in the interior of the room or building to store and use cryogenics.
  - Areas where cryogenics are dispensed, and in excess of 60 gallons, require an oxygen sensor(s).

  **Toxic and Pyrophoric Gases:**
  - Continuously mechanically vented gas cabinets are required for toxic and pyrophoric gas cylinders larger than lecture size and in use.
  - Pyrophoric gas cabinets must be sprinkled.
  - Appropriate sensors and alarms should be used.

  **Gas Cylinder Storage:**
  - Compressed gas cylinders must be properly secured in a safe and upright position.
  - Cylinders must not be secured to plumbing or electrical conduits.
  - Area should be ventilated per code requirements and [Prudent Practices in the Laboratory](#) recommendations.

  **Manifolds (House Gas Systems):**
  - All compressed gas manifolds or house gas systems must have centrally located shutoff valves. Valves should be located near the entrance or exit of each laboratory or near fire stairwells.
  - All gas outlets must have a regulator and gauge installed at the point of use to show outlet pressure. All dual-outlet gas valves must have independent controls.
  - Manifold piping must be labeled to comply with all applicable standards.
**Confined Space Entry**

- Under no circumstances should a contractor enter any confined space unless the contractor has been properly trained to do so and the space is deemed safe to enter. Only contractors that have been properly trained to enter confined spaces are allowed to do so in accordance with OSHA guidelines and regulations. Please ensure that the contractor provides proof of training and an entry/exit plan before anyone is to enter the confined space.

- What is a confined space?
  1. A space that is large enough and so configured that an employee can bodily enter and perform assigned work. Note: If any part of your body breaks the plane of a confined space, you have entered the space.
  2. Has limited or restricted means for entry or exit.
  3. Is not designed for continuous employee occupancy.

- Confined space classifications:
  1. Non-permit. A non-permit confined space is a space that does not contain or, with respect to atmospheric hazards, have the potential to contain any hazard capable of causing death or serious physical harm.
  2. Permit required. A permit-required confined space is a space that contains one or more of the following characteristics: Contains or has potential to contain hazardous atmosphere; Contains a material that has the potential for engulfing an entrant; Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross-section; Contains any other recognized serious safety or health hazard.

**Crystalline Silica Standard**

- To improve worker protection, the Occupational Safety and Health Administration (OSHA) has enacted a new rule for respirable crystalline silica on June 23, 2016. The rule consists of 2 new crystalline silica standards – one for general industry and the other for the construction industry. There are numerous common elements in the two standards. The biggest provisions pertaining to the new rule are:
  - The permissible exposure limit (PEL) for respirable crystalline silica is 50 micrograms per cubic meter (μg/m³) of air over an 8-hour time weighted average (TWA).
  - Requirements for employees to:
    - Use engineering controls (such as water or ventilation) to limit worker exposure to the PEL.
    - Provide respirators when engineering controls cannot adequately limit exposure (remember in order to wear a respirator a worker must be medically cleared).
    - Limit worker access to high-exposure areas.
    - Develop a written exposure control plan.
    - Offer medical exams to highly exposed workers.
    - Train workers on silica risks and how to limit exposures.

Please click [here](#) for more information regarding the Silica standard.
Emergency and Safety Equipment

Biological Safety Cabinets (BSCs):

- Biological safety cabinets must be used whenever aerosol-generating procedures are performed with risk group 2 agents or human-derived materials. BSCs must be used for all procedures involving risk group 3 agents. BSCs may also be used to maintain a sterile environment.
- BSCs may discharge filtered air into the room or may be indirectly connected to building exhaust (thimble connection)
  - Please note that NSF49 is being updated to require alarming of thimble connections for newly-installed BSCs
- BSCs should be located in low traffic areas, away from doors, and away from supply vents to minimize airflow disruptions that may lead to loss of containment
- BSCs must not have natural gas piped to them (use of flames in BSCs disrupts airflow and may damage the HEPA filter)
- BSCs must be certified on installation, annually thereafter, and whenever relocated. Field certification must be performed by someone familiar with, and preferably accredited by, NSF 49.

Eyewash and Safety Shower Guidance:

- Where the eyes or body of any person may be exposed to injurious corrosive or toxic materials, suitable facilities for quick drenching or flushing of the eyes and body shall be provided within the work area for immediate emergency use. In addition, emergency eyewashes units shall also be installed in tissue culture rooms.
- The maximum distance and travel time from the hazard shall not exceed 100 feet and/or 10 seconds. All eyewash and safety shower units installed must meet the most current version of ANSI/ISEA Z358.1. Tempered water must be used.

Fire Extinguishers:

- Fire extinguishers are to be included in the design for all spaces which includes laboratories, mechanical rooms, maintenance shops, machine shops, and workshops or any space where flammable liquids are stored. Exception: Fire extinguishers are not required in common areas that have quick sprinkler activation.
- A carbon dioxide or other clean agent fire extinguisher must be provided in areas with costly equipment that can be damaged by ABC extinguishers.
- Areas in which high voltage or sensitive equipment are in use (e.g., elevator Mechanical rooms) must have at least one CO2 extinguisher.

Fire Extinguishers in Laboratories:

- At a minimum, one 10-pound ABC fire extinguisher must be posted within the door to the laboratory (including laboratory procedure rooms).
- Extinguishers must be located so that no point in the laboratory is farther than 50 feet from an extinguisher.
- The use/storage of alkali metals (e.g., metallic sodium) requires a dry graphite extinguisher be available, not dry powder. All other extinguishing agents react violently with burning metals; only dry graphite will extinguish an alkali metal fire.

Fume Hoods:

- Chemical fume hoods are required whenever volatile solvents, corrosive materials, or other hazardous chemicals will be used. Fume hoods should be located in low traffic areas, away from doors, and away from supply vents to minimize airflow disruptions
that may lead to loss of containment Chemical fume hoods are required whenever volatile solvents, corrosive materials, or other hazardous chemicals will be used.

- Fume hoods must be hard-ducted to the building exhaust
- Ductless fume hoods may be allowed in certain limited circumstances
- Fume hoods must be ASHRAE 110 tested as to-be-used on installation and following relocation
- Fume hoods should be located in low traffic areas, away from doors, and away from supply vents to minimize airflow disruptions that may lead to loss of containment

**Environmental Compliance and Regulatory Permitting**

- In order to comply with requirements and obligations, certain conditions must be met. Some environmental laws require you to obtain an environmental permit before you can emit or discharge a pollutant into the air or water, dispose of hazardous waste, or engage in certain regulated activities.

  **Air Permitting:**
  - The following items require notification to the Environmental Compliance office at least 30 days prior to changes being made (an air registration or permit could be required). This list is not exhaustive. Please provide a brief notification to EH&S to minimize potential non-compliance with City and State air pollution permitting regulations. If you are unsure if notification is required please contact the Environmental Compliance office at (314) 326-6816 for information pertaining to this policy. On the Danforth Campus, please contact Donna Hall at halld22@wustl.edu. On the Medical School campus, please contact Livi Isringhausen at isringhausenm@wustl.edu.
    - Addition/replacement or removal of an Emergency generator
    - Addition of:
      - Paint spray booths and equipment
      - Parts washer or cold cleaner for cleaning metal parts
      - Combustion equipment for heating or reheating (i.e. boilers) burning natural gas/LPG with heat input greater than 10 MMBtu/hr
      - Combustion equipment for heating, fuel oil (#1 or #2), diesel, or wood with heat input greater than 1 MMBtu/hr
      - Dust collection equipment
      - Gasoline dispensing equipment (pumps, lines, tanks)
      - Kilns, ovens, incinerators
      - Oil water separators
      - Ethylene oxide sterilizers
    - Anything that causes the creation of air contaminants
    - Anything that causes the emission of air contaminants (in excess of 200 pounds)
    - Anything that may eliminate or reduce the control of emissions of air contaminants

**Chemical Waste Disposal:**

- Anytime a chemical is no longer wanted or that the chemical has become inherently waste-like, the following practices must be followed. This includes any rags or debris contaminated with a chemical. If this large scale clean up please contact Donna Hall (Danforth Campus) at halld22@wustl.edu; or Livi Isringhausen (Medical School) at isringhausenm@wustl.edu.
Apply a yellow Hazardous Waste label to the waste container at time of first filling and complete the label. Hazardous Waste labels may be obtained from the Environmental Compliance office.
- Ensure full chemical name is printed on the label (no acronyms).
- Ensure location and Manager Name is printed on the label.
- Ensure the start date is printed on the label.
- Use correct generator label for your campus or building.

Ensure each container is closed at all times (except when adding waste).

Ensure that you do not exceed 55-gallons or 220 lbs of waste, whichever is smaller.

Ensure that all Hazardous Waste is picked up by EH&S within 12 months or 1 year.

Complete the online EH&S “Request for Pick Up” as needed, when container is almost full or upon approaching 12 months or 1 year of storage, whichever comes first.
- Use the appropriate online waste request form found on the EH&S website (ehs.wustl.edu) under the Hazardous Material Management link.

Do not dispose of chemicals via drain/sewer, in trash, dumping on ground or by evaporation.

Do not dilute chemicals in attempt to eliminate the need for disposal as Hazardous Waste.

**Clean Water Act – Discharge to Surface Waters:**
- Please contact the Environmental Compliance office at (314) 362-6816 for information pertaining to this policy.

**Contaminated Soil:**
- Anytime contaminated soil is suspected or discovered, contact the Environmental Compliance Office at (314) 362-6816 for assistance.

**Emergency Generators:**
- Please see Air Permitting Section.

**Fuel Oil Storage:**
- Any time any addition, modification or removal of any fuel oil storage is to be done the Environmental Compliance office must be notified at least 30 days in advance.
- On the Danforth Campus, please contact Donna Hall at halld22@wustl.edu. On the Medical School campus, please contact Livi Isringhausen at isringhausenm@wustl.edu.

**Light Bulbs:**
- Anytime a light bulb is to be disposed of the following practices must be followed. These requirements also apply to all WU contractors, Facilities must coordinate all projects that require used bulb disposal through EH&S.
- **Broken light bulbs must be packaged and disposed of differently.**
- If this large scale clean up or light bulbs are broken, on the Danforth Campus, please contact Donna Hall at halld22@wustl.edu. On the Medical School campus, please contact Livi Isringhausen at isringhausenm@wustl.edu.

- Packaging Discarded Bulbs
  - Bulbs should be placed in cardboard containers with the same kind and size of bulbs.
  - The recommended container is the reuse of manufacturer packaging.
- Remove any dividers in the containers prior to placing the spent bulbs inside to avoid bulbs from extending beyond the end of the container. Larger cylinder type containers are available. They are available from the Environmental Compliance Office.

- Labeling Requirements for Light Bulb Boxes
  - All containers of spent bulbs must be labeled with the Universal Waste Label completely filled out. They are available from the Environmental Compliance Office.
  - The Start date must be completed with the date the first bulb was placed in the container.

- Amount of time bulbs may be stored:
  - Bulbs must be sent for final disposal in no more than one year after the start date.
  - All boxes stored must have their start date less than one year.

- Storage Requirements
  - Boxes must be closed when not in use.
  - Bulbs must be secured from falling or from potential damage.
  - Bulbs should be stored in a dry location.

Metropolitan Sewer District Permits:
- The Environmental Compliance office must be notified as follows:
  - When new buildings are erected. All sewer connections must be sent in to the permitting section for addition to our MSD Permit, new sampling point may be need to be added to the permit.
  - Whenever a discharge will be made into a sewer.

- On the Danforth Campus, please contact Donna Hall at halld22@wustl.edu. On the Medical School campus, please contact Livi Isringhausen at isringhausenm@wustl.edu.

Phase I Environmental Site Assessment (ESA):
- Phase I ESA is a tool used to recognize site-specific environmental conditions that may or likely be present for that particular parcel of land or real estate. The assessment must be conducted using American Society for Testing and Materials (ASTM) standard E1527-13. Washington University has a list of preferred vendors to conduct the ESA. Please contact Linda Vishino, Director Office of Environmental Compliance (314-935-7864) for additional information.

- Please follow the below guidelines before major renovations or new construction is to begin:
  1. Contact the Washington University Environmental compliance office and ask if a Phase I ESA exists for the property.
  2. If an ESA does not exist for the property you will have to hire a preferred vendor to conduct one.
  3. If the ESA does determine the presence or likely presence of environmental materials then an additional Phase II ESA may be necessary.
  4. The Environmental Compliance office asks that a copy of the Phase I ESA be sent to them for future reference.
If you need assistance reading or understanding the ESA please feel free to contact the Environmental Compliance office for assistance.

- Note: A Phase I ESA will not confirm the presence of Asbestos Containing Materials (ACM) at the site unless specifically requested. An additional Asbestos survey must be conducted to determine the presence of ACM.

**Phase II Environmental Site Assessment (ESA):**

- Phase II ESA is a tool that can be used to confirm if the potential recognized environmental conditions (REC) identified in the Phase I are indeed hazardous. Phase II ESA’s are conducted under the ASTM standard E1903-11. Phase II ESA use sampling and laboratory testing to confirm the presence of hazardous materials. Phase II ESA should outline additional site investigation needs and potential remedial actions that may be required to clean up the property.

- Some examples of tests that may be performed in a Phase II ESA are:
  - Surficial soil and water samples
  - Subsurface soil borings
  - Drum sampling
  - Sampling of dry wells, floor drains, and catch basins
  - Transformer/capacitor sampling of Polychlorinated Biphenyls (PCB’s)
  - Testing of underground storage tanks (UST’s)
  - Geophysical testing for buried tanks and drums

**Regulated Equipment (fluorescent bulbs, ballasts, batteries, etc.):**

- All electronic equipment or e-waste owned by WU, privately owned computers are not included in this policy, must be disposed of following the practices outlined below. There is no clear definition for e-waste at this time. Items that contain circuit boards or chips or can be plugged into an electrical outlet should be considered e-waste.

- All e-waste materials must be disposed of through the ECD. Any disposal of e-waste generated by contractors or operations funded by other departments must be approved by ECD. All contractors are required to have all necessary and appropriate licenses, certifications and permits according to Federal, State and local requirements. DO NOT dispose of these items in the trash or your recycling bins.

- If your department or location would like to utilize another disposal method such as donating the e-waste to a charity, this must be approved by EH&S.

- On the Danforth Campus, please contact Donna Hall at halld22@wustl.edu. On the Medical School campus, please contact Liv Isringhausen at isringhausenm@wustl.edu.

**Lead-Based Paint Management**

- Activities that could potentially involve the removal of lead-based paint shall be in the accordance of the Occupational Safety and Health Administration (OSHA), the Environmental Protection Agency (EPA) and the Department of Housing and Urban Development (HUD).
  - OSHA:
    - The OSHA Lead Standard applies to all construction work where an employee may be exposed to lead. All work related to construction, alteration repair, including painting and decorating, is included. The standard establishes maximum limits of
exposure to lead for all workers covered. The OSHA maximum permissible exposure limit to lead is 50 micrograms per cubic meter of air (50 ug/m3) averaged over an eight-hour period. The “action limit”, regardless of respirator use, is an airborne concentration of 30 ug/m3, averaged over an 8-hour work period. The “action limit” is the level at which an employer must begin specific compliance activities outlined in the standard. An initial hazard assessment is required to determine whether employees are exposed to lead at or above the “action limit”.

- Note: Contractors can use objective data and historical measurements of lead to satisfy the standards initial monitoring requirements.

- **EPA:**
  - Any construction work conducted (in pre-1978 constructed buildings) with the sole intention of removing (abating) known lead-based paint hazards must be done by certified lead workers. There must be at least one certified lead supervisor onsite during abatement of lead paint.
  - Any construction work conducted (in pre-1978 constructed buildings) for any purposes other than lead abatement must follow best practices for working with lead paint. See Appendix A of Washington University’s Lead Safe Practices and Compliance policy for best practice guidelines.

- **HUD:**
  - U.S. Department of Housing and Urban Development (HUD)/EPA Requirements for Child Occupied facilities/Residential Properties: The EPA’s lead renovation, repair and painting rule (RRP) requires that Contractors and their employees performing the work that disturbs lead in homes, child care facilities and pre-schools built before 1978 have the proper certifications. A contractor performing RRP work **MUST** have both a “Firm” certification (business certification) and at least one worker must have an individual RRP certification. For more detailed information regarding the RRP rule please see Appendix C of Washington University’s Lead Safe Practices and Compliance policy by clicking [here](#).
  - Lead-based paint waste disposal: To determine proper disposal, Lead-based paint must be laboratory tested using the EPA Toxicity Characteristic Leaching Procedure, (EPA Method 1311).

**Ergonomic Furniture**
- Please contact Resource Management regarding ergonomic policies before purchasing furniture. Please click [here](#) for our ergonomic guidelines for desk set-up.

**Fall Protection**
- Fall Protection (e.g. safety lines, guardrails, davits, parapets) need to be incorporated into the building design to ensure safe rooftop access. In addition, fall protection needs to be incorporated as needed on interior projects.
- There are two types of fall protection to consider (fall restraint and fall arrest) and each has its own specific requirements.
Fall restraint systems are systems that prevent you from falling. A fall restraint system has a line that is attached to an anchor point and your harness in such a way that you cannot fall. The anchor point must be able to withstand 3.5 kN (800 lb.)

Fall arrest systems are designed to protect you after a fall by stopping you from impacting the surface below. Anchor points must be able to withstand 22kN (5000 lb.) or 2X the maximum arrest force.

For Washington University’s Fall Protection Program click here.

**Flammable Liquid Storage**
- It is important to understand what flammable liquids and what quantities will be used/stored in the designed space. Please follow International Fire Code (IFC) Flammable Liquid Guidelines when designing these spaces. Click here for IFC Building Guidelines.

**Laboratories and Clinics**

**Laboratory Closure Guideline:**
- The laboratory closure guidelines are to facilitate the process of laboratory closure when an investigator is vacating, relocating, or renovating a lab space. These guidelines only cover the removal of regulated materials. It is the investigator’s Department’s responsibility to coordinate removal of all non-regulated materials (books, furniture, etc.). Both the investigator and the Department/Division business manager are responsible for ensuring that all necessary signatures are obtained on the Laboratory Safety Status form before renovations begin or a new investigator enters the lab.
- The following link has the complete guidelines for laboratory closure: http://ehs.wustl.edu/resources/EHS%20Documents/Guidelines_for_Laboratory_Closure.pdf

**Laboratory Design:**
Research laboratories must be designed to support the equipment and materials necessary for the proposed research and should be designed with flexibility for future projects as objectives or occupants change. Laboratories must also be designed to promote safety and compliance. See Appendix 2 (page 21) for guidelines regarding laboratory design.

**Heating, Ventilation and Air Conditioning Considerations**
- Heating, ventilation and air conditioning systems must be designed to maintain appropriate temperature and humidity for occupants and to prevent the spread of hazardous materials in the event of a release within the laboratory. Consideration must be given to the quantity and type of equipment planned for the space to accommodate heat loads as well as any specialized exhaust needs.
  - Laboratories must have a minimum of 6 air changes per hour (ACH) when occupied
  - Airflow must be balanced such that air flows from clean to dirty areas
  - Laboratories and hazardous material storage areas must be negative air pressure relative to clean corridors
- Interior procedure rooms (e.g. tissue culture rooms) may be positive to larger lab space if both spaces are operating at the same biosafety level, but both must be negative relative to clean corridor.
- Laboratory equipment may require point exhaust – see manufacturer’s specifications

**Infection Prevention Risk Assessment**

An Infection Prevention Risk Assessment is required to be completed and faxed to the Infection Prevention Office prior to any renovation or demolition in buildings that provide patient care, particularly those areas where patients are immune-compromised, such as transplant and bone marrow recipients and HIV-positive patients. In addition, buildings that patients are transported through require a completed risk assessment prior to the beginning of a project. Click [here](#) for a copy of the Infection Prevention Risk Assessment.

**Life Safety Guidelines**

- Design considerations must be in accordance with local Fire Marshal requirements. The City of Clayton, the City of St. Louis and University City have adopted the International Codes.

  **Public Egress and Corridor Storage:**
  - Design in adequate storage to prevent materials from being stored in egress corridors, stairwells and combustible materials being stored under assembly areas.
  - Storage in egress corridors is prohibited for new construction or renovation projects. (Likewise, contractors should not store items in or block egress routes during construction or remodeling activities.)
  - Adequate storage must be provided within the footprint of the project without compromise.

  **Elevator Lobbies:**
  - Unobstructed egress must be maintained from elevator lobbies to fire stairwells.
  - Enclosed elevator lobbies are not permitted to have locking doors without prior EH&S and Fire Marshal approval and appropriate measures in place to permit safe egress from the lobby.

  **Interior Central Egress Pathways:**
  - Interior central egress pathways are the primary/central paths within a space which lead to public egress corridors and/or stairwells.
  - The central egress pathways must be designed to maintain adequate egress clearance.
  - Equipment stored in central egress paths should be organized to one side of the path to promote a straight egress out of the space avoiding a “zigzag” egress path.
**Radiation Safety**

- Contact Radiation Safety for the following:
  - Legacy Surveys: Radiation Safety needs to conduct legacy surveys on drains, ventilation ducts, fume hoods prior to planned work.
  - Laboratory Decommissioning (refer to laboratory decommissioning guidelines p. 15)
  - Tritium exit lights that are removed from buildings are required to be properly disposed. Therefore, never install emergency exit signs containing tritium.
## Planning (check if completed)

<table>
<thead>
<tr>
<th></th>
<th>Description – Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type of Construction</strong></td>
<td>(Expand descriptions as needed to convey necessary information)</td>
</tr>
<tr>
<td>- New Construction</td>
<td></td>
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<tr>
<td>- Renovation (Partial or Gut Remodel) (circle)</td>
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<tr>
<td>- Demolition</td>
<td></td>
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<tr>
<td><strong>Scope of Project</strong></td>
<td></td>
</tr>
<tr>
<td>- Animal Facility</td>
<td></td>
</tr>
<tr>
<td>- Auditorium or large assembly space</td>
<td></td>
</tr>
<tr>
<td>- Office Space</td>
<td></td>
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<tr>
<td>- Mixed Use</td>
<td></td>
</tr>
<tr>
<td>- Laboratories:</td>
<td></td>
</tr>
<tr>
<td><strong>Submit a complete inventory all chemicals, infectious agents, radioactive materials and research equipment of concern (research magnets, NMR, class 3 and 4 lasers, etc.) to EH&amp;S for review</strong></td>
<td></td>
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</tbody>
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<table>
<thead>
<tr>
<th></th>
<th>Darkroom</th>
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</thead>
<tbody>
<tr>
<td>BSL3/BSL3+</td>
<td></td>
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<tr>
<td>Wet Lab</td>
<td>Clean Room</td>
</tr>
<tr>
<td>Dry Lab</td>
<td>Microscopy</td>
</tr>
<tr>
<td>Teaching Lab</td>
<td>Simulation Lab</td>
</tr>
<tr>
<td>Other:</td>
<td></td>
</tr>
</tbody>
</table>

(circle or highlight)

Specialized Research (circle or highlight and describe):
- Nano Facility
- Cryogenic Facility
- Cyclotron
- Research Magnet/NMR
- High pressure/high temperature
- Combustion facilities

Clinics:
- Patient Care Areas
- Significant airborne infectious patient concerns (TB, Ebola, anthrax, SARS, MERS, etc.)
- Art Studios, Woodworking Shops, Ceramic Shops, etc.
- Pilot Plant Research (such as: Clean Coal Research, pilot scale combustion chambers, large scale pharmaceutical (>10 L), race car design labs, other.)

**Property Environmental Site Assessment (ESA)**
- Phase I and Phase II assessments need to be prepared which meet EPA’s and Missouri Department of Natural Resources (MDNR) “All Appropriate Inquiry” Rules and the newly revised ASTM Phase I and Phase II ESA standards (Standards
ASTM E1527, E2247, and E1903

- ESA’s must be approved by and done in conjunction with the EH&S Environmental Compliance Officer, or her or his designee
- ESA’s must include remediation cost assessments for all hazardous materials, such as asbestos, USTs and environmental contamination, to meet Finance Office FIN 47 reporting requirements
- Missouri One Call System – 1-800-DIG-RITE

### Hazardous Materials Review

- Asbestos, lead, PCB’s Surveys, plus estimated cost of abatement required needed for project
  - Use the University’s Continuous Service Agreements (CSAs) for asbestos abatement and third party air monitoring
  - Laboratory Decommissioning (chem., bio., and rad.) requirements
  - See Facilities / EH&S checklist

### Fire Marshal and Life Safety Requirements

- Anticipated hazardous material inventories and maximum quantities of each chemical (including their hazard class)
- Total maximum quantities of flammable liquids (and other hazard classes) by control area per floor of building, and by room
- Compare International Code Requirements vs. agreed variance with local jurisdiction
- Wet labs on lower floors, below floor five
- No material, equipment, combustible material, furniture in egress corridors;
- Emergency signage and emergency egress requirements
- Location of fire extinguishers
- Responsibility for installing fire extinguishers
- Fire Department Access
- Siamese Connections
- Fire lanes around building
- Fire hose connections/Knox box
- Fire (& CO) detection and suppression systems
- Approvals by Building and Fire Code Officials

### Equipment

Potentially hazardous equipment to include but not limited to (circle or highlight):
- UV lighting
- Lasers (Class 3 or higher)
- High temperature, high pressure equipment
- Cell sorters
- Autoclaves/Sterilizers
- Chemical fume hoods
- Biological safety cabinets (BSCs)
- Down draft tables
- Sterilizers
- Research magnets

**Description – Comments**
- Infectious animal and non-human primate vivariums
- Combustion facilities, such as coal gasification research
- Toxic, pyrophoric, flammable or oxidizer compressed gas use

Cryogenic liquid, such as liquid nitrogen and helium, use

<table>
<thead>
<tr>
<th>☐ Biological Safety (requirements for)</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Biological Safety Level 3 or 3+ (BSL3/BSL3+) Laboratories</td>
</tr>
<tr>
<td>- Animal ABSL3/ABSL+3</td>
</tr>
<tr>
<td>- Select Agents and Toxins</td>
</tr>
<tr>
<td>- DEA Controlled substances</td>
</tr>
<tr>
<td>- Ability to isolate HVAC systems to do CDC/UDSA required testing that demonstrates the laboratory space does not reverse airflow during supply and exhaust fan shutdown/power failure; also demonstrates redundant HVAC systems capability, if required.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>☐ Radiation Safety:</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Specialized radioactive material production or use Machines: Cyclotrons, Linear Accelerators, View Ray, High Dose Brachytherapy, Gamma Knife, Proton Beam, e</td>
</tr>
<tr>
<td>- Research and Clinical Magnets – Nuclear Magnetic Resonance (NMR), Magnetic Resonance Imaging (MRI) and other</td>
</tr>
<tr>
<td>- Shielding calculations</td>
</tr>
<tr>
<td>- Decommissioning of existing facilities</td>
</tr>
<tr>
<td>- Lead shielding safety</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>☐ Smart design</th>
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</thead>
<tbody>
<tr>
<td>- Easy maintenance access – e.g. of changing lights in atriums, cleaning glass/windows and ledges in tall atriums, access to shut-off valves and tempered water valves for safety eyewashes and showers, ease of cleaning in laboratories, clinics, shops and rest rooms, ease of repair of equipment or addressing water leaks, shut-off of high pressure steam and electricity for maintenance work, etc.</td>
</tr>
<tr>
<td>- Strongly consider including interstitial mechanical spaces outside of BSL3, animal vivarium and airborne infectious disease spaces so mechanical and HVAC equipment can be repaired without the need to shut down research and doing costly room disinfections.</td>
</tr>
<tr>
<td>- Design of laboratories and clinics to keep Food &amp; Drink areas, including desks and offices, out of laboratory and clinic spaces</td>
</tr>
<tr>
<td>- Where possible, follow NIH facility design criteria, as it tends to be industry standard for research settings</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>☐ General Design</th>
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</thead>
<tbody>
<tr>
<td>- Floor and counter material – chemically resistant, easy to clean</td>
</tr>
<tr>
<td>- Utility shutoff locations</td>
</tr>
<tr>
<td>- Flooring and step slip coefficients, wet and dry</td>
</tr>
<tr>
<td>- Maintain good indoor air quality (IAQ)</td>
</tr>
<tr>
<td>American with Disabilities (ADA) requirements</td>
</tr>
<tr>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>Emergency Assembly Points</td>
</tr>
<tr>
<td>Clinical Safety</td>
</tr>
<tr>
<td>- Renovation – impact on immunosuppressed patient Infection Prevention requirements</td>
</tr>
<tr>
<td>- Follow WUSM/BJH Infection Prevention requirements for construction, renovation and repair.</td>
</tr>
</tbody>
</table>
Appendix 2: Lab Design Checklist

Architectural/Layout Considerations

Research laboratories must be designed to support the equipment, materials and animals necessary for the proposed research and should be designed with flexibility for future projects as the type of research or occupants change. These laboratories must also be designed to promote safety and compliance.

- Eating/drinking/food storage areas, including desks and offices, must be separate from areas containing hazardous materials and access must be provided from a clean corridor (see http://ehs.wustl.edu/resources/EHS%20Documents/Eating%20Drinking%20and%20Related%20Activities%20in%20Laboratories.pdf)
- Secure storage locations must be provided in clean areas for storage of personal items (coats, bags, food, etc.)
- Room construction must meet the specifications outlined in Biosafety in Microbiological and Biomedical Laboratories and the NIH Guidelines For Research Involving Recombinant Or Synthetic Nucleic Acid Molecules for the biosafety level designated for the room.
- Doors must be lockable, yet allow emergency egress
- Secure, temperature-appropriate storage must be provided for work with DEA Controlled Substances or radioactive materials
- Meet recommendations of the National Research Council Committee on Laboratory Safety Culture and Prudent Practices in the Laboratory.

<table>
<thead>
<tr>
<th>Planning (check if completed)</th>
<th>Description - Comments</th>
</tr>
</thead>
</table>
| ☐ Laboratory and Clinical Design | - Designed to keep food and drink out of labs/clinics; keep coats and personal items out, keep contaminated lab coats/gloves, etc. in
- NIH design (NIH funded laboratory and clinical projects are required to comply with NIH design standards)
- No carpets, negative pressure relative to corridors, etc.
- special use (Please describe)
- Fume hood and biosafety cabinet (BSC) placement relative to traffic patterns and room air supply and exhaust
- Eyewash / safety showers – tempered, easy access, inside labs, placement
- Gas cabinet(s) for toxic gas use
- Sensor and alarm system requirements for toxic gasses, cryogenic gasses
- Adequate number of storage cabinets for segregation of hazard classes of chemicals and wastes
- Security requirements for Drug Enforcement Agency (DEA) Controlled Substances, Nuclear Regulatory Commission (NRC) material, Department of Homeland Security (DHS) Chemicals of Interest (COI), Center for Disease Control and Prevention (CDC), US Department of Agriculture (USDA) and National Institutes of Health |
(NIH) Dual-Use Research of Concern, export controls, Select Agents and Toxins, research magnets, high power lasers (class 3 and 4), etc.
- Design in flexibility to accommodate future use of lab and clinic space – increase or lower air changes, need for fume hoods, eyewash and showers, containment, blowout panels, intrinsically safe electrical systems, localized/specialized exhausts; formaldehyde use, etc.
- Extremely toxic, poison by inhalation hazard (PIH), pyrophoric, reactive material use
- Research requirements with regards to vibration, noise, dust, electrical fields
- BSL3 requirements – pressure differentials; testing requirements (shut down of supply and exhaust, without reversal of airflow); kill tanks; pass-through autoclaves; hands-free operation of sinks and eyewash
- Smart lab energy conservation flexibility
- Adequate storage for biological/infectious/medical, chemical, and radioactive waste

<table>
<thead>
<tr>
<th>Emergency Equipment:</th>
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</thead>
<tbody>
<tr>
<td>- Fire extinguisher type and placement</td>
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<tr>
<td>- Fire detection and proper suppression systems</td>
</tr>
<tr>
<td>- Smart detection – carbon monoxide, where needed</td>
</tr>
<tr>
<td>- Voice annunciators over fire panel system – tie into emergency announcement system</td>
</tr>
<tr>
<td>- Quenching monitoring system – displacement of O2 – alarms and increase air supply</td>
</tr>
<tr>
<td>- Emergency lighting</td>
</tr>
<tr>
<td>- Number of egress doors from labs and corridor length to exit stairwell</td>
</tr>
<tr>
<td>- Safety and security controls – research magnets, ELF, UV, lasers, cyclotrons, cell sorters, etc.</td>
</tr>
<tr>
<td>- Emergency power where needed</td>
</tr>
<tr>
<td>- updating signage; seal wall penetrations with fireproofing material</td>
</tr>
</tbody>
</table>

Meet AAALAC, BNDD, Building Code, CAP, CDC, City/County/State Ordinance, DEA, EPA, Fire Code, Infection Prevention, MDNR, NIH, NRC OSHA, The Joint Commission, USDA and other regulatory and accreditation requirements

Other