RESEARCH

CHEMICAL HYGIENE PLAN AND LABORATORY SAFETY MANUAL

HARRY S. TRUMAN MEMORIAL VA HOSPITAL

IMPORTANT NUMBERS

SAFETY OFFICE:	56307/56306
GEMS COORDINATOR:	56297
RADIATION SAFETY OFFICER:	52590
HEALTH PHYSICIST:	52594
EMPLOYEE HEALTH:	52317
VA POLICE:	56320
EMERGENCY NUMBER:	3333
FACILITIES MANAGEMENT	56370

Updated / Approved February 2015

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RESEARCH SERVICE

SAFETY PROGRAM

1. Purpose – To provide a service-wide plan for the protection of all staff and visitors from hazards associated with chemicals and other hazardous materials utilized within the Research Service.

2. Policy – The Research Service maintains a program to educate employees on a continuous basis and to protect them from health hazards associated with hazardous chemicals in the laboratory by keeping exposure to below permissible limits and ensuring compliance with pertinent Federal, State and local regulations. Protection is secured for patients, research personnel, visitors, property and the environment.

3. Responsibilities –

a. Associate Chief of Staff for Research and Development (ACOS/R&D)

(1) Ensures that an adequate written plan has been developed for ensuring the safe operation of all research programs for the facility.
(2) Ensures that the Research Service Safety Program is conducted according to published procedures.
(3) Ensures a properly constituted Subcommittee for Research Safety is in place and functioning.

b. Administrative Officer for Research and Development (AO/R&D)

(1) Ensures all research personnel receive adequate training in laboratory safety and waste management to include aspects of the GEMS program.
(2) Ensures a process is in place to inspect all research laboratories on a quarterly basis.
(3) Ensures that Safety Data Sheets (SDS) are available for all hazardous chemicals used in the research area.
(4) Ensures accidents or safety incidents are investigated and reported.
(5) Maintains membership on the Subcommittee on Research Safety.
(6) Represents Research Service on the facility GEMS Committee.

c. Research Compliance Officer (RCO)

(1) Provide oversight of research safety issues to ensure compliance with all Federal and VA regulations.
(2) Keep current on and provide guidance and assistance in implementation of any regulatory changes.

d. Principal Investigators (PIs)

(1) Train employees in laboratory safety, hazardous waste disposal, use of personal protective equipment and other relevant areas. Maintain training records for all supervised staff.

(2) Ensure that the least hazardous chemicals are used in research protocols and that the waste stream is minimized.
(3) Conduct an annual inventory in January of all chemicals currently used in research protocols. Ensure chemicals are properly labeled and stored.

e. Employees

(1) Read and comply with hospital and research safety policies.
(2) Promptly report unsafe conditions or unsafe use of hazardous chemicals to their supervisor, the Research Safety Officer, or the Industrial Hygienist.

4. Procedures –

a. A Subcommittee for Research Safety (SRS) shall be established according to procedures found in VHA Handbook 1200.08. SRS shall function as delineated in the VHA Handbook as well as other duties and functions as assigned by the Research and Development (R&D) Committee.
b. The AO/R&D shall act as the Research Safety Coordinator (RSC). The AO/R&D shall act as liaison with the Hospital Safety Officer and Industrial Hygienist to ensure all hospital safety requirements and GEMS program requirements are met within the research area.
c. The Chemical Hygiene Officer and the RSC shall ensure that a chemical hygiene plan specific to the Research Service is in place and is reviewed on an annual basis by the SRS.

CHEMICAL HYGIENE PLAN

1. **Purpose** – To establish a written program that provides for and supports the procedures, equipment, personal protective equipment (PPE), and work practices for protecting laboratory personnel from potential hazards of using hazardous chemicals in the laboratory. The Chemical Hygiene Plan is designed to comply with OSHA's Occupational Exposure to Hazardous Chemicals in the Laboratory Standard (29 CFR 1910.1450).

2. **Policy** – Research Service administers a Safety Program capable of educating employees on a continuous basis that protects them from health hazards associated with hazardous chemicals in the laboratory, maintains an environment that should keep chemical exposure limits below permissible limits, and ensures compliance with pertinent federal, state, and local regulations. Protection is secured for patients, research laboratory personnel, visitors, property, and the environment. Employees are encouraged to minimize the use of hazardous chemicals and to meet GEMS program requirements.

The following principles govern the Research Service Chemical Hygiene Program for the Truman VA:

a. **Minimize All Chemical Exposures:** Because few chemicals used in Research area are without hazards, general precautions for handling all laboratory chemicals should be adopted. Skin contact with all chemicals should be avoided.

b. **Provide Adequate Ventilation:** The best way to prevent exposure to airborne substances is to prevent their escape into the working atmosphere by use of fume hoods and other ventilation devices.
c. **Institute a Chemical Hygiene Program:** A mandatory Chemical Hygiene Program designed to minimize exposures has been established and the recommendations are expected to be followed by all laboratory workers.
d. **Observe Chemical(s) Exposure Thresholds:** Applicable exposure thresholds for chemicals should not be exceeded.

3. **Scope** – Under the Chemical Hygiene Plan, research laboratory personnel will be trained regarding the hazardous chemicals and materials to which they may be exposed by means of a hazard communication program, product labeling, Safety Data Sheets (SDSs), training, and monitoring compliance of the personnel.

4. **Responsibilities** –

a. ACOS/R&D-
(1) Ensures that an adequate written plan has been developed for hazards within the research area.
(2) Ensures research personnel comply with the written hazard plan.

b. AO/R&D- Acts as Research Safety Officer or appoints a Research Safety Officer to accomplish the following:
(1) Ensures employees are trained about the safe handling and disposal of hazardous chemicals.
(2) Inspects the facility on a regular basis to determine that hazardous chemicals are stored, labeled, and disposed of in compliance with federal, state, and local regulations.
(3) Maintains a current inventory of all hazardous chemicals utilized by Research. Ensures availability of SDS information.
(4) Ensures accidents or safety incidents are investigated and reported.
(5) Performs quarterly inspection of Research Service and ensures compliance with the hospital Safety Program.
(6) Maintains membership on SRS.
(7) Coordinates the Hazardous Waste Program with the GEMS Coordinator.

c. Principal Investigators (PIs)-
(1) Ensure employees are trained in the use of hazardous chemicals. Maintain records of employee training.
(2) Ensure that the least hazardous chemicals are used for the work required.
(3) Conducts an annual inventory in January of all chemicals currently used in research protocols. Ensure chemicals are properly labeled and stored.

d. Employees-
(1) Reads and complies with hospital and research safety policies.
(2) Promptly reports unsafe conditions or unsafe use of hazardous chemicals to their supervisor or the Facility Safety Officer.

5. **The Research Facility:**

a. Design- Research facilities will be designed with:
   1. An appropriate general ventilation system with air intakes and exhausts to avoid the intake of contaminated air.
   2. Adequate, well-ventilated stockrooms and storerooms.
   3. Laboratory hoods, where necessary, and sinks in each laboratory.
   4. Other safety equipment, including eyewash stations and fire extinguishers.
   5. Arrangements for safe and legal waste disposal.

b. Maintenance-
   Chemical hygiene related equipment (hoods, exhaust fans, etc.) will undergo continuing preventive maintenance and be modified/repaired if inadequate.

c. Usage-
   The work conducted and its scale must be appropriate to the physical facilities and ventilation capabilities.

d. Ventilation-
   Laboratories will be designed with adequate general ventilation. As general lab ventilation cannot be relied upon to protect personnel from localized exposures to hazardous levels of airborne chemicals, engineering controls such as laboratory fume hoods and other local exhaust systems (e.g., drop down flexible ducts) may be necessary to provide additional exposure control. In general, laboratory fume hoods are recommended whenever using hazardous chemicals that:

   - Have high acute toxicity, or which are carcinogens, or reproductive toxins, except where there is very low risk of exposures (e.g., use of minimal quantities in a closed system).
   - Have low exposure threshold values.
   - Are appreciably volatile (e.g., solvents) or are easily dispersible in air (e.g.,dust).

e. Administrative Controls-
   Administrative controls will be used, as appropriate, to minimize exposure to hazardous chemicals. Such controls include:
   - Substituting less hazardous chemicals for higher hazardous chemicals, where possible.
   - Keeping containers of volatiles chemicals closed, except when adding/removing material from the container.
   - Isolating or enclosing an experiment within a closed system.
   - Micro scaling the size of the experiment to reduce the amount of chemical usage.

6. **Research Procedures for Working with Hazardous Laboratory Chemicals:**

a. General Requirements:
(1) Eating and drinking are prohibited in research laboratories. Food and drink containers may not be discarded in laboratory trash cans.

(2) Do not apply make-up or cosmetics in the laboratory.
(3) Avoid use of contact lenses in the laboratory unless absolutely necessary. If used, inform supervisor so that special precautions can be taken.
(4) Wash hands before leaving laboratory technical area, after spills, after taking off gloves, etc.
(5) Mouth pipetting is prohibited.
(6) Use of a fume hood or wearing of face shields and/or eye protection when handling caustics and corrosives is required.
(7) Hair should be secured back and off the shoulders in such a manner to prevent contact with hazardous chemicals and contaminated materials.
(8) Avoid practical jokes or other behavior which might confuse, startle, or distract other laboratory personnel.
(9) Keep work area clean and uncluttered, properly label and store chemicals and equipment, clean-up work area upon completion of task or at the end of each day.
(10) Glassware that is chipped or broken must be discarded in puncture-proof containers and labeled as such. Do not fill sharps containers more than ¾ full to ensure that they can be closed properly.
(11) Consult safety data sheets (SDS) when performing new procedures and initiate appropriate protective procedures.
(12) Chemicals must have a SDS available for review.
(13) Do not centrifuge uncapped specimens.
(14) Organic chemicals may not be disposed of by evaporating under a fume hood. Residual amounts must be collected and disposed of properly.
(15) Waste streams will be monitored to ensure prompt disposal of accumulated wastes. All waste containers will be labeled with the date that waste accumulation starts, the chemical content of the waste, investigators name and a hazard warning if appropriate. Containers used to accumulate waste must be sealed around drain tubes. When the container becomes full, indicate the "full date" on the label, and contact the GEMS Coordinator (x56297) for pickup. The waste must be picked up within 3 days of the full date.
(16) All chemicals, solutions, reagents, or working solutions in secondary (not original) containers must be labeled with chemical content, concentration, type of hazard, and date they were prepared.
(17) All chemicals must be inventoried annually. The original chemical container must contain the following information: Manufacturers name, chemical content, inventory date, and investigator's name. Chemicals with expiration dates must be discarded in accordance with applicable regulations when expired.
(18) Hazardous chemicals are not to be discarded into the sanitary sewer system regardless of dilution.
(19) Maintain adequate ventilation when working with dry ice or cryogenic solutions. Exposure to dry ice gases in an enclosed space for an extended period may be lethal.
(20) Appropriate gloves and face shields are provided and must be used when working with liquid nitrogen. Wearing an additional pair of safety goggles under the face shield is recommended.

b. Special Laboratory Procedures:

(1) Compressed Gases

(a) Gas cylinders must be secured to wall or counter with a chain or suitable strap at all times to prevent falling.
(b) Valve safety covers are to be left on until pressure regulators are attached.
(c) Gas containers must be clearly labeled with name of contents and hazards.
(d) Hand trucks or dollies with a securing device installed must be used when moving cylinders.
(e) The use of oil, grease, or lubricants on valves is prohibited.
(f) Do not repair damaged cylinders or force frozen cylinder valves.

(2) Flammable Gases

(a) No more than two flammable gas cylinders may be connected in a room unless approved by the Safety Officer. However, several instruments or outlets are permitted for a single cylinder.
(b) When more than two cylinders of a highly flammable gas are to be used in one room, specific approval by the Safety Officer must be obtained.
(c) Only one stand-by cylinder for each type of gas is to be stored in the laboratory.
(d) Valves on all flammable gas cylinders are to be shut off when the unit is unattended.

(3) Radioactive Materials

(a) Permission to use radioactive materials and approval of any protocol using radioactive materials must be obtained through the Radiation Safety Committee before use of those materials. After these approvals are obtained, strict adherence to the Radiation Safety Policies and Procedures Manual is required.
(b) Each laboratory authorized to use radioactive materials will maintain a complete inventory of radioactive materials. All radioactive material usage, storage, and disposal activities are periodically audited by the Radiation Safety Officer.
(c) All radioactive waste will be managed in accordance with applicable requirements and the Radiation Safety Policies and Procedures Manual.

(4) Caustic Materials

(a) If strong acids or alkalis are being used, a shield or barrier of impervious material is recommended to control any breaks or spills.
(b) Wear aprons, gloves, and eye protection when handling highly corrosive materials as recommended on SDS.
(c) Do not mouth pipette.
(d) Reagents must not be identified by sniffing contents.
(e) Use great care when diluting reagents. When diluting acids, **slowly add acid to water.** Allow acid to run down the side of the container and mix slowly by gentle rotation. Avoid overheating. Use Pyrex where heat is generated.
(f) Use plastic bottle carriers when transporting amounts in glass containers larger that one liter.

(5) Formaldehyde/Formalin

(a) All operations/procedures using formaldehyde/formalin must be evaluated to determine the potential exposure to formaldehyde. Formaldehyde is used as a fixative and is commonly found in research laboratories.

Routes of Exposure: Inhalation, ingestion, skin and/or eye contact
Signs of Over Exposure: Irritation of eyes, skin, nose, throat, respiratory system; tearing; coughing; wheezing; dermatitis; potential occupational nasal carcinogen (chronic exposure)
Target Organs: Eyes, skin, respiratory system

(b) Employees at risk of potential over exposure to formaldehyde will be monitored as specified by OSHA. The facility Industrial Hygienist will coordinate the monitoring. The following exposure limits apply to formaldehyde.

- The OSHA Permissible Exposure Limit (PEL) is the airborne concentration above which no employee is to be occupationally exposed. The PEL for formaldehyde is 0.75 parts per million (ppm) calculated as an eight (8) hour time weighted average (TWA).
- The Short Term Exposure Limit (STEL) is a 15-minute airborne concentration exposure, which cannot be exceeded at any time during the workday. The STEL for formaldehyde is 2.0 ppm.
- The Formaldehyde Action Level (AL) is 0.5 ppm calculated as an eight (8) hour Time Weighted Average (TWA).

(c) The facility must assure that no employee is exposed to an airborne concentration exceeding 0.75 parts formaldehyde per million parts air as an eight hour TWA.

(d) The following ***general handling*** procedures apply to formaldehyde use:

- Formaldehyde should be used only in areas with adequate ventilation, preferably within a fume hood, to minimize the inhalation of vapor formaldehyde.
- Use chemical goggles or a face shield when handling formaldehyde to minimize the risk of liquid/vapor contact to the corneas.
- During handling, wear a lab coat and appropriate gloves to prevent skin contact.

(e) The following ***storage*** procedures apply to formaldehyde use:

- Ensure that containers are clearly labeled with chemical name and appropriate hazard warnings.
- Ensure that containers are intact and closed when not in use. Provide secondary containment for containers larger than 1 gallon.

(f) Areas identified as exceeding the PEL or STEL must be identified with signs with the following warning and access limited to authorized/trained personnel.

DANGER
FORMALDEHYDE
IRRITANT AND POTENTIAL CANCER HAZARD
AUTHORIZED PERSONNEL ONLY

(6) Toluene/Xylene

(a) Toluene and Xylene are solvents that are used to fix tissue specimens and rinse stains.

- Routes of Exposure: Inhalation, ingestion, skin and/or eye contact
- Signs of Over Exposure: Toluene: Irritation of eye and nose; weakness, exhaustion, confusion, euphoria, headache; dilated pupils, tearing; anxiety; muscle fatigue; insomnia; tingling, pricking, or numbness of skin; dermatitis; liver, kidney damage
- Signs of Over Exposure: Xylene: Irritation of eyes, skin, nose, throat; dizziness, excitement, drowsiness, incoherence, staggering; corneal vacuolization (cell debris); anorexia, nausea, vomiting, abdominal pain; dermatitis
- Target Organs: Toluene: Eyes, skin, respiratory system, central nervous system, liver, kidneys
- Target Organs: Xylene: Eyes, skin, respiratory system, central nervous system, liver, kidneys, GI tract, blood

(b) Exposure Limits:

- Toluene: Exposure to Toluene is not to exceed 200 ppm calculated as an 8-hourr TWA; Also, exposures shall not exceed 300 ppm (ceiling) with the following exception: exposures may exceed 300 ppm, but not more than 500 ppm (peak), for a single time period up to 10 minutes for any 8-hour shift.
- Xylene: Exposure to xylene is not to exceed 100 ppm calculated as an 8-hourr TWA, or 150 ppm per 15 minute STEL.

(c) Employees at risk of exposure will be monitored by the Industrial Hygienist during baseline surveys of Research Service laboratories or as part of a special request.
(d) Solvents should be used in an adequately ventilated area. Containers should remain closed when not in use to reduce/prevent vaporization. Appropriate PPE should be worn to prevent skin/eye contact. Corrective action will be taken should the air monitoring results exceed the exposure threshold. Follow-up monitoring will be performed to ensure the adequacy of implemented corrective actions.

(7) Carcinogens (as defined by OSHA; *see Appendix A*)
(a) Use of carcinogens requires the following:

1 Designation of specific work areas with restricted access.
2 Listing of personnel authorized to work in the area.
3 Inventory of types and quantities of reagents on hand.

4 Personnel must be trained in safe handling procedures for the carcinogenic chemical.
5 Records of exposure should be maintained.
6 Procedures for monitoring storage, decontamination, disposal, and emergency procedures should be established.
7 Medical surveillance of personnel. To include:
  a Pre-assignment examination.
  b Periodic examination.
  c Record-keeping.
8 Clean protective clothing must be provided.
9 Handwashing is required immediately after handling.

(8) Perchloric Acid

(a) Do not attempt to heat Perchloric Acid if you do not have access to a properly functioning Perchloric Acid fume hood. Perchloric Acid can only be heated in a hood specially equipped with a wash down system to remove any Perchloric Acid residue. The hood should be washed down after each use and it is preferred to dedicate the hood to ***Perchloric Acid Use Only***. No organic material should be stored in the hood containing Perchloric Acid.
(b) Do not order or use anhydrous Perchlorate Acid or Perchloric Acid solutions > 72% concentration. These can be unstable at room temperature.
(c) Use of PPE is mandatory.
(d) Always transfer acid in a laboratory fume hood designed for ***Perchloric Acid Use Only***.
(e) Heating of Perchloric Acid must be performed so as to capture fumes in H_20 aspirator.

CAUTION: Explosion Hazard - Special care must be taken when heating Perchloric Acid to avoid heating this substance to dryness.

(f) Perchloric Acid is to be checked by the user for discoloration periodically and before each use. If brownish discoloration is noted, the GEMS Coordinator should be contacted to arrange for safe disposal.

(9) Particularly Hazardous Substances (PHS)
(a) OSHA has designated certain substances as Particularly Hazardous Substances (PHS) due to their potential to cause severe adverse health effects. PHS should be identified, evaluated, and managed to ensure that adequate protection is provided.
(b) The OSHA Laboratory Standard (29 CFR 1910.1450) defines a PHS as a select carcinogen, reproductive toxin or substance with a high degree of acute toxicity.
(c) Select carcinogens are those that are listed by OSHA, the International Agency for Research on Cancer (IARC), and the National Toxicology Program (NTP) as known or suspected human carcinogens. Complete lists of these compounds can be found at:
- OSHA: http://www.osha-slc.gov/SLTC/carcinogens/index.html
- NTP: http://ehp.niehs.nih/gov/roc/toc10.html
- IARC: http://monographs.iarc.fr

(d) Reproductive toxins are chemicals that may adversely affect male and female reproductive health and the developing fetus. One source of information about reproductive toxins is the Proposition 65 list developed by the State of California. This list is updated annually and available on-line (http://www.oehha.org/prop65.html).
(e) Chemicals having a high acute toxicity are those that have oral, inhalation, or dermal LD50

and LC50 values below specified thresholds listed in the OSHA Lab Standard. These values are as follows:

- Oral LD50 (albino rats) < 50 mg/kg
- Dermal LD50 (albino rats) < 200 mg/kg
- Inhalation LC (albino rats) < 200 ppm in air
- Probable Equivalent Lethal Oral Dose in Humans (70 kg) < 3.5 g (@1/10 oz or ½ teaspoon)

(f) The Public Health Security and Bioterrorism Preparedness and Response Act of 2002 requires the Department of Health and Human Services (HHS) to establish and regulate a list of biological agents and toxins that have the potential to pose a severe threat to public health and safety. The Agricultural Bioterrorism Protection Act of 2002 requires the United States Department of Agriculture (USDA) to establish and regulate a list of biological agents that have the potential to pose a severe threat to animal health and safety, plant health and safety, or to the safety of animal or plant products (Select Agents). CDC and APHIS share responsibility for some agents because they potentially threaten both humans and animals (overlap agents). The laws require HHS and USDA to review and republish the lists of Select Agents and toxins on at least a biennial basis. The list of Select Agents and Toxins can be found at: http://www.selectagents.gov/SelectAgentsandToxins.html

(g) When working with PHS

- Maintain a current inventory of PHS in your laboratory.
- Maintain the smallest possible quantity of PHS that is needed for the research project.
- Establish designated work areas for PHS use. Depending on the nature of the work, the designated work area may be a specific area of a lab, or a device such as a hood.
- Communicate PHS hazards using labels, color coding or signage.
- Avoid inhalation and skin contact by using fume hoods and wearing appropriate PPE.
- Ensure staff is trained on specific hazards and safe handling/management procedures.
- Thoroughly clean/decontaminate designated areas at regular intervals. Proper decontamination procedures are determined by the type of chemical, the amount of use, the location of use and other factors.
- Be prepared for accidents. Utilize secondary containment for chemical containers and maintain spill supplies on hand.
- Use of highly toxic gases must be approved in advance by the Subcommittee for Research Safety (SRS).

7. **Chemical Procurement and Storage:**

a. Procurement:

(1) Chemicals must be ordered in the smallest quantity that is practical for the intended use. Do not order flammable liquids in single containers larger than four liters.

(2) Every effort should be made to find less hazardous substitutes for hazardous chemicals.

(3) Avoid the use of Picric Acid. If necessary to purchase, notify the Safety Office prior to purchase and when disposal is needed.

(4) All chemicals received and utilized in Research must have a Safety Data Sheet (SDS), which is available from the chemical manufacturer/supplier.

b. Storage:

(1) General-

(a) Chemicals should be stored by reactive class (i.e. flammables with flammables, etc.). Incompatible chemicals should not be stored together. Secondary containment tubs may be used to segregate by chemical compatibility. Secondary containment tubs are required for all hazardous chemicals.
(b) Stored containers should be examined periodically for deterioration and container integrity.
(c) Amounts permitted in the laboratory work area should be as small as possible and practical.
(d) Exposure of chemicals to heat sources or direct sunlight should be avoided.
(e) Fume hoods should not be used as storage areas for chemicals. It is permissible to designate a portion of the fume hood as a hazardous waste satellite accumulation area.
(f) Consult the Safety Data Sheet (SDS) for specific storage requirements.

(2) Flammable and Explosive Chemicals-

(a) Quantities of more than one liter of any particular flammable liquid must be stored in a flammables safety cabinet. If a flammable liquid is stored in a glass container, the glass container should be placed in a plastic bottle carrier to alleviate the possibility of breakage while transporting or pouring.
(b) Small quantities (containers of one liter or less) may be stored on open shelves in the laboratories; however, bulk storage (four liters or more of any one solvent) must be stored in a flammables storage cabinet.
(c) Ether: All ether containers must be dated upon receipt and upon opening. Do not store ether in a closed area such as a refrigerator. Ether may be stored in an explosion proof refrigerator in small quantities. Ether should not be kept in storage for more than one year. Opened containers of ether should be discarded within six months of date first opened. Ether is not to be discarded via the drains. Residual amounts of ether may not be evaporated under a fume hood.
(d) Peroxide-forming chemicals (*e.g*., diethyl ether and tetrahydrofuran) should be stored in airtight containers in a dark, cool place. Each bottle of flammable chemicals prone to peroxide formation shall be labeled with the date of receipt, the user initials and the date the container was opened. An inspection of the chemical should be performed at monthly intervals. Use or dispose of peroxide-forming chemicals prior to their expiration dates or the time recommended in the National Safety Council document *Recognition and Handling of Peroxidizable Compounds*, whichever is shorter.
(e) Picric Acid is classified as a flammable solid when wetted with more than 30% water and a class 1 high explosive with less than 30% water. It is highly sensitive to shock, heat and friction. Do not allow Picric Acid to dry out as explosive picric salts may form.
(f) Store flammable chemicals that must be kept cool in explosion proof refrigerators only.
(g) The transfer of flammable chemicals from one metal container to another should be preceded by electrical bonding in order to avoid a static spark that may result from pouring the solvent.

(3) Perchloric Acid-
(a) No organic materials should be stored in a hood containing Perchloric Acid.
(b) Do not allow Perchloric Acid to come in contact with strong dehydrating agents (concentrated sulfuric acid, anhydrous phosphorous pentoxide, etc.).

(4) Acids-
(a) Large bottles of acids should be stored on a low shelf or in an acid cabinet in secondary containment.
(b) Oxidizing acids are to be segregated from organic acids, flammable and combustible materials.
(c) Acids must be separated from strong bases and from active metals, such as sodium, magnesium, and potassium.

(5) Incompatible Chemicals Requiring Separate Storage Areas-
The following table summarizes chemicals that are incompatible and require separate storage.

Chemical	Incompatible Substances
Alkali metals (calcium, potassium, sodium	Water carbon dioxide, carbon tetrachloride
Acetic Acid	Chromic acid, nitric acid, hydroxyl-containing compounds, ethylene glycol, perchloric acid, peroxides and permanganates
Acetylene	Copper (tubing), fluorine, bromine, chlorine, iodine, silver, mercury, and their compounds
Acetone	Concentrated sulfuric and nitric acid mixtures
Ammonia (anhydrous)	Mercury, halogens, calcium hypochlorite, hydrogen fluoride
Ammonium nitrate	Acids, metal powders, flammable liquids, nitrates, sulfur and finely divided metal.
Aniline	Nitric acid, Hydrogen Peroxide
Bromine	Ammonia, acetylene, butadiene, butane, hydrogen, sodium carbide, and finely divided metals.
Chlorates	Ammonium salts, acids, metal powders, sulfur, finely divided organics or combustibles, carbon.
Chromic Acid	Acetic acid, naphthalene, camphor, alcohol, glycerin, turpentine, and other flammables.
Chlorine	Ammonia, acetylene, butadiene, benzene, and other petroleum fractions, sodium carbides, turpentine, and finely divided powdered metals.
Cyanides	Acids
Hydrogen Peroxide	Copper, chromium, iron, most metals or their respective salts, flammables, aniline, nitromethane
Hydrocarbons, general	Nitric acid, oxidizing gases
Iodine	Acetylene, ammonia
Mercury	Acetylene, fulminic acid, ammonia

Nitric Acid	Acetic, chromic, and hydrocyanic acids, aniline, carbon, hydrogen sulfide, flammables, readily nitrated substances
Oxygen	Oils, grease, hydrogen, flammables
Oxalic Acid	Silver, mercury
Perchloric Acid	Acetic anhydride, bismuth and its alloys, alcohol, paper, wood, and other materials
Phosphorus Pentoxide	Water
Picric Acid	Metals, reducing agents, bases, amines, ammonia
Potassium permanganate	Glycerine, ethylene, glycol, benzaldehyde and sulfuric acid
Sodium	Any oxidizable substance, i.e. methanol, glacial acetic acid, carbon disulfide, benzaldehyde, ethylene glycol, ethyl acetate, etc.
Sulfuric Acid	Chlorates, perchlorates permanganates
Flammable Liquids	Ammonium nitrate, chromic acid, hydrogen peroxide, nitric acid, sodium peroxide, the halogens
Potassium	Carbon tetrachloride, carbon dioxide, water

8. **Exposure Monitoring:**
a. The Industrial Hygienist is responsible for coordinating routine and non-routine air monitoring to minimize exposure to potentially hazardous materials. All monitoring will be in accordance with OSHA regulations. (See HPM 589A4-151 Airborne Hazards Survey Program).
b. The following list of substances may be evaluated by the Industrial Hygienist:

(1) Formaldehyde
(2) Waste Anesthetic Gases
(3) Xylene
(4) Toluene
(5) Others as deemed necessary

c. SRS may request the Industrial Hygienist to conduct an evaluation of any workplace exposure, if conditions warrant it.
d. Research Service personnel are responsible for notifying the Industrial Hygienist and their supervisor of potential hazards and when there is a change in processes, equipment, personnel or control measures which may result in new or additional exposure.

9. **Housekeeping, Maintenance, and Inspections:**
a. Housekeeping-

(1) Facilities Management (FM) is responsible for routine cleaning of all floors within Research Service, except for those in the animal rooms, and for emptying designated trash cans. PIs must request and coordinate cleaning of floors within their assigned areas.

(2) All research laboratory personnel are responsible for daily cleaning of all bench tops, work areas, and equipment.

b. Maintenance-
(1) Facilities Biomedical Engineering is responsible for all routine maintenance on research equipment. Equipment must be disinfected and cleaned prior to contacting the Biomedical Shop for service.
(2) All laminar flow hoods, fume hoods and biosafety cabinets will be inspected, certified, and maintained by the manufacturer and/or qualified contractor on a yearly basis. Staff will not use hoods lacking certification or where certification has expired.
(3) Eye wash fountains
(a) Research Service staff will inspect all eyewash stations weekly. Inspections will be annotated on a card attached to the eyewash stations. The AO/R&D will perform monthly inspections to ensure weekly checks are completed and will notify PI of non-compliance.
(4) Emergency drench-type showers - Engineering Service will inspect all emergency showers monthly.
(5) Fire extinguishers - The Safety Office will inspect all fire extinguishers within Research Service monthly.

c. Inspections-
(1) The Safety Office will inspect the Research Service area annually.
(2) SRS will inspect the Research Service laboratories annually.
(3) The AO/R&D and Safety Officer will inspect the Research area on an ongoing basis to ensure compliance with safety policies.

d. Passageways-
(1) Stairwells and hallways will not be used as storage areas.
(2) Access to emergency exits, emergency equipment and utilities controls must never be blocked.
(3) Emergency exit routes are to be posted within each laboratory.

10. **Laboratory Decommissioning:**
a. In accordance with VHA Handbook 1058.01, Research Compliance Reporting Requirements, the PI or Laboratory Director must obtain authorization from the SRS and the ACOS/R&D for Research ***prior to*** decommissioning (including vacating, reassigning, converting to non-laboratory use, or otherwise modifying) existing laboratory space that requires the identification and disposal of hazardous materials, infectious agents, or equipment between uses.

(1) The request for authorization must be made in writing **at least one (1) month prior to implementation** using the Request for Authorization for Laboratory Decommissioning (Appendix B).
(2) Once approval for decommissioning is received, the PI is responsible for providing an inventory of hazardous materials, infectious agents and/or equipment for removal and for completing the Laboratory Exit/Renovation/Decommissioning Checklist (component of the Request for Authorization for Laboratory Decommissioning).

(3) VHA Handbook 1058.01 requires the following notifications:

(a) If decommissioning is implemented without the required authorization, the ACOS/R&D must report the incident directly to the Director and VISN Safety Office within five (5) business days of discovery.

(b) The Director must report any unauthorized decommissioning to the appropriate Office of Research Oversight (ORO) Research Compliance Officer (RCO) within five (5) business days after being notified.

11. **Medical Program:**

a. Routine Surveillance:

(1) Medical surveillance activities will be conducted by Employee Health in accordance with OSHA regulations and VA and Employee Health policies and guidance for all VA employees are exposed to hazardous materials above exposure thresholds. A health evaluation is conducted upon initial employment and when requested thereafter.

b. Emergency First Aid Procedures:

(1) Eye

(a) In the event of a chemical splash to the eyes, ask coworkers to help you wash your eyes thoroughly. Lift eyelids to avoid pooling of chemicals under eyelids. Flush thoroughly with water for approximately 15 minutes.

(b) Seek medical attention immediately.

(c) Report accident to immediate supervisor.

(d) See Appendix C for additional information on accident reporting and seeking medical treatment.

(2) Cuts, punctures, and needle sticks

(a) If the injuries are clean cuts, punctures, or needle sticks, clean the affected area immediately with surgical soap, then flood or soak the affected area in antiseptic fluid. Bandage to prevent infection.

(b) If the injuries are dirty cuts, punctures, or needle sticks, i.e., those contaminated with patient blood or body fluids or bacterial agents, proceed as above as long as no object which caused the wound is left in the wound, contact your supervisor immediately and be evaluated by Employee Health.

(c) If the object causing the injury is not easily removed, do not attempt to cleanse the area; doing so may cause further damage. Contact your supervisor immediately and be evaluated by Employee Health immediately.

(d) If the object which caused the injury is contaminated with patient's specimens, identify the specimen with the patient's name for further evaluation and investigation by supervisor. Thoroughly cleanse wound. Contact your supervisor immediately and be evaluated by Employee Health immediately.

(e) Report all accidents of any degree to your supervisor and consult Employee Health for proper care. An incident report will need to be completed by the staff member and supervisor. The AO/R&D and the SRS Chair will follow-up with all incident reports.

(f) See Appendix C for additional information on accident reporting and seeking medical treatment.

(3) Chemical burns

(a) Corrosives can cause second or third degree burns. These chemicals include alkalis such as sodium hydroxide and common acids such as hydrochloric, sulfuric, and nitric.

(b) Chemicals should be diluted and washed off with plenty of water. Minor splashes and spills can be flooded in a sink. Larger splashes and spills require the use of the emergency drench-type laboratory shower. Enlist the help of coworkers. Some chemical powders should be brushed off the skin before flooding with water to avoid further skin and tissue damage. Always consult the chemical manufacturer's SDS for emergency first aid procedures *BEFORE* working with any chemical.

(c) Report accident to immediate supervisor.

(d) See Appendix C for additional information on accident reporting and seeking medical treatment.

12. **Protective Apparel and Equipment** *(Reference Personal Protective Equipment Policy - HPM 589A4-299)*

a. **Personal Protective Equipment (PPE)** is special gear used to protect the wearer from specific hazards of a hazardous substance. PPE includes gloves, goggles, face shields, chemical protective clothing and masks. The need for PPE is dependent upon the type of operations and the nature and quantity of the materials in use, and must be assessed on a case by case basis. Workers who rely on PPE must understand the functioning, proper use, and limitations of the PPE used. PPE alone should not be relied on to provide protection against hazards, but should be used in conjunction with guards, engineering controls, and sound work practices.

b. **Hazard Assessments.** Each service is responsible for conducting a hazard assessment to determine which personal protective devices are required for each task performed by employees. This process is outlined in the Personal Protective Equipment Program (HPM 589A4-299).

c. **Types of Personal Protection Equipment (PPE)**

(1) Eye Protection

(a) Chemical splash goggles and/or face shields rather than safety glasses should be used when pouring any hazardous chemicals or hazardous waste as they provide the best protection against splashes.

(b) Protective eyewear must be available and worn in all areas where hazardous substances are utilized.

(c) Protective eyewear should be easy to clean and disinfect, and maintained in good condition.

(d) For those employees who wear glasses, goggles must fit over the glasses.

(2) Gloves

(a) Appropriate gloves must be selected when employees are exposed to skin absorption of harmful substances, chemical burns, thermal burns, harmful temperature extremes, severe cuts, lacerations, abrasions or punctures, and blood or body fluids.

(b) No single type of glove provides protection against all potential hand hazards. Therefore, it is important to select the most appropriate glove for a particular application, to determine how

long it can be worn and whether it can be reused. The work activity should be examined to determine dexterity requirements and the duration, frequency, and degree of exposure to the hazard.
(c) For protection from chemical exposure, review the Safety Data Sheet (SDS) for recommended material construction or consult with the Industrial Hygienist.

(3) Other Personal Protective Equipment (PPE):
(a) Rubber, acid-resistant aprons should be worn when pouring concentrated chemicals.
(b) Respirators will be provided, as appropriate, to protect employees from airborne hazards where feasible engineering controls are not available or provide insufficient protection, in emergency situations, and where the health of an employee could be at risk as determined by a hazard assessment and recognized standards, e.g. OSHA/National Institute for Occupational Safety and Health (NIOSH) threshold values, Center for Disease Control (CDC) guidance.
1 Respiratory protection will be used in accordance with the requirements of OSHA's Respiratory Protection Standard (29 CFR 1910.134) and the facilities Respiratory Protection Program (HPM 589A4-065). The Industrial Hygienist is the administrator of the respiratory protection program.
2 The Industrial Hygienist must be contacted to evaluate the hazards and select appropriate respiratory protection.

13. **Recordkeeping**
a. Accident Reporting:
- **All** Research workers should report accidents/injuries to their supervisor.
- For **VA Employees** working in Research (*See HPM 589A4-227 – Management of Work-Related Injuries)*:
  - Go to the nearest Emergency Department (ED) for Life Threatening[1] injuries.
  - For all other injuries or exposures, go to Employee Health (7:30 AM – 4 PM, M – F). For after hours injuries go to VA ED.
  - Employee Health provides treatment, creates report in ASISTS & helps employee complete the report. If after hours, the Administrative Officer of the Day (AOD) will enter information into ASISTS and assist employee in completing the report.
  - The supervisor completes the CA1/CA2 and incident report in ASISTS.
- For **MU Employees** working in Research:
  - Go to the nearest Emergency Department (ED) for Life Threatening injuries.
  - For all other injuries or exposures, get a work injury form from the MU intranet:
    - Go to "My apps"
    - Click "Human Resources Intranet"
    - Click "Employee Health"
    - Click "Report of Injury Form"
    - http://uminfopoint.umsystem.edu/media/fa/management/records/forms/risk/umwc1.pdf
  - This form must be completed by the supervisor.

[1] A life threatening injury or illness is one that is acute and poses an immediate risk to a person's life or long term health.

- Go to University Work Injury Services in McHaney Hall, MC11 (6:30 AM – 4 PM, M-F)
- For after hours injuries, go to University Physicians (UP) Urgent Care or MU's ED.
- MU must provide treatment to MU employees. Your supervisor will complete the required MU accident form.

- For Research workers that are paid by **both MU and the VA:**
  - Follow the work injury rules (above) for the facility where the injury occurs.
- For **Unpaid MU Students** working in Research:
  - For any human body fluid exposures and initial medical evaluation, go to VA's Employee Health (7:30 AM – 4 PM, M – F). If after hours, go to the VA ED.
  - You will then be sent to Student Health in the University Physicians Medical Building for any further treatment.
- If you are paid by **someone other than VA or MU**:
  - For non-life threatening injuries or exposures, check with your supervisor or call VA Human Resources.
  - Employees of the Missouri Foundation for Medical Research (MFMR), notify your supervisor and the Executive Director of MFMR, and go to the VA Employee Health for treatment. Your supervisor will complete the MFMR required accidents forms.

b. Medical Recordkeeping: Medical records will be retained in accordance with the requirements of state and federal regulations and may be accessed by employees in accordance with 29 CFR 1910.1020.

c. Chemical Inventory:
(1) A complete inventory of all hazardous chemicals utilized by the research laboratories will be maintained by the PI and the PI will ensure that all laboratory personnel know the location of this inventory.
(2) A copy of the complete chemical inventory will be sent to the Medical Center Safety Office annually and as requested.
(3) Each investigator will keep an inventory of hazardous wastes collected in their laboratories.
(4) A copy of the hazardous waste inventory will be sent to the GEMS Coordinator, when requested.
(5) All inventories will contain the following:
(a) Chemical name
(b) Quantity of each chemical
(c) Location (room #) of storage
(d) Contact person
(6) Inventories should be updated continuously and each chemical listed will have a corresponding SDS, readily accessible to affected employees via hard copy or web site.

14. **Signs and Labels:**
a. Signs must be posted for rooms that contain biological or radiation hazardous agents. A clearly visible sign must be posted on the door to the room that shows:
1) That access to the room is limited,
2) The nature of the hazard [biological or radiation] including the name of the agent,

3) Name and telephone number of the emergency contact,
4) A list of required personal protective equipment. Signage for rooms containing biohazardous etiological agents must also include:
4a) the biosafety level,
4b) exit procedures, and
4c) any required immunizations.

b. Chemical Labeling
(1) Each stored chemical must be labeled with the following information:
(a) Manufacturers name,
(b) Chemical identity.
(c) Hazardous designation (if corrosive, flammable, toxic/reactive, or carcinogen/ mutagen/teratogen – see hazardous chemical supplement for definitions).
(d) Investigator's name,
(e) Expiration date, if any and/or "In Use date"
(f) Inventory date,
(g) Special Storage requirements, ex. Refrigerate.

(2) The information in (1) above may be contained on more than one label. For instance, the Investigator's name and inventory date may be a separate label or the hazard label may be a separate label.

c. Working Solution Labeling
(1) All working solutions must be labeled with the following information:
(2) Chemical name
(3) In use date
(4) Expiration date, if applicable
(5) Hazard identification, i.e. flammable, caustic, etc.

d. Waste Labeling
All wastes must be labeled in accordance with applicable regulations.

15. **Chemical Spills:**
*NOTE: This facility does not have an on-site emergency response team for chemical spills. In the event of an **Emergency Spill**, external responders would be called upon by the facility's Emergency Manager or designee. An Emergency Spill is a release that exceeds an Incidental Spill (defined below) and may exist under any of the following conditions:*

- The identity of the chemical is unknown; or
- Multiple or large quantities of chemicals are involved; or
- The chemical is highly toxic, highly flammable, or highly reactive; or
- The spill has the potential to spread to other parts of the building, such as through the ventilation system; or

- The clean-up procedures are not known or appropriate spill response equipment/PPE are not readily available; or

- The spill may endanger the environment, such as by reaching waterways or outside ground.

a. In the event of an **Emergency Spill:**

- Evacuate the area and dial x3333 to report a Code Yellow. Identify the exact location of the spill or release and the chemical involved, if known. Notify the Medical Center Industrial Hygienist of the release.
- Notify others in the area and barricade the area to prevent others from entering spill area.
- Never attempt to clean up any spill larger than can be accommodated by the spill kits.

b. **Incidental Chemical Release-** Responses to incidental releases of hazardous substances where the substance can be absorbed, neutralized, or otherwise controlled at the time of the release by employees in the immediate area, or by maintenance personnel are not considered to be emergency responses (29 CFR 1910.120).

An incidental release is a release of a hazardous substance which does not pose a significant safety or health hazard to employees in the immediate vicinity or to the employee cleaning it up, nor does it have the potential to become an emergency within a short time frame. Incidental releases are limited in quantity, exposure potential, or toxicity and present minor safety or health hazards to employees in the immediate work area or those assigned to clean them up. An incidental spill may be safely cleaned up by employees who are familiar with the hazards of the chemicals with which they are working.

Qualified laboratory personnel can clean-up incidental spills/releases. General spill response procedures include:

- Evacuate personnel from the immediate area of the spill and prevent others from entering the spill area. Ventilate the area as much as possible.
- Don appropriate personal protective equipment. Consult the chemical's SDS.
- Contain/control the spill. Solid absorbents, spill pads, pillows and pigs can be used to contain and clean-up spills.
- For flammable materials, shut off ignition sources in the area and use non-sparking tools.
- Clean up the spill.
- Spill control kits are provided in designated areas of Research Service for cleanup of small spills and may be specific to the material spilled.
    - Spills involving acids or caustics can be absorbed with the appropriate neutralizing

- Dispose of the spill in accordance with local, state and federal regulations. Consult with the GEMS Coordinator for proper waste management.
- Ensure that spill response supplies are restocked.

c. **Radioactive Material Spill-** Follow minor or major spill procedures as defined in the Radiation Protection Program Manual.
d. Biological Spills:
(1) Large spills with significant airborne contamination.
(a) Evacuate area immediately.
(b) Notify the Industrial Hygienist and Infection Control Practitioner.
(2) Small spills with aerosol formation - Use Universal Precautions.
(a) Place paper towel over spill.
(b) Flood with 5% sodium hypochlorite, leave covered for 10 minutes.
(c) Notify Safety Officer or Infection Control Officer.
(d) Wear gloves to pick up contaminated materials. Dispose in biohazard bags.

e. Spill Evaluation:
(1) Spills will be carefully analyzed by SRS and the Safety Management Council for compliance with established procedures.
(2) Following analysis, results will be given to all personnel to prevent further incidents.

16. **Employee Information and Training:**
a. The Safety Program Manual will be readily available to all personnel working in the research area for reference and training use. Electronic copies will be distributed to all research staff and hard copies kept by each principal investigator.
b. Research Service personnel will be educated on safe handling practices and work practices to avoid exposure to chemicals, including the OSHA permissible exposure limits (PEL), through a review of the chemicals utilized within the labs to which they are assigned. Training will be carried out by the laboratory supervisor and/or Safety Officer and must be documented. Supervisors are responsible for insuring their personnel are properly trained.
c. Research personnel working in laboratories will receive annual training in the following areas:

(1) Methods and observations utilized to detect the presence and release of hazardous chemicals to include the following methodologies:
(a) Continuous monitoring devices.
(b) Personal monitoring devices.
(c) Visual appearance or odor of chemicals in the laboratory.

(2) The physical and health hazard of chemicals in the laboratory.
(3) Measures employees can take to protect themselves from exposure to chemical hazards to include the following:
(a) Emergency procedures.
(b) Personal protection equipment.

(4) Spill clean-up procedures.
(5) Signs and symptoms associated with exposure to hazardous chemicals utilized by the Research Office.

(6) Safe handling and disposal of hazardous chemicals.
(7) Procedures to ensure elements of GEMS program are met.

d. Modes of Training:
(1) In-service training will be conducted after initial employment.
(2) Laboratory meetings held by the individual PIs can be held at any time.
(3) Handout materials, audio visual aids and computerized formats may be utilized.
(4) Special sessions arranged by Research Service and conducted by the Industrial Hygienist, Radiation Safety Officer, and/or the Safety Specialist may be arranged.

17. **Waste Disposal-**
a. Consult with the GEMS Coordinator for appropriate waste management practices. Consult with the Radiation Safety Officer regarding radioactive waste management.

b. Sewer Disposal:
(1) Liquid Wastes
(a) Some liquids may be flushed into the sewer system with copious amounts of water provided chemical volume is minimal. Refer to City of Columbia policy publication Chapter 22, Section 22-215 for restrictions of discharge into public sewer systems. Organic chemicals may not be disposed of in the sewer system.
(b) Disposal through the sewer system must comply with GEMS requirements and all federal, state, and local regulations and ordinances.
(c) Check with the GEMS Coordinator when in doubt as to whether a chemical can be disposed via the sewer system.

c. Hazardous Waste Management:
(1) All hazardous wastes will be managed in accordance with applicable regulations. Consult with the GEMS Coordinator for technical assistance regarding proper waste management. Refer to HPM 589A4-51 – Waste Management and Pollution Prevention Program.
(a) Waste containers must be compatible with the waste and should remain closed except when adding waste.
(b) The laboratory will ensure that a hazardous waste label is on the container and that the accumulation start date and end date is filled in.
(c) Hazardous waste needing contracted disposal will be kept in the laboratory until picked up. Notify the GEMS Coordinator when waste needs to be picked up.
(d) Satellite Accumulation Waste must be picked within 3 days of the "full date" on the container or within 1 year from the start date, whichever comes first. Call the GEMS Coordinator for pick up.

d. Regulated Medical Waste Management:
(1)Regulated medical waste will be separated from the general waste at the point of generation to ensure that these wastes receive appropriate handling and treatment. Sharps will be collected in red, puncture-proof containers marked with the biohazard symbol. For all bio hazardous material waste including animal remains (carcasses) that may be infected with (Microbiological or viral agents, pathogens, toxins, select agents) {*Reference HPM 589A4-51– Waste Management and Pollution Prevention Program &* Title 42 Code of Federal Regulations (CFR) }
(a) Refer to Title 42 (CFR) to determine if waste should be deactivated thermally prior to being placed in a biohazard (“red bag lined”) container for disposal.

(b) Containers must be tall enough so that nothing prevents the lids from closing properly when not in use.
(c) When Bags become full: Research staff will balloon tie and place the bags in the Red Bio Hazard Tubs (Located in B051) provided by housekeeping staff.
(d) Research staff will be responsible for relining containers with Red Bags.
(e) Housekeeping staff will be responsible for removing full tubs from B051 and providing replacement tubs.
(f) Housekeeping staff will insure that all Bio waste removed from research B051 is marked for incineration and removed to the central accumulation point for incineration by our approved vendor

Animal remains (carcasses) will be handled as biohazardous waste for eventual incineration off-site. As such, these remains will be placed in red bags labeled with the bio hazardous symbol. These red bags will be temporarily stored in a cold room or freezer until they are thermally deactivated (if required by Title 42 CFR) and packaged for transportation and off-site incineration.

e. Radioactive Waste:
All radioactive waste will be managed in accordance with applicable requirements and the Radiation Safety Policies and Procedures Manual.

18. **Safety-**
a. The following practices are primarily directed toward prevention of physical injury rather than toward prevention of toxic exposure. However, failure of precaution against injury will often have the secondary effect of causing toxic exposures. Therefore, the following have been added to this Chemical Hygiene Plan.

(1) Electrical Safety
(a) Grounding- All instruments must be grounded and be checked by Biomedical Engineering before use.
(b) Shocks- All shocks of any magnitude from electrical equipment or instruments must be reported immediately.
(c) Corrective Action- Shut off the current and/or unplug the instrument(s). Do not attempt to use an instrument that is causing shock. Report the incident to Biomedical Engineering.
(d) Repairs-
1. Repairs on the electrical system of the building are prohibited.
2. Any work performed on switches, outlets, circuit boxes, or equipment must be referred to the Biomedical Engineers or Facilities Management personnel.
(e) Extension Cord Usage- Three-to-two wire adapters (cheater plugs, multiple outlet plugs), and extension cords are prohibited from use on all equipment. Modifications to electrical distribution systems shall be accomplished in areas where their use seems to be indicated. Excessively long line cords (over six feet) will not be used.

(2) Fire Safety
(a) Prevention
1. Be aware of ignition sources, i.e., open flames, heating elements, and spark gaps.
2. Do not use flammable liquids in the presence of ignition sources.
3. Flammable liquids give off vapors that may also ignite or explode. Be sure flammable liquids are properly stored in approved flame cabinets. Quantities of one liter or less may

be stored in well ventilated areas. Quantities of greater than one liter should be stored in safety cans. Bulk storage of 4 liters or more must be stored in approved storage cabinets or approved storage rooms. Do not store any flammable liquid in areas exposed to heat.
4. Stairwells and hallways will not be used for storage.
5. Access to emergency exits, emergency equipment and utility controls will never be blocked.

(3) Reporting of fires
(a) Report any observed fires by pulling the nearest fire alarm pull box and calling x3333.
(b) Call extension 3333 to report the fire when safely away from the fire.

(4) Control of fires
(a) Follow hospital procedures - R.A.C.E
1. **Rescue** - check all laboratories for personnel. Rescue any person in immediate danger. Protect life.
2. **Alarm –** Call out "code red", activate closest fire alarm pull station located at each exit, and dial extension 3333 to report location of fire.
3. **Confine** - Close all doors in area.
4. **Evacuate/Extinguish** - Only attempt to extinguish a fire if it is small and manageable, but still activate the alarm. If extinguishing the fire is not possible, evacuate the area by the most direct route. If possible, the laboratory involved should have personnel available to inform the fire department of the type and location of the fire and other information required by the fire department. See posted evacuation routes for your nearest exit.

(5) Electrical equipment
(a) Do not use water unless the circuit has been shut down.
(b) Shut down circuit if possible.
(c) CO_2 is most suitable to prevent further damage to computer equipment, but dry chemical extinguishers are also safe and effective.

(6) Gas
(a) Shut off source if possible.
(b) Extinguish flame with CO_2 or dry chemical, only after gas has been shut off.
(c) Keep flames away from gas cylinders.

(7) Fire Safety Equipment
(a) Absorbent material is to be used to contain spread of liquids that have not ignited.
(b) Fire extinguishers are of the CO_2 and the dry chemical type. They may be used on any type of fire.
(c) Heat resistant gloves may be used to move or handle small burning objects, to handle hot vessels, to turn off hot valves or handles, etc.

19. **Security Plan-**
a. The following procedures are in place to provide for the security of the research laboratories: It is the investigators responsibility to make sure that these procedures are understood and followed by their employees, including Without Compensation (WOC) employees. All personnel accessing the research facility shall have background investigations appropriate to their status

and duties. Access card usage is reviewed weekly and quarterly, which is reported to SRS, verifying the validity of access card usage.

1. All corridor doors to the research areas, including the Veterinary Medicine Unit (VMU), are to remain closed and locked at all times.
2. Access to any research area is limited to those personnel with a work related reason for being in the area.
3. Unaccompanied access to any research area is restricted to those individuals who have a photo ID card and a functioning access card or key in their possession.
4. Visitors to the research area (students, sales reps, interviewees, etc) must be escorted at all times by personnel who are authorized to be in the research area.
5. VA police (ext 56320) are to be notified anytime an unauthorized or unidentified (no photo ID card) individual is present in the research area. In lieu of contacting the police, an authorized user of the research area may vouch for an unidentified person, but must then escort them while they are in the research area.

b. The following special procedures apply to the research area accessed through vestibules F002A, F023A, or F009A, commonly referred to as the Biomolecular Imaging Center (BIC).

1. Independent access to the BIC area is restricted to individuals who have completed training as required by the Radiation Safety Officer.

c. Access cards have wire and electronic parts imbedded in the card. You cannot bend, cut or punch holes in the card. The card is sensitive to excess heat – *DO NOT* expose the card to excess heat (such as closed cars in the summer time).

20. **Provisions for Utility Failure-**

1. Purpose: To define a policy to be followed by Research service personnel in the event of a partial or total utility failure.

2. Policy: To provide uninterrupted service to each component activity in research in order to preserve valuable scientific samples and on-going testing. To safeguard animal welfare and to maintain safe working conditions.

3. Procedures:

a. Localized/Room Utility Failures: Emergent failures of any utility such as electrical, heating/air conditioning, water supply, or sewer system that threaten personnel safety or that might cause property damage will be immediately reported to Facility Management Service at extension 52396 and to the Administrative Officer for Research. Minor failures that do not pose a threat to safety, property or normal operations will be reported to the Administrative Officer, who will place any needed work orders with FMS.

b. Research Area/Multiple Room Utility Failure:

(1). Loss of normal electrical power: Research Service office and administrative personnel will be responsible for escorting laboratory personnel from areas not lighted by emergency power (labs B-27 to B-41). Laboratory personnel will ensure that the laboratory is left in a safe condition that experiments in progress are terminated safely and that equipment is turned off or set appropriately should power be restored.

(2). Total electrical failure including emergency power (black-out): In the event of a total power loss in Research Service, the following procedures will be implemented:

(a) Research Service Office: Office personnel will immediately use flashlights stored

in their desks and move to the north and south corridors outside of E002. These personnel will proceed room to room in assisting laboratory employees out of their laboratories and into the hallway. The condition of experiments underway will be assessed and appropriate safeguards taken to maintain laboratory safety. All personnel will be escorted to a lighted area via the nearest exit.

(b) Laboratories: Laboratory personnel should stand-in-place until escorted from the laboratory by office or other personnel with lights. Do not try to exit the darkened laboratory; communicate by voice and let your presence be known. Once rescued, inform emergency personnel of experiments underway using natural gas burners, chemical reactions or other potentially dangerous studies that should be attended to before evacuation.

(c) Veterinary Medical Unit (VMU): Animal caretakers and technicians caught in animal rooms during an electrical failure should stand in place until emergency personnel with lights arrive. Communicate by voice and let your presence be known. Secure all animals in proper caging before evacuation to a lighted area. Long term evacuation of the Animal Research Facility may necessitate the transfer of animals to other suitable locations. These situations will be evaluated on a case-by-case basis and the Animal Emergency Plan will be followed.

(d) Animal Procedure Rooms: Personnel performing animal surgery during an electrical failure must stand in place until emergency personnel with lights arrive. Communicate by voice and let your presence be known. Anesthetized animals should be properly cared for before evacuation to a lighted area.

c. Return to normal service is critical for the following functions:

(1) Ultra-low Refrigeration: Ultra-low refrigerators in B051, B017 and B018 are on the emergency power system. Freezers in A015 are not on emergency power.

(2) CO_2 Incubators: All CO_2 incubators not on emergency power must be hooked to a emergency power outlet within one hour to preserve cells and cell lines.

d. Emergency Power Locations: Emergency power is available in most of the A section, B051, B017, B018, and most of the F section. Electrical outlets powered by the emergency generator have red cover plates. Critical equipment should be plugged into emergency power outlets.

21. **DISASTER PLAN-**

1. The emergency plan is an outlined in the Truman VA Safety and Emergency Plan Manual which specifies various duties and responsibilities of employees in specific service lines. The call back numbers are noted:

Call Back - When a call back of off-duty Research Service personnel is required, the following chain of notification will be followed:

Adam Whaley-Connell, D.O., ACOS/R&D (573) 356-8393
ACOS/R&D will notify:

Robert Crawford, AO/R&D (573) 289-2460
AO/R&D will notify:

Subcommittee for Research Safety (SRS):

Rajiv Mohan, Ph.D., Co-Chair, SRS (573) 529-2348

Mahesh Thakkar, Ph.D., Co-Chair, SRS	(573) 303-1998
Alt. Michael Lewis, Ph.D., Vice Chair, SRS	(573) 214-0133

Subcommittee for Animal Studies (SAS):

R. Scott Rector, Ph.D., Chair, SAS	(573) 999-1586
Alt. Vincent DeMarco, PhD, Vice Chair, SAS	(573) 356-8539

Investigators:

Tim Hoffman, Ph.D.	(573) 445-3243
Alt. Slava Glinskii, M.D.	(573) 256-6094

Research Office:

Bob Miller	(573) 638-4327
Alt. Stanley Brajner	(573) 999-5004
Karen Johnston	(660) 537-5376
Karen Smarr	(573) 864-8744
Brenda McCoy	(573) 529-3062 or (573) 474-2286

2. Bomb Threat (per HPM589A4-008): The Truman VA Safety and Emergency Plan Manual states that if a bomb threat occurs on Truman VA property, the VA police shift leader on duty will call the Medical Center Director. The Truman VA will contact the Incident Commander, local/state/federal agencies, and the ACOS/R&D for Research. Research staff will use Appendix F: Bomb Threat Checklist, if a bomb threat is received and report the incident immediately to the supervisor. The Bomb Threat Checklist has been placed in prominent areas within Research Service.

22. **Hazardous Chemicals Supplement-**

Laboratories can have five major groups of Hazardous Chemicals. They are:

1. Corrosive Chemicals
2. Flammable Chemicals
3. Toxic or Reactive Chemicals
4. Carcinogenic Chemicals
5. Compressed and Liquid Gases

This guide will define each major group and list storage, handling, labeling, spill, and waste disposal procedures for each group.

1. Corrosive Chemicals: A corrosive chemical is one that causes visible destruction of, or irreversible alterations in, living tissue by chemical action at the site of contact. Generally speaking, corrosive materials have a very low pH (acids) or a very high pH (bases). Strong bases are usually more corrosive than acids. For hazardous waste determination, EPA defines corrosive hazardous waste as either liquids that corrode steel greater than a quarter inch per

year or aqueous wastes with a pH of 2.0 or less or 12.5 or more.

1.1 Safety Data Sheets (SDS): SDS's are available for all corrosive chemicals on the hospital's web site, other web sites or by contacting the Research Service Safety Officer or Industrial Hygienist.

1.2 Corrosive Chemical Storage: Corrosive reagents must be stored separately from flammable liquids, cyanides, and sulfides.

Incompatible chemicals requiring separate storage areas:

CHEMICAL	**INCOMPATIBLE SUBSTANCES**
Acetic Acid	Chromic acid, nitric acid, hydroxyl containing compounds, ethylene glycol, perchloric acid, peroxides and permanganates
Sulfuric Acid	Chlorates, perchlorates, permanganates
Any Acid	Flammable liquids, cyanides, sulfides

1.3 Corrosive Chemical Handling: Handle only one bottle of corrosive reagent at a time. Carry the bottle in front of you holding firmly with both hands. Use a cart or carrier for transporting large bottles (over 500 ml) making sure to have the bottle in a container so that the bottle can not roll off the cart. Never pipette anything by mouth!! Always use a pro-pipette. Prepare corrosive solutions under the fume hood using goggles to protect your eyes and a lab coat and gloves to protect the hands and forearms. Do not roll up the sleeves on the lab coat. Because much heat is evolved on mixing these substances with water, *mixing should always be done by adding the corrosive agent to water to avoid violent reaction and spattering.* Allow acid to run down the side of the container and mix slowly by gently swirling the container. Do not allow the solution to overheat. After working with corrosive materials, wash the hands and arms immediately.

1.4 Corrosive Labeling: All bottles containing corrosive hazards must be labeled in accordance with the OSHA Hazard Communication Standard and include:

1. Name of chemical and hazard warning information
2. Date of receipt
3. Expiration date of chemical and /or "In Use"
4. Name of Investigator
5. Inventory date

1.5 Corrosive and Caustic Spills: Any spill involving the eyes is serious and you should call for help. The eyes must be flushed immediately with copious amounts of water. It is important for the eyelids to be held open while washing the eyes thoroughly. Eyewash sink attachments are located in each laboratory. The *procedure to be followed when corrosive reagents are splashed on the body* are as follows:

1. Call for assistance as you proceed to the nearest emergency shower.
2. Remove affected clothing
3. Shower long enough to wash off the affected area.
4. Alert the Employee Health staff or Urgent Care staff of the accident, letting them know the chemical involved and the extent of the body involvement. Get the SDS on the chemical; the SDS should go with the employee to Employee Health or Urgent Care.
5. Proceed to the Clinic for further treatment.

For the control and disposal of corrosive spills, the spill control kit (found in B045 or A043) should be used. Directions for its use are located on the spill kit. Special protective equipment, goggles, gloves, masks, and fluid impervious gowns should be used for clean up. In the event of a large spill, ventilate the area, evacuate the area, call the hospital operator, and declare a "code yellow." Notify your supervisor and the hospital Industrial Hygienist.

1.6 Corrosive Waste Disposal: Strong acids and bases should be diluted to the pH 5 - 9 range and then given to the GEMS Coordinator for disposal. Acids and alkalis should not be poured into the sanitary/sewer drain.

2. **Flammable Chemicals:** OSHA defines a flammable liquid as any liquid with a flashpoint less than 100°F. OSHA considers chemicals with a flashpoint greater than 100°F, but less than 200°F to be combustibles. For hazardous waste determination, EPA defines ignitable wastes as wastes that can create fires under certain conditions, are spontaneously combustible, or have a flash point less than 60°C (140°F).

2.1 Properties of Flammable Substances:

2.1.1 Flash Point - The flash point is the lowest temperature at which a liquid gives off enough vapors that will ignite and flashover but will not continue to burn without the addition of more heat.

2.1.2 Ignition Temperature - The minimum temperature required to ignite gas or vapor without a spark or flame being present.

2.1.3 Limits of Flammability - It is possible for a flammable liquid to be above its flash point and yet not ignite in the presence of an adequate energy source. The explanation for this phenomenon lies in the composition of a fuel-air mixture that may be too lean or too rich for combustion. Each flammable gas and liquid has two fairly definite limits defining the range of concentration in mixtures with air that will propagate flame and explode.

2.1.3.1 Lower Explosive Limit (LEL): Is the minimum concentration (% by volume) of the vapor in air below which a flame is not propagated when an ignition source is present.

2.1.3.2 Upper Explosive Limit (UEL): Is the maximum concentration (% by volume) of the vapor in air above which a flame is not propagated. Above this concentration the mixture is too rich to burn. The flammable range consists of all concentrations between the LEL and UEL. Among the most hazardous liquids are those that have flash points at room

temperature or lower, particularly if their range of flammability is broad. The vapors of all flammable liquids are heavier than air and are capable of traveling considerable distance. This possibility should be recognized and special note should be taken of ignition sources at a lower level than that at which the substance is being used.

2.2 Flammable Chemicals: Typical flammable chemicals found in laboratories include:

- Acetone
- Ethyl Acetate
- Ethyl Alcohol 100% and 95%
- Ethyl Ether
- Methanol
- Permount
- Petroleum Ether
- Propanol-2 (isopropyl alcohol)
- Xylene

2.3 Flammable Storage: All flammable liquids, except working quantities, will be stored in flammable storage cabinets. The amount of flammable liquids allowed in the section at one time is governed by OSHA definitions and allowable container size. *Refers to OSHA Standard 1910.106 – Flammable Liquids.*

OSHA Definition of Flammable and Combustible Liquids:

Class IA Flammable Liquid -
a. flash point below 73 F (22.7°C)
b. boiling point below 100 F (37.8°C)

Class IB Flammable Liquid -
a. flash point below 73 F (22.7°C)
b. boiling point above 100 F (37.8°C)

Class II Combustible Liquid -
a. flash point above 100°F (37.8°C) and below 140°F (59.9°C)

Class IIIA Combustible Liquid -
a. flash point above 140°F (59.9°C)

Maximum Allowable Container Size in the Laboratory

Container Type	IA	IB	IC	II	IIIA
Glass, Plastic, or Metal	0.5 L	1.0 L	4.0 L	4.0 L	4.0 L
Safety Can	4.0 L	8.0 L	8.0 L	8.0 L	8.0 L

Classes of common flammables:

Acetone IB
Ethyl Acetate IB
Ethyl Alcohol IB
Ethyl Ether 1A
Permount 1B
Petroleum Ether IA
Isopropyl Alcohol IB
Xylene IC

Methanol IB

Incompatible chemicals requiring separate storage areas:

Chemical	Incompatible Substances
Acetone	Concentrated sulphuric and nitric acid mixtures
Flammable Liquids	Ammonium nitrate, chromic acid, hydrogen peroxide, nitric acid sodium peroxide, the halogens

2.4 Flammable Liquids Handling: Handle only one bottle of flammable reagent at a time carrying the bottle in front of you holding firmly with both hands. Use a cart or carrier for transporting large bottles (over 500 ml). Never pipette anything by mouth; always use a hand held pipette. Pour or prepare the flammable reagent under the fume hood and be sure no ignition source is around (open flame or electrical equipment "on" in the hood).

2.5 Flammable Labeling: All containers that contain flammable reagents will be labeled in accordance with the OSHA Hazard Communication Standard and include:

- Chemical Name
- A Flammable Warning
- Date of Receipt
- Name of Investigator

2.6 Flammable Spills: When pouring or otherwise measuring flammable liquids, one should always check the area in which he is working to make certain there are no open flames. If spillage of flammables occurs, the following should be done:

1. Turn off any flames or electrical equipment in the immediate area of involvement.
2. Contain the spill to the smallest area possible by the use of absorbent towels or the absorbent material in the Spill Kits located in B045 or A043.
3. If Spill Tamer absorbent is used it should be picked up (see instructions for Spill Tamer) and placed in a plastic bag. Notify supervisor for proper disposal.
4. If towels are used to absorb the flammable liquid spill, then they should be rinsed out in a fume hood sink until all of the flammable liquid is rinsed down the drain.
5. Rinse the counter or floor well with water so that all traces of the flammable liquid are gone.

2.7 Flammable Waste Disposal: Laboratory waste with flashpoints less than 140°F exhibit the EPA Characteristic of Ignitability and must be managed as a hazardous wastes. Wastes should be collected in an appropriate, compatible containers and properly labeled as a Hazardous Waste with the accumulation start date. Consult with the GEMS Coordinator regarding proper waste management practices and to dispose of the waste.

3. **Toxic or Reactive Chemicals-**

3.1 Properties of TOXIC or REACTIVE CHEMICALS: Hazardous and toxic substances are defined as those chemicals present in the workplace which are capable of causing harm.

Toxicity is classified and labeled as: DANGER (high), WARNING (medium) or CAUTION (low). A reactive chemical is one that has the ability to undergo a chemical reaction with the release of energy. It could be initiated by mixing or reacting with other materials, application of heat, physical shock, etc.

Reactive substances are normally unstable, react violently with water, have explosive potential, or release poisonous gases. It is essential that all laboratory workers understand the types of toxicity, know the routes of exposure and recognize the major classes of toxic and reactive chemicals. It is important to recognize that the combination of the toxic effects of two substances may be significantly greater than the toxic effect of either substance alone. Furthermore, chemical reactions involving two or more substances may form reaction products that are significantly more toxic than the starting reactants. Examples are:

Aqueous ammonia and sodium hypochlorite (bleach) may generate hydrazine (which poses both acute and chronic toxicity hazards)

Inadvertent mixing of formaldehyde and hydrochloric acid (hydrogen chloride) could result in the generation of bis-(chloromethyl) ether, a potent human carcinogen.

3.2 Terms used on SDS's dealing with toxicity and reactivity

Threshold Limit Values (TLV) - Means the airborne concentration of the substance which represent conditions under which it is believed nearly all workers may be repeatedly exposed day after day without adverse effect. There are three categories of TLV:
Time Weighted Average (TWA) - The TWA concentration for a normal 8 hour work day or 40 hour work week, to which nearly all workers may be exposed, day after day, without adverse effect. The total time weighted exposure per day should not exceed the TLV value.
Short Term Exposure Limits - The maximum concentration that workers can be exposed to for a period up to 15 minutes. Such exposures should be limited to no more than 4 per day with periods of at least 60 minutes each between exposures.
Ceiling (C) - the concentration that should not be exceeded even instantaneously.
Permissible Exposure Levels (PEL) - The maximum time-weighted concentration at which 95% of exposed, healthy adults suffer no adverse effects over a 40 hour work week. PEL's are used by OSHA and are based on an eight-hour, time-weighted average concentration. A list of PEL's for air contaminants is kept by the Industrial Hygienist.
Acute Toxicity - Acute toxicity occurs when a toxic substance causes damage with exposure occurring within seconds, minutes, hours or days.
Chronic Toxicity - Chronic toxicity occurs when a toxic substance causes damage with exposure occurring within weeks, months or years.
Lethal Dose (LD_{50}) - The concentration of an ingested, absorbed, or injected substance which results in the death of 50% of the test population.
Lethal Concentration (LC_{50}) - The concentration of an inhaled substance which results in the death of 50% of the test population in a specific time period.

3.3 Toxic or Reactive Chemical Storage: Treat poisonous compounds with extreme caution. Toxic compounds should be stored according to the nature of the chemical. Water-reactive chemicals should be stored in a cool, dry place. Do not store water-reactive chemicals near or under water sinks. Minimize storage of reactive chemicals. Chemicals should be stored in accordance with any special storage requirements – consult SDS. Incompatible chemicals should be segregated.

CHEMICAL	INCOMPATIBLE SUBSTANCES
Cyanides	acids, humid air
Mercury	Acetylene, fulminic acid, ammonia

3.4 Toxic or Reactive Chemical Handling: Good laboratory practice dictates that all chemicals be handled as if they are toxic or reactive. The following procedures are considered essential.

- Protect the hands and forearms by wearing gloves and a lab coat or suitable long gloves to avoid contact of toxic materials with the skin.
- Procedures involving volatile toxic substances and those involving solid or liquid toxic substances that may result in the generation of aerosols should be conducted in a fume hood or other suitable containment device.
- After working with toxic materials, wash the hands and arms immediately. Never eat, drink, smoke, chew gum, apply cosmetics, take medicine, or store food in areas where toxic substances are being used.

These standard precautions will provide laboratory workers with good protection from most toxic substances. The laboratory worker should be prepared for possible accidents or spills involving toxic substances.

The ***Cardinal Rule*** for safety in working with toxic substances is that all work with these materials in a laboratory should be performed in such a way that they do not come in contact with the skin and that quantities of their vapor or dust that might produce adverse toxic effects are prevented from entering the general lab atmosphere. Thus, operations should normally be performed in a hood.

3.5 Toxic or Reactive Chemical Labeling: All toxic or reactive chemicals will be labeled in accordance with the OSHA Hazard Communication Standard and include:

Name of Chemical
Toxic or reactive property of the chemical
Date of expiration (if applicable)
Name of Investigator
Any special storage instructions (refrigerate, store in secondary container, etc)

3.6 Toxic or Reactive Chemical Spills: The SDS should be consulted for the control and disposal of toxic or reactive spills. If in doubt about how to clean up a spill, consult the Industrial Hygienist of call the hospital operator and report a code yellow. If necessary use the spill kits located in room B045 and A043. Do not attempt to clean up a spill unless you KNOW the hazards involved and the proper cleanup and disposal procedures.

3.7 Toxic or Reactive Chemical Waste Disposal: Laboratory waste that meet exhibit the characteristic of a toxic or reactive waste, or are a listed hazardous waste must be managed as hazardous waste. Wastes should be collected in an appropriate, compatible containers and properly labeled as a Hazardous Waste with the accumulation start date. Consult with the GEMS Coordinator regarding proper waste management practices and to dispose of the waste.

4.0 **Carcinogens, Mutagens, Teratogens**- Carcinogens are physical or chemical agents that cause abnormal cell growth and spread that could lead to the development of malignant tumors.

A chemical is considered to be a carcinogen if:

- It is regulated by OSHA as a carcinogen (see Appendix A)
- It is listed as a carcinogen in the Annual Report on Carcinogens published by the National Toxicology Program (see Appendix A), or

A mutagen is a chemical that can alter genetic material in an organism and result in physical or functional changes in all subsequent generations. Studies show that most mutagens are carcinogens.

A teratogen is a chemical that has been demonstrated to cause physical defects in the developing embryo.

The following precautions must be followed when carcinogens are used on a regular basis as part of a protocol in the laboratory.

- Maintain an inventory of all carcinogens and reproductive toxins.
- Known carcinogens must be placed in a controlled access area.
- Storage and work areas where carcinogens are used must be designated with a "Carcinogen" warning sign.
- Carcinogens must be labeled as such.
- Access to carcinogens must be controlled and work surfaces must be decontaminated after use.

Hospital policy is that we do not use any of these compounds unless absolutely necessary and if they are used, the above criteria must be followed.

5. **Compressed or Liquid Gases-**

5.1 Compressed and Liquid Gases include the following

- Carbon dioxide gas
- Propane gas
- Nitrogen gas
- Liquid Nitrogen
- Dry Ice
- Helium gas
- Oxygen

Compressed gases present an unique hazard in that they have the potential for exposing laboratory workers to both mechanical and chemical hazards (depending on the particular gas). If the gas is flammable, flashpoints lower than room temperature compounded by high rates of diffusion present the danger of fire or explosion. Additional hazards can arise from the reactivity and toxicity of the gas and asphyxiation can be caused by high concentrations of even "harmless" gases such as nitrogen. Finally, the large amount of potential energy resulting from compression of the gas makes a compressed gas cylinder a potential rocket or fragmentation bomb.

5.2 Identification of Compressed Gas Cylinders: The contents of any compressed gas cylinder should be clearly identified so as to be easily, quickly, and completely determined by any laboratory worker. Such identification should be stenciled, or stamped on the cylinder itself or a label should be provided that cannot be removed from the cylinder. No compressed gas cylinder should be accepted for use that does not legibly identify its contents by name. If the labeling on a cylinder becomes unclear or an attached tag is defaced so that the contents cannot be identified, then the cylinder should be marked "Contents Unknown" and returned directly to the manufacturer.

5 3 Handling, Use and Storage of Cylinders: Compressed gas cylinders must be firmly secured at all times. A clamp and belt, or a chain, are generally suitable for this purpose. Valve safety covers are to be left on until pressure regulators are attached. A hand truck with a securing device installed must be used when moving cylinders. Standard cylinder-valve outlet connections have been devised by the Compressed Gas Association (CGA) to prevent the mixing of incompatible gases due to an interchange of connections. Cylinders should be placed so that the cylinder valve is accessible at all times. Cylinder valves should be opened slowly; the valve on an unregulated cylinder should never be "cracked". It is never necessary to open the main valve all the way; the resulting flow will be much greater than one would ever want. It is safe practice to open the main valve only to the extent necessary. Pressure regulators are generally used to reduce a high-pressure supplied gas to a desirable lower pressure and to maintain a satisfactory delivery pressure and flow level for the required operating conditions. Under NO circumstances should oil, grease, or lubricants be used on regulator valves or cylinder valves. To detect leaks of flammable gases or any compressed gas, soapy water

should be used. All cylinders containing flammable gases should be stored in a well-ventilated place. Reserve stocks of such cylinders should never be stored in the vicinity of cylinders containing oxygen.

5.4 Empty Cylinders:-A cylinder should never be emptied to a pressure lower than 251bf/in2 because the residual contents may become contaminated if the valve is left open. When empty the regulator valve is closed, the cylinder valve is closed, then the regulator is removed and the valve cap placed on the tank. The cylinder should be clearly marked as "empty".

5.5 Handling of Leaking Compressed Gas Cylinders: Occasionally, a cylinder or one of its component parts develops a leak. Most such leaks occur at the top of the cylinder in areas such as the valve threads, regulator, valve stem, or valve outlet. If a leak is suspected, use a flammable-gas detector or soapy water to check for location of leak. If the leak cannot be remedied by tightening the connections, contact the Hospital Safety Officer. Laboratory workers should never attempt to repair a leak at the valve threads or regulating device.

5.6 Cryogens and Dry Ice: Cryogenic liquids have boiling points below minus 130°F and are used in research to provide extremely low temperatures for frozen storage and for experimentation. Common cryogenic liquids of concern include nitrogen, helium, argon, and methane. Although not a cryogen, solid carbon dioxide or dry ice which converts directly to carbon dioxide gas at minus 109°F is also used in laboratories.

Personnel should be aware of the hazards associated with handling and use of cryogens. If a lab worker is injured, the person should seek immediate medical attention.

Overview of Cryogenic Safety Hazards

Cold Contact Burns: Liquid or low-temperature gas from any cryogenic substance will produce effects on the skin similar to a burn.

Asphixiation: Degrees of asphyxia will occur when the oxygen content of the working environment is less than 20.9% by volume. This decrease in oxygen content can be caused by a failure/leak of a cryogenic vessel or transfer line and subsequent vaporization of the cryogen. Effects from oxygen deficiency become noticeable at levels below approximately 18% and sudden death may occur at approximately 6% oxygen content by volume.

Explosion-Pressure: Heat flux into the cryogen from the environment will vaporize the liquid and potentially cause pressure buildup in cryogenic containment vessels and transfer lines. Adequate pressure relief should be provided to all parts of a system to permit this routine outgassing and prevent explosion.

Explosion-Chemical: Cryogenic fluids with a boiling point below that of liquid oxygen are able to condense oxygen from the atmosphere. Repeated replenishment of the system can thereby cause oxygen to accumulate as an unwanted contaminant. Similar oxygen enrichment may

occur where condensed air accumulates on the exterior of cryogenic piping. Violent reactions, e.g. rapid combustion or explosion, may occur if the materials which make contact with the oxygen are combustible.

General Precautions When Working with Dry Ice or Liquid Nitrogen (LN2)

- Avoid eye or skin contact ;
- Never handle dry ice or LN2 with bare hands;
- Always use tongs when handling objects in liquid;
- Wear appropriate PPE and clothing:
  - PPE includes cryogenic gloves, lab coat or apron, eye protection (e.g. goggles, face shield).
  - Gloves should be loose enough so that they can be readily removed if LN2 splashes into them or a piece of dry ice falls into them.
  - Long sleeves and pants should be worn. Shoes must be closed-toed leather or safety shoes.

- Stay out of the vapor pathway.
- Ensure adequate ventilation. Use fume hoods when working with cryogens, if possible.
- Do not use or store dry ice or LN2 in confined areas, walk-in refrigerators, environmental chambers or rooms without ventilation. A leak in such an area could cause an oxygen-deficient atmosphere.
- Never place a cryogen on tile or laminated counters because the adhesive will be destroyed.
- Never store a cryogen in a sealed, airtight container at a temperature above the boiling point of the cryogen; the pressure resulting from the production of gaseous carbon dioxide or nitrogen may lead to an explosion.

Dispensing and Transport of Cryogenic Liquids: Special precautions must be taken to prevent a spill while dispensing or transporting cryogens in addition to minimizing exposures from liquids and vapors. The high liquid to vapor expansion ratio could rapidly displace all oxygen in a room and result in asphyxiation. To minimize exposure:

- Always where proper PPE when dispensing or transferring cryogenic liquids.
- When obtaining liquid from a large dispensing dewar or cylinder, cool the secondary container by adding a little cryogenic liquid first. Dispense slowly to mitigate thermal stress, stay in constant attendance of the filling operation, do not overfill, and do not allow the cryogenic liquid to fall through a distance to reach the receiving vessel.
- When manually pouring liquid into a smaller dewar, assure that the secondary container is secured, pour slowly to prevent excess splashing, do not overfill, and use a phase separator, if available, to control the vapor path while pouring.
- Use no fewer than two personnel to transport cryogenic liquids and use handcarts equipped with brakes for large dewars and cylinders. *Best practice is to avoid traveling in an elevator with a dewar.* Spills or elevator failures may be dangerous in this restricted space by displacing oxygen if the cylinder failed or leaked. If this is not avoidable make sure to use the buddy system and have another employee remain outside the elevator during transport.
- Always use care when handling equipment. Damage to dewars could result in the loss of vacuum and increased evaporation.

- When carrying a dewar, wear PPE and hold it as far away from the face as possible. Containers that cannot be easily and safely carried should be placed on a stable wheeled base designed for the dewar.

Storage of Cryogenic Liquids: A cryogenic liquid storage unit left open to the atmosphere, or catastrophic failure of a storage unit, could create an oxygen deficient atmosphere. The following procedures reduce the likelihood of this occurrence:

- Use appropriate containers, designed for cryogenic liquids, that are in good condition for storage.
- Cylinders and other pressure vessels used for the storage and handling of liquified gases should not be filled to more than 80% of capacity. This is a precaution against possible thermal expansion of the contents and bursting of the vessel by hydrostatic pressure.
- Only store dewars in well-ventilated rooms (minimum of 6 air changes per hour).
- Storage of cryogenic liquid dewars in hallways, unventilated closets, and stairwells is prohibited.

23. **Use of Biological Safety Cabinets** *See Appendix E for Recommended Biosafety Levels for Infectious Agents*

23.1 Operational Description - Biological Safety Cabinets (BSC) are primary containment devices that are designed to provide protection of the worker and the environment, as well as provide a work environment free of extraneous contaminants. The effectiveness of the BSC is directly dependent on the manner in which users perform their work.

The effectiveness of the BSC is a function of three separate directional air flows inward from the room through the front grille (providing personal protection with this air barrier); downward through a high efficiency particulate air (HEPA) filter onto the work surface (providing product protection); and out of the cabinet through an exhaust HEPA filter (providing environmental protection).

Disrupting these airflow patterns reduces cabinet effectiveness. Such disruptions may be caused by:

- Rapidly moving your arms in and out of the BSC.
- People walking rapidly behind you across the face of the cabinet.
- Down-drafts from room ventilation systems; cross drafts from open laboratory windows or doors.
- Blockage of the front or rear grilles.
- Placement of bulky materials or equipment within the cabinet.

A biological safety cabinet is not a chemical fume hood. You will be at increased risk of exposure to potentially hazardous chemical vapors if you use volatile chemicals in a biological safety cabinet (rather than a fume hood), because air is recirculated within the cabinet and back into the laboratory.

Boxes stored on top of BSCs may block the filters; excess materials inside the cabinet will disrupt the air flow and may compromise the containment capability of the BSC. Good laboratory housekeeping reduces the chance of contamination.

A BSC certification involves performance and safety tests that are conducted by an authorized contractor to ensure that the cabinet is working according to the NSF-49 Standard for biohazard cabinets. BSC's are certified when new, when moved or serviced, and annually thereafter.

23.2 Work Practices

- Prior to working in the BSC, always verify that the hood is certified (Certification Sticker posted by the outside contractor). Never use a hood that has failed certification and/or has been taken out of service.
- Ready the work area: If the BSC has been shutdown, operate the cabinet blowers for five minutes before beginning work to allow the cabinet to purge or remove particulates from the cabinet.
- Disinfect the work area: Wipe the work surface, interior walls and surface of the window with a suitable disinfectant; such as 70% ethanol, bleach solution, or other disinfectant as determined by the investigator to meet the requirements of the activity.
- Assemble material: Introduce only those items that are required to perform the procedures and arrange in a logical order. Each item should be wiped with a disinfectant prior to placing it into the cabinet to minimize the introduction of contaminants. The flow of work should proceed across the work surface from clean to contaminated areas.
- Wear protective clothing: A buttoned lab coat or back-closing gown will protect your street clothes. Wear gloves to protect your hands from microbes with which you work. Wash hands thoroughly after working in the BSC.
- Keep the rear exhaust and the front air intake grilles clear from research objects or notebooks; arms should not rest across the front grille.
- Arrange materials in the BSC so as to segregate contaminated and clean items. Avoid movement of contaminated items over clean ones.
- Perform work as least four inches from the front air intake grille.
- Wipe down cabinet work surfaces when work is completed.
- Move your arms slowly to minimize disruption of the air barrier when you remove or introduce items into the BSC.
- If a piece of equipment that that creates air turbulence (e.g. centrifuge, vortex mixer) is to be used in the BSC, place the equipment in the back third of the cabinet work surface; stop other work while the equipment is operating.

23.3 Use of Bunsen burners or Open Flames- According to the Center for Disease Control (CDC), "open-flames are not required in the near microbe-free environment of a biological safety cabinet" and create "turbulence which disrupts the pattern of air supplied to the work surface" jeopardizing the sterility of the work area. In fact, the use of open flames in a Biosafety cabinet:

- disrupts the air flow, compromising protection of both the worker and the work,
- causes excessive heat buildup, may damage HEPA filters and/or melt the adhesive holding the filter together, thus compromising the cabinet's integrity,
- presents a potential fire or explosion hazard. Electrical components such as the fan motor,

lights and electrical outlets are not designed to operate in flammable atmospheres, where a flash fire could be ignited by a spark,

- inactivates manufacturers warranties on the cabinet: cabinet manufacturers will assume no liability in the event of fire, explosion or worker exposure due to the use of a flammable gas in the cabinet. Additionally, the UL approval will automatically be void.

Therefore, the use of Bunsen burners or alcohol flames is prohibited in biological safety cabinets unless specifically approved by SRS. When deemed absolutely necessary, touch-plate micro-burners equipped with a pilot light to provide a flame on demand may be used after receiving approval by the SRS.

The use of gas burners inside the cabinet: Gas burners (natural or propane) are **NOT PERMITTED** for use inside a Class II biological safety cabinet because if the burner goes out, gas may build up inside the cabinet resulting in an explosive atmosphere. The heat from the flame will disrupt the laminar air flow pattern and may result in leakage of microbial agents from the work space into the laboratory and also allow contaminants to enter the sterile work space.

Alternative techniques for sterile work include using sterile Pasteur pipettes as an aspirator and using electronic bacterial loop incinerators. Sufficient equipment should be available so that a fresh supply for sterile equipment replaces the need to flame items. Where gas lines have been permanent or temporarily connected to a cabinet, these must be disconnected.

23.4 Use of UV light-The use of UV light in biological safety cabinets is strongly discouraged. The Center for Disease Control (CDC), the National Institute of Health (NIH), and the National Sanitation Foundation (NSF) all agree that UV lamps are not recommended nor required in biological safety cabinets. The National Sanitation Foundation (NSF) Standard 49(6), the industry testing standard for all biohazard cabinetry, does not provide any performance criteria for UV lighting and specifically states in section 4.24.2 “UV lighting is not recommended in class II (laminar flow) biohazard cabinetry.” Due to the short time for UV overexposure to occur, it is recommended that neither laboratory nor maintenance personnel work in a room where UV lights are on. Criteria is not even available from NSF to evaluate the performance of the UV lights within a biological safety cabinet. Numerous factors affect the activity of the germicidal effect of UV light, which require regular cleaning, maintenance and monitoring to ensure germicidal activity. If the use of UV light is deemed necessary, the UV light should not be turned on for more than 10 minutes. Never leave a UV light on overnight. You must post a sign stating "UV light in use" on the door to any room in which UV light is in use.

24. **Chemical Fume Hoods-** The fume hood is often the primary control device for protecting laboratory workers when working with flammable and/or toxic chemicals.

Before using a fume hood:

- Know the hazards of the chemical you are working with. Refer to the chemical’s Safety Data Sheet for hazard information and safe work practices.
- Ensure that the hood is on and operating properly.
- Check certification label on front of hood to ensure that it has received an annual check/certification.

- Make sure that the sash is open to the proper operating level, which is usually indicated by arrows on the frame.
- Make sure that the air gauge indicates that the air flow is within the required range.

When using a fume hood:

- Never allow your head to enter the plane of the hood opening. For example, for vertical rising sashes, keep the sash below your face; for horizontal sliding sashes, keep the sash positioned in front of you and work around the side of the sash.
- Use appropriate eye protection.
- Be sure that nothing blocks the airflow through the baffles or through the baffle exhaust slots.
- Elevate large equipment (e.g., a centrifuge) at least two inches off the base of the hood interior.
- Keep all materials inside the hood at least six inches from the sash opening. When not working in the hood, close the sash.

Promptly report any hood that is not functioning properly to your supervisor. The sash should be closed and the hood "tagged" and taken out of service until repairs can be completed.

25. **References**:

- Prudent Practices for Handling Hazardous Chemicals in Laboratories; National Academy Press, Washington D.C. 2011
- OSHA Laboratory Standard Implementation Guide; Ennis, Lumsden, Boylston & Associates, Inc., Chapel Hill, NC 1990
- 29 CFR Section 1910.1048 Formaldehyde
- 29 CFR Section 1910.1000 Occupational Safety and Health Standards Subpart Z - Toxic and Hazardous Substances
- 29 CFR Section 1910.1200 Hazard Communication
- 29 CFR Section 1910.1450 occupational Exposure to Hazardous Chemicals in Laboratories
- American Conference of Government Industrial Hygiene, TLV booklet
- American Biological Safety Association (ABSA)
- Center for Disease Control (CDC)
- OSHA Laboratory Safety Guidance, OSHA 3404-9N, 2011
- OSHA Safety and Health Topics-Laboratories http://www.osha.gov/SLTC/laboratories
- Primary Containment for Biohazards: Selection, Installation and Use of Biological Safety Cabinets, 2nd Edition, CDC and NIH, September 2000

APPENDICES

Appendix A: Carcinogens Listing
Appendix B: Laboratory Decommissioning
Appendix C: Accident/Injury Reporting Process
Appendix D: Evacuation Plan
Appendix E: Summary of Recommended Biosafety Levels for Infectious Agents
Appendix F: Bomb Threat Checklist
Appendix G: Laboratory Inspection Checklist
Appendix H: Chemical Compatibility Storage Guide
Appendix I: OSHA Hazard Communication Standard - Labels

Appendix A: Carcinogens Listing

Table C–1 Basis of OSHA Carcinogen Listing for Individual Chemicals

Chemical	IARC	NTP	OSHA–Z	Chemical	IARC	NTP	OSHA–Z
Acetaldehyde	2B	P	–	Catechol	2B	–	–
Acetamide	2B	–	–	Chlordane	2B	–	–
2-Acetylaminofluorene	–	P	Z	Chlorendic acid	2B	P	–
Acrylamide	2A	P	–	p-Chloroaniline	2B	–	–
Acrylonitrile	2B	P	Z	Chloroform	2B	P	–
2-Aminoanthraquinone	–	P	–	Chloromethyl methyl ether	1	K	Z
4-Aminoazobenzene	2B	–	–	3-Chloro-2-methyl-1-propene	–	P	–
4-Aminobiphenyl	1	K	Z	Chlorophenols	2B	–	–
1-Amino-2-methylanthraquinone	–	P	–	Chloroprene***	2B	P	–
Amitrole	2B	P	–	Chlorothalonil	2B	–	–
o-Anisidine	2B	–	–	p-Chloro-o-toluidine	2A	P	–
o-Anisidine hydrochloride	–	P	–	Chromium (VI) compounds	1	K	–
Arsenic and inorganic arsenic compounds	1	K*	Z	Cobalt and cobalt compounds	2B	–	–
Asbestos (friable)	1	K	Z	Creosote	2A	K	–
Atrazine**	–	–	–	p-Cresidine	2B	P	–
Benzene	1	K	Z	Cupferron	–	P	–
Benzidine	1	K	Z	2,4-D****	2B	–	–
Benzoic trichloride	2B	P	–	2,4-D butoxyethyl ester****	2B	–	–
Beryllium and beryllium compounds	1	P*	–	2,4-D butyl ester****	2B	–	–
Bis(chloromethyl)ether	1	K	Z	2,4-D chlorocrotyl ester****	2B	–	–
1,3-Butadiene	2A	K	–	2,4-D 2-ethylhexyl ester****	2B	–	–
1,2-Butylene oxide	2B	–	–	2,4-D 2-ethyl-4-methylpentyl ester****	2B	–	–
C.I. Acid Red 114	2B	–	–	2,4-Diaminoanisole	2B	–	–
C.I. Direct Black 38	2A	K	–	2,4-Diaminoanisole sulfate	–	P	–
C.I. Direct Blue 6	2A	K	–	4,4'-Diaminodiphenyl ether	2B	–	–
C.I. Direct Brown 95	2A	–	–	2,4-Diaminotoluene	2B	P	–
C.I. Food Red 5	2B	–	–	Diaminotoluene (mixed isomers)	2B	P	–
C.I. Solvent Yellow 3 (o-aminoazotoluene)	2B	P	–	1,2-Dibromo-3-chloropropane	2B	P	Z
C.I. Solvent Yellow 34 (Auramine)	2B	–	–	1,2-Dibromoethane	2A	P	–
Cadmium and cadmium compounds	1	K*	–	1,4-Dichlorobenzene	2B	P	–
Carbon tetrachloride	2B	P	–	Dichlorobenzene (mixed isomers)	2B	P	–

Note: The list of TRI chemicals meeting the OSHA carcinogen standard and, therefore, reported when in a mixture at a concentration level below the de minimus level of 0.1% has been updated, and this list reflects the update.
IARC: 1–The chemical is carcinogenic to humans; 2A–The chemical is probably carcinogenic to humans; 2B–The chemical is possibly carcinogenic to humans.
NTP: K–The chemical is known to be carcinogenic; P–The chemical may reasonably be anticipated to be carcinogenic.
OSHA: Z–The chemical appears at 29 CFR part 1910 Subpart Z.
*Certain compounds.
**IARC classification was recently downgraded and the chemical no longer meets the OSHA carcinogen criteria (effective for the 2000 reporting year).
***NTP classification meets OSHA carcinogen criteria (effective for the 2001 reporting year)
****Chlorophenoxy herbicides (IARC 2B).
*****IARC classification meets OSHA carcinogen criteria (effective for the 2001 reporting year)

Table C–1 Basis of OSHA Carcinogen Listing for Individual Chemicals *(continued)*

Chemical	IARC	NTP	OSHA–Z	Chemical	IARC	NTP	OSHA–Z
3,3′-Dichlorobenzidine	2B	P	Z	2,4-D propylene glycol butyl ether ester****	2B	–	–
3,3′-Dichlorobenzidine dihydrochloride	2B	P	–	2,4-D sodium salt****	2B	–	–
3,3′-Dichlorobenzidine sulfate	2B	P	–	Epichlorohydrin	2A	P	–
Dichlorobromomethane	2B	P	–	Ethyl acrylate	2B	–	–
1,2-Dichloroethane	2B	P	–	Ethyl benzene*****	2B	–	–
Dichloromethane	2B	P	–	Ethyleneimine	–	–	Z
trans-1,3-Dichloropropene	2B	–	–	Ethylene oxide	1	K	Z
1,3-Dichloropropylene	2B	P	–	Ethylene thiourea	2B	P	–
Dichlorvos	2B	–	–	Formaldehyde	2A	P	Z
Diepoxybutane	2B	P	–	Heptachlor	2B	–	–
Di-(2-ethylhexyl)phthalate	–	P	–	Hexachlorobenzene	2B	P	–
Diethyl sulfate	2A	P	–	alpha-Hexachlorocyclohexane	2B	P	–
Diglycidyl resorcinol ether	2B	P	–	Hexachloroethane	2B	P	–
Dihydrosafrole	2B	–	–	Hexamethylphosphoramide	2B	P	–
3,3′-Dimethoxybenzidine	2B	P	–	Hydrazine	2B	P	–
3,3′-Dimethoxybenzidine dihydrochloride	2B	P	–	Hydrazine sulfate	–	P	–
3,3′-Dimethoxybenzidine hydrochloride	2B	P	–	Lead and inorganic lead compounds	2B	–	Z
4-Dimethylaminoazobenzene	2B	P	Z	Lindane	2B	P	–
3,3′-Dimethylbenzidine	2B	P	–	Mecoprop****	2B	–	–
3,3′-Dimethylbenzidine dihydrochloride	2B	P	–	Methoxone****	2B	–	–
3,3′-Dimethylbenzidine dihydrofluoride	2B	P	–	Methoxone sodium salt****	2B	–	–
Dimethylcarbamyl chloride	2A	P	–	4,4-Methylenebis (2-chloroaniline)	2A	P	–
N,N-Dimethylformamide**	–	–	–	4,4′-Methylenebis (N,N-dimethyl) benzeneamine	2B	P	–
1,1-Dimethylhydrazine	2B	P	–	4,4′-Methylenedianiline	2B	P	Z
Dimethyl sulfate	2A	P	–	Michler's ketone	–	P	–
2,4-Dinitrotoluene	2B	–	–	Mustard gas	1	K	–
2,6-Dinitrotoluene	2B	–	–	alpha-Naphthylamine	–	–	Z
1,4-Dioxane	2B	P	–	beta-Naphthylamine	1	K	Z
1,2-Diphenylhydrazine	–	P	–	Nickel	2B	P	–
2,4-D isopropyl ester****	2B	–	–	Nickel compounds	1	P*	–
2,4-DP****	2B	–	–	Nitrilotriacetic acid	–	P	–

Note: The list of TRI chemicals meeting the OSHA carcinogen standard and, therefore, reported when in a mixture at a concentration level below the de minimus level of 0.1% has been updated, and this list reflects the update.

IARC: 1–The chemical is carcinogenic to humans; 2A–The chemical is probably carcinogenic to humans; 2B–The chemical is possibly carcinogenic to humans.

NTP: K–The chemical is known to be carcinogenic; P–The chemical may reasonably be anticipated to be carcinogenic.

OSHA: Z–The chemical appears at 29 CFR part 1910 Subpart Z.

*Certain compounds.

**IARC classification was recently downgraded and the chemical no longer meets the OSHA carcinogen criteria (effective for the 2000 reporting year).

***NTP classification meets OSHA carcinogen criteria (effective for the 2001 reporting year)

****Chlorophenoxy herbicides (IARC 2B).

*****IARC classification meets OSHA carcinogen criteria (effective for the 2001 reporting year)

Table C–1 Basis of OSHA Carcinogen Listing for Individual Chemicals *(continued)*

Chemical	IARC	NTP	OSHA–Z	Chemical	IARC	NTP	OSHA–Z
Nitrobenzene	2B	–	–	7,12–Dimethylbenz(a)anthracene	2B	–	–
4-Nitrobiphenyl	–	–	Z	Indeno[1,2,3–cd]pyrene	2B	P	–
Nitrofen	2B	P	–	5–Methylchrysene	2B	P	–
Nitrogen mustard	2A	–	–	1–Nitropyrene	2B	P	–
2-Nitropropane	2B	P	–	Potassium bromate	2B	–	–
N-Nitrosodi-n-butylamine	2B	P	–	Propane sultone	2B	P	–
N-Nitrosodiethylamine	2A	P	–	beta-Propiolactone	2B	P	Z
N-Nitrosodimethylamine	2A	P	Z	Propyleneimine	2B	P	–
N-Nitrosodi-n-propylamine	2B	P	–	Propylene oxide	2B	P	–
N-Nitroso-N-ethylurea	2A	P	–	Saccharin (manufacturing)**	–	–	–
N-Nitroso-N-methylurea	2A	P	–	Safrole	2B	P	–
N-Nitrosomethylvinylamine	2B	P	–	Sodium o-phenylphenoxide	2B	–	–
N-Nitrosomorpholine	2B	P	–	Styrene	2B	–	–
N-Nitrosonornicotine	2B	P	–	Styrene oxide	2A	–	–
N-Nitrosopiperidine	2B	P	–	Tetrachloroethylene	2B	P	–
Pentachlorophenol	2B	–	–	Thioacetamide	2B	P	–
Phenytoin	2B	P	–	4,4′-Thiodianiline	2B	–	–
Polychlorinated alkanes (C12, 60% chlorinated)	–	P	–	Thiourea	2B	P	–
Polybrominated biphenyls (PBBs)	2B	P	–	Toluene-2,4-diisocyanate	2B	P	–
Polychlorinated biphenyls (PCBs)	2A	P	–	Toluene-2,6-diisocyanate	2B	P	–
Polycyclic aromatic compounds (PACs):				Toluene diisocyanate (mixed isomers)	2B	P	–
Benz(a)anthracene	2A	P	–	o-Toluidine	2A	P	–
Benzo(b)fluoranthene	2B	P	–	o-Toluidine hydrochloride	–	P	–
Benzo(j)fluoranthene	2B	P	–	Toxaphene	2B	P	–
Benzo(k)fluoranthene	2B	P	–	Trichloroethylene	2A	P	–
Benzo(rst)pentaphene	2B	–	–	2,4,6-Trichlorophenol	2B	P	–
Benzo(a)pyrene	2A	P	–	1,2,3-Trichloropropane	2A	P	–
Dibenz(a,h)acridine	2A	P	–	Tris(2,3-dibromopropyl) phosphate	2A	P	–
Dibenz(a,j)acridine	2B	P	–	Trypan blue	2B	–	–
Dibenzo(a,h)anthracene	2B	P	–	Urethane	2B	P	–
7H–Dibenzo(c,g)carbazole	2B	P	–	Vinyl acetate	2B	–	–
Dibenzo(a,e)pyrene	2B	P	–	Vinyl bromide	2A	–	–
Dibenzo(a,h)pyrene	2B	P	–	Vinyl chloride	1	K	Z
Dibenzo(a,l)pyrene	2B	P	–	2,6-Xylidine	2B	–	–

Note: The list of TRI chemicals meeting the OSHA carcinogen standard and, therefore, reported when in a mixture at a concentration level below the de minimus level of 0.1% has been updated, and this list reflects the update.

IARC: 1–The chemical is carcinogenic to humans; 2A–The chemical is probably carcinogenic to humans; 2B–The chemical is possibly carcinogenic to humans.

NTP: K–The chemical is known to be carcinogenic; P–The chemical may reasonably be anticipated to be carcinogenic.

OSHA: Z–The chemical appears at 29 CFR part 1910 Subpart Z.

*Certain compounds.

**IARC classification was recently downgraded and the chemical no longer meets the OSHA carcinogen criteria (effective for the 2000 reporting year).

***NTP classification meets OSHA carcinogen criteria (effective for the 2001 reporting year)

****Chlorophenoxy herbicides (IARC 2B).

*****IARC classification meets OSHA carcinogen criteria (effective for the 2001 reporting year)

Carcinogens Listed in the Eleventh Report

Part A. Known to be Human Carcinogens.

Name or synonym	Page No
Aflatoxins	8
Alcoholic Beverage Consumption	10
4-Aminobiphenyl	13
Analgesic Mixtures Containing Phenacetin (See Phenacetin and Analgesic Mixtures Containing Phenacetin)	212
Arsenic Compounds, Inorganic	18
Asbestos	21
Azathioprine	25
Benzene	26
Benzidine (See Benzidine and Dyes Metabolized to Benzidine)	28
Beryllium and Beryllium Compounds	32
1,3-Butadiene	37
1,4-Butanediol Dimethanesulfonate (Myleran®)	39
Cadmium and Cadmium Compounds	42
Chlorambucil	47
1-(2-Chloroethyl)-3-(4-methylcyclohexyl)-1-nitrosourea (MeCCNU)	53
bis(Chloromethyl) Ether and Technical-Grade Chloromethyl Methyl Ether	56
Chromium Hexavalent Compounds	63
Coal Tar Pitches (See Coal Tars and Coal Tar Pitches)	68
Coal Tars (See Coal Tars and Coal Tar Pitches)	68
Coke Oven Emissions	71
Cyclophosphamide	74
Cyclosporin A	75
Diethylstilbestrol	98
Dyes Metabolized to Benzidine (See Benzidine and Dyes Metabolized to Benzidine)	29
Environmental Tobacco Smoke (See Tobacco Related Exposures)	251
Erionite	114
Estrogens, Steroidal	115
Ethylene Oxide	118
Hepatitis B Virus	**131**
Hepatitis C Virus	**133**
Human Papillomas Viruses: Some Genital-Mucosal Types	**142**
Melphalan	164
Methoxsalen with Ultraviolet A Therapy (PUVA)	165
Mineral Oils (Untreated and Mildly Treated)	174
Mustard Gas	176
2-Naphthylamine	179
Neutrons (See Ionizing Radiation)	**150**
Nickel Compounds (See Nickel Compounds and Metallic Nickel)	181
Radon (See Ionizing Radiation)	152
Silica, Crystalline (Respirable Size)	231
Smokeless Tobacco (See Tobacco Related Exposures)	253
Solar Radiation (See Ultraviolet Radiation Related Exposures)	266
Soots	233
Strong Inorganic Acid Mists Containing Sulfuric Acid	234
Sunlamps or Sunbeds, Exposure to (See Ultraviolet Radiation Related Exposures)	266
Tamoxifen	239
2,3,7,8-Tetrachlorodibenzo-*p*-dioxin (TCDD); "Dioxin"	241
Thiotepa	249
Thorium Dioxide (See Ionizing Radiation)	154
Tobacco Smoking (See Tobacco Related Exposures)	255
Vinyl Chloride	272
Ultraviolet Radiation, Broad Spectrum UV Radiation (See Ultraviolet Radiation Related Exposures)	266
Wood Dust	276
X-Radiation and Gamma Radiation (See Ionizing Radiation)	**147**

Bold entries indicate new or changed listing in *The Report on Carcinogens, Eleventh Edition.*

Appendix B: Laboratory Decommissioning

REQUEST FOR AUTHORIZATION FOR LABORATORY DECOMMISSIONING
TRUMAN VA
COLUMBIA, MO

In accordance with VHA Handbook 1058.01, Research Compliance Reporting Requirements, the PI or Laboratory Director must obtain authorization from the SRS and the ACOS/R&D ***prior to*** decommissioning (including vacating, reassigning, converting to non-laboratory use, or otherwise modifying) existing laboratory space that requires identification and disposal of hazardous materials, infectious agents, or equipment between uses. The request for authorization to decommission laboratory space must be made **at least 1 month prior to** implementation.

Date of Request: _____

Requestor Name: _____ **Phone:** _____

Lab Room Number: _____

Reason for Request (Check below as appropriate & provide supporting description):

☐ Vacating ☐ Reassigning ☐ Convert to non-lab space ☐ otherwise modifying

Additional information:

Projected Date for Move/Decommissioning: _____

Indicate Type(s) of Materials/Equipment Used/Stored in Lab:

☐ Radioactive Material ☐ Biohazardous Material ☐ Biosafety Cabinets ☐ Fume Hoods

☐ Compressed or Liquid Gases ☐ Corrosives ☐ Flammables/Combustibles

☐ Toxic or Reactive Chemicals ☐ Carcinogens, Mutagens, Teratogens

After review of this request, decommissioning of the above referenced laboratory has been approved. The PI is responsible for providing an inventory of hazardous materials, infectious agents and/or equipment for removal and for completing the Laboratory Exit/Renovation/Decommissioning Checklist.

_____ _____
SRS Chair **Date**

_____ _____
ACOS/R&D **Date**

Laboratory Exit/Renovation/Decommissioning Checklist

This checklist is designed to guide laboratory personnel safely through decommissioning procedures in the event that laboratory operations are moved or discontinued. Complete all sections, as applicable. In addition to the items in the checklist, please also consider the following:

- So that arrangements can be made for moving, cleaning, decontamination, and disposal, review the form with the Safety Office and GEMS Coordinator 60 days prior to vacating the laboratory, room, or area.
- To assure others that appropriate cleaning and decontamination have been done, prepare a written **clearance statement** or form to attach to decontaminated equipment, furniture, and space. A clearance statement should include contact information and the date of decontamination.
- Use appropriate personal protective equipment when cleaning, during decontamination, when handling hazardous materials, and when handling waste.
- Ensure that hazardous materials and their locations remain secure. Movers must be trustworthy and reliable. Do not leave hazardous materials unattended or unsecured in hallways, loading areas, and vehicles.
- Be sure to clean and decontaminate areas outside the lab such as coldrooms, hallway freezers, and common storage areas. If these areas will no longer be used, remove all materials, including chemicals and biologicals.

Complete each section of the checklist, as applicable.

Section A: Radioactive Materials Checklist

Lab Room No. _____

☐ Check here if no radioactive materials are used/stored in this area and proceed to next checklist.

Answer each question Yes, No or N/A. Provide additional comments below. For assistance, contact the Radiation Safety Officer.	Yes	No	N/A
1. Has the Radiation Safety Officer (RSO) been notified of plans to vacate the room at least two weeks in advance?			
2. Have all radioactive freezers, refrigerators, and other storage units been searched for radioactive samples and stock containers?			
3. Clean, decontaminate, survey, and wipe-test benchtops, furniture, other surfaces, laboratory hoods, storage cabinets, and other fixed equipment. Attach clearance statements to equipment and spaces. (Do not remove radiation warning tape/signs – this will be performed by the RSO).			
4. Clean, decontaminate, survey, and wipe-test refrigerators, freezers, and other movable equipment. Attach a clearance statement. (Do not remove radiation warning tape/signs – this will be performed by the RSO).			
5. Survey and wipe-test lead bricks, lead pigs, shielding, and source containers to verify decontamination. Follow organizational procedures for reuse, redistribution, recycling, or disposal.			
6. Has the RSO been notified concerning the need to transfer material to a new location and/or the need to dispose of material?			
7. Have radioactive material inventory records been updated?			
8. Have all radiation dosimeters (badges) been located and submitted to the RSO?			
9. Has fixed radiation detection equipment (e.g. liquid scintillation counter) been relocated to another approved location? Have portable radiation survey meters been transferred to another suitable lab or to the RSO for redistribution?			
Comments:			

Completed by/Date: _____

Reviewed by RSO/Date: _____

Section B: Biological Materials Checklist
Lab Room No. _____

☐ Check here if no biological materials are used/stored in this area and proceed to next checklist.

Answer each question Yes, No or N/A. Provide additional comments below. For assistance, contact the Safety Office.	Yes	No	N/A
1. Have all biological materials been appropriately destroyed or transferred to another laboratory?			
2. Have biological safety cabinet(s)[2] been emptied and surfaces decontaminated with a 10% bleach/water solution or other approved disinfectant?			
3. Has FM been contacted regarding biological safety cabinets that are to be relocated or discarded? (Note: Only a qualified contractor can perform gaseous decontamination of a BSC).			
4. Has FM been contacted to re-certify biological safety cabinets after being moved or relocated? (Note: Only a qualified contactor can perform gaseous decontamination and re-certify a BSC).			
5. Have all stocks and media solutions been decontaminated by autoclaving or appropriate disinfectant (e.g. 10% bleach/water solution) before drain disposal?			
6. Have all unused supplies been relocated to a new laboratory?			
7. Have all biological materials been removed from freezers and refrigerators? Have the freezers and refrigerators been decontaminated with an appropriate disinfectant (e.g. 10% bleach/water solution)?			
8. Have all laboratory surfaces used for infectious materials been decontaminated with an appropriate disinfectant (e.g.10% bleach/water solution)?			
9. Have all biohazard signs and labels been removed from equipment, cabinets, doors, etc?			
10. Have all solid infectious materials and used supplies been disposed in an infectious waste container?			
11. Have all sharps been placed into sharps containers and the sharp containers disposed of as infectious waste?			
Comments:			

Completed by/Date: _____

[2] See the following references for additional information on Biological Safety Cabinet Management: *Primary Containment for Biohazards: Selection, Installation and Use of Biological Safety Cabinets, 3rd Edition, CDC/NIH, September 2007* and *NSF 49: Class II (Laminar Flow) Biohazard Cabinetry.*

Reviewed by Safety Office/Date: _____

Section C: Chemical Materials and Gases Checklist

Lab Room No. _____

☐ Check here if no chemicals/gases materials are used/stored in this area.

Answer each question Yes, No or N/A. Provide additional comments below. For assistance, contact the Safety Office.	Yes	No	N/A
1. Have all regulators and manifolds been removed from gas cylinders? Have all cylinders and bottles been capped?			
2. Have cylinders been returned to the stockroom or supplier?			
3. Has the GEMS Coordinator been contacted to pick-up non-returnable bottles?			
4. Has the Controlled Substance Coordinator been contacted if controlled substances are to be moved?			
5. Have chemical materials been appropriately managed? a. All containers are labeled b. Useful chemicals are redistributed to another lab c. Chemical wastes are disposed via the GEMS Coordinator. d. Chemical inventories are updated, as appropriate.			
6. Have all materials/equipment been removed from the fume hoods? Note: If radioactive materials have been used in the fume hood, you must first receive clearance from the RSO.			
7. Have all laboratory benchtops, furniture, other surfaces, laboratory hoods, storage cabinets, and other fixed equipment been cleaned and decontaminated (using appropriate surfactant soaps, solvents, neutralizing agents or other cleaners)? Have warning stickers/signs been removed and clearance statements attached to equipment and/or spaces?			
8. Was Perchloric Acid used in any fume hood (following accepted procedures to capture and contain vapors if not performed in a perchloric acid fume hood)? If so, has the hood been tested for surface contamination using a diphenylamine or methylene blue test?			
9. As a final step, have all lab spaces been inspected to verify the removal of all chemicals? Be sure to check all drawers, cabinets, refrigerators, etc.			
Comments:			

Completed by/Date: _____

Reviewed by Safety Office/Date: _____

Appendix C: Accident/Injury Reporting Process

ACCIDENT/INJURY REPORTING PROCESS FOR RESEARCH

In Accordance with VHA Handbook 1058.01 – Research Compliance Reporting Requirements

Injury/Incident Occurs – All Workers Notify Their Supervisor, Then:

WOC Workers (MU Employees) seek medical treatment at MU. All MU Employees should report work-related injuries to MU Work Injury Services. If injury is life threatening, initial medical treatment may be provided at VA. Supervisor completes MU Intranet Work Injury Form. MU Work Injury Services Representative faxes completed Injury Form to VA Workers Compensation Representative at (573) 814-6401, who then forwards a copy of the form to the Research Office.

VA Employees working in Research will follow HPM 589A4-277 Management of Work-Related Injuries. Seek medical treatment at Employee Health (ED after hours). Employee Health enters information into ASSISTS & Supervisor completes CA1/CA2 & Incident Report Form in ASSISTS. Employee Health will notify the Research Office of any work-related injury sustained by a VA Employee in Research.

Unpaid Students – Seek medical treatment at Employee Health. Employee Health enters information into logsheet and notifies Research Office. Student seeks further medical treatment at Academic Institution, if necessary.

MO Foundation for Medical Research (MFMR) Employees – Seek medical treatment at Employee Health. Employee Health enters information onto log sheet and notifies Executive Director of MFMR, who then notifies the Research Office.

↓

Written Notification to the Subcommittee for Research Safety (SRS)

The Research Office reports the incident in writing to the Chair of the SRS **within 5 business days of the incident.** The Research Office then conducts an investigation using the Accident Investigation Form **.**

↓

SRS Review of Incident and Reporting Requirements

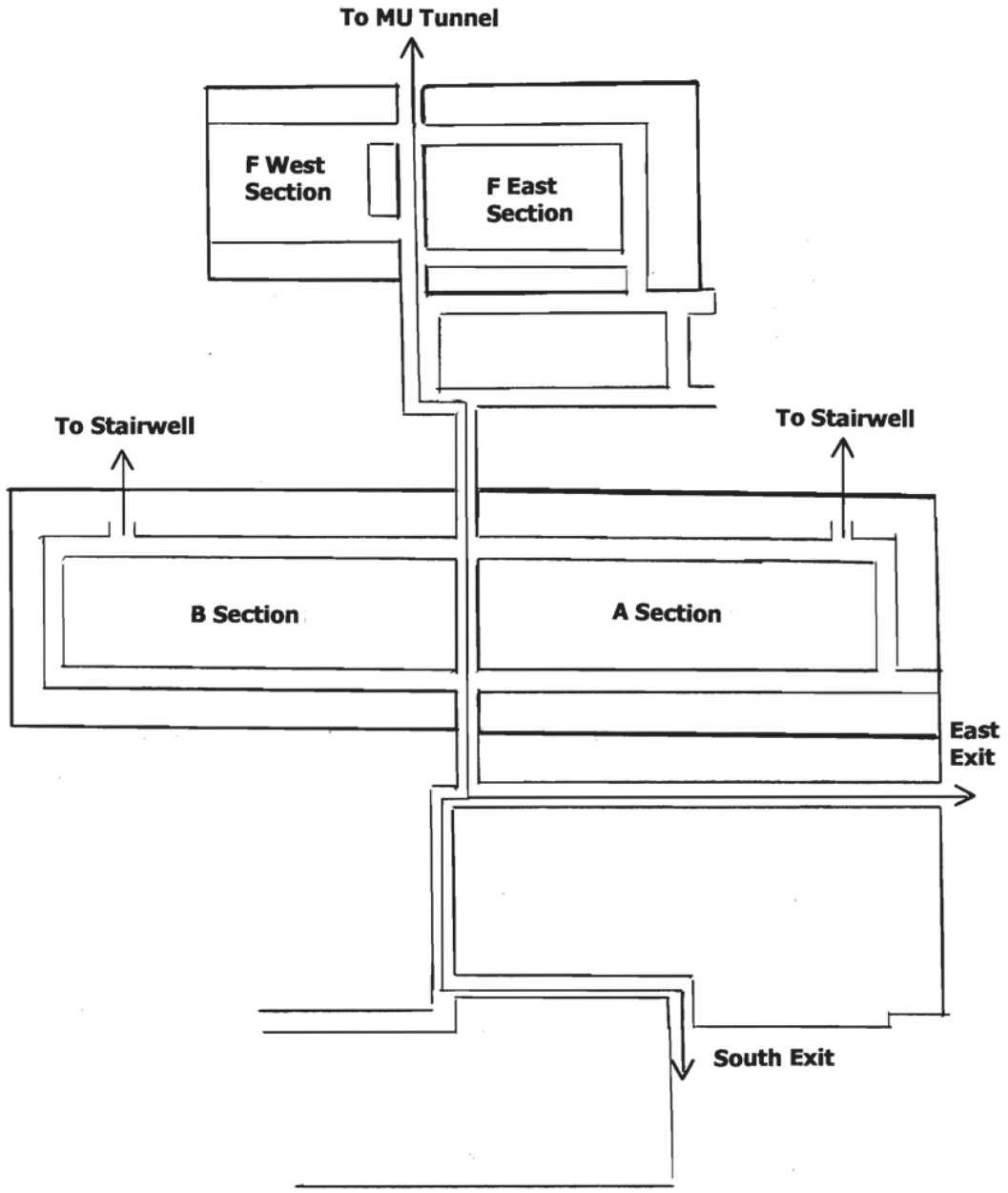
The SRS reviews the reported incident at the next scheduled meeting. An emergency session of the SRS will be convened, at the Chair's discretion, for incidents that present a significant risk and require immediate attention.

If the SRS determines that the incident is reportable in accordance with VHA Handbook 1058.01, subparagraph 9a through 9c:

- The SRS Chair must report the determination directly to the facility Director **within 5 business days** after the SRS's determination. This report must be in writing, with a simultaneous copy to the ACOS for Research and the R&D Committee.
- The facility Director must report the SRS's determination to ORO CO, with a simultaneous copy to the VISN Director and the ORD within **5 business** days after receiving such notification.

Appendix D: Evacuation Plan

Evacuation Plan



Appendix E: Summary of Recommended Biosafety Levels for Infectious Agents

Appendix E: Summary of Recommended Biosafety Levels for Infectious Agents *Biosafety in Microbiological & Biomedical Laboratories, 5th Edition, CDC/NIH*				
BSL	**Agents**	**Practices**	**Primary Barriers and Safety Equipment**	**Facilities (Secondary Barriers)**
1	Not known to consistently cause diseases in healthy adults.	Standard microbiological practices.	-No primary barriers required. -PPE: laboratory coats & gloves; eye, face protection, as needed.	Laboratory bench and sink required.
2	-Agents associated with human disease. -Routes of transmission include percutaneous injury, ingestion, mucous membrane exposure	BSL-1 practice plus: -Limited access -Biohazard warning signs -"Sharps" precautions -Biosafety manual defining any needed waste decontamination or medical surveillance policies.	Primary Barriers: -BSCs or other physical containment devices used for all manipulations of agents that cause splashes or aerosols of infectious materials -PPE: Laboratory coats, gloves, face and eye protection, as needed.	BSL-1 Plus: -Autoclave available
3	Indigenous or exotic agents that may cause serious or potentially lethal disease through the inhalation route of exposure.	BSL-2 practice plus: -Controlled access -Decontamination of all waste -Decontamination of laboratory clothing before laundering	Primary Barriers: -BSCs or other physical containment devices used for all open manipulations of agents -PPE: Protective laboratory clothing, gloves, face, eye and respiratory protection, as needed.	BSL-2 Plus: -Physical separation from access corridors -Self-closing, double-door access, -Exhausted air not recirculated -Negative airflow into laboratory -Entry through airlock or anteroom -Hand washing sink near laboratory exit
4	-Dangerous/exotic agents which post high individual risk of aerosol-transmitted laboratory infections that are frequently fatal, for which there are no vaccines or treatments. -Agents with a close or identical antigenic relationship to an agent requiring BSL-4 until data are available to redesignate the level. -Related agents with unknown risk of transmission.	BSL-3 practices plus: -Clothing change before entering -Shower on exit -All material decontaminated on exit from facility	Primary Barriers: -All procedures conducted in Class III BSCs or Class I or II BSCs in combination with full-body, air-supplied, positive pressure suit.	BSL-3 plus: -Separate building or isolated zone -Dedicated supply and exhaust , vacuum, and decontamination systems -Other requirements outlined in the text

Appendix F: Bomb Threat Checklist

589A4-008
January 22, 2013

BOMB THREAT CHECKLIST

QUESTIONS TO ASK:

1. When is bomb going to explode?
2. Where is it right now?
3. What does it look like?
4. What kind is it?
5. What will cause it to explode?
6. Did you place the bomb?
7. Why?
8. What is your address?
9. What is your name?

EXACT WORDING OF THE THREAT:

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

Sex of caller: _____ Race: _____

Age: _____ Length of call: _____

Number at which call is received:

_____

Time: _____ Date: ____/____/_____

BOMB THREAT

Department of Veterans Affairs-POLICE SERVICE

CALLER'S VOICE:

_____ Calm	_____ Nasal
_____ Angry	_____ Stutter
_____ Excited	_____ Lisp
_____ Slow	_____ Raspy
_____ Rapid	_____ Deep
_____ Soft	_____ Ragged
_____ Loud	_____ Clearing throat
_____ Laughter	_____ Deep breathing
_____ Crying	_____ Cracking voice
_____ Normal	_____ Disguised
_____ Distinct	_____ Accent
_____ Slurred	_____ Familiar
_____ Whispered	

If voice is familiar, whom did it sound like?

_____

_____

BACKGROUND SOUNDS:

_____ Street noises	_____ Factory machinery
_____ Crockery	_____ Animal noises
_____ Voices	_____ Clear
_____ PA System	_____ Static
_____ Music	_____ Local
_____ House noises	_____ Long distance
_____ Motor	_____ Booth
_____ Office machinery	Other_____

_____

THREAT LANGUAGE

_____ Well spoken (educated)	_____ Incoherant
_____ Foul	_____ Taped
_____ Irratlonal	_____ Message read by threat maker

Remarks: _____

_____

Report call immediately to VA Police x56320:

Phone number: _____

_____

Date ___/___/_____

Name_____

Position_____

Phone number_____

Appendix G: Laboratory Inspection Checklist

Truman VA - Research Laboratory Safety Inspection Checklist Date: 6/2/14 Rev. A

Area Inspected: _____ **Date of Inspection:** _____

Name of Inspector: _____

Y = Yes, N = No, N/A = not appliable, C = Corrected

Note: Radiation Safety Officer conducts separate radiation safety inspections. Controlled Substance inspectors review narcotics management. VA Police conduct periodic security inspections.

I.	Laboratory Environment	Y	N	N/A	C	Comments
a.	Work areas illuminated/lighting is adequate.					
b.	Storage of combustible materials are minimized.					
c.	No penetrations is walls, floor, or ceiling/all ceiling times in place.					
d.	Trash is removed daily.					
e.	No evidence of food or drink in active laboratory areas.					
f.	Excess clutter is not present in lab: Lab is adequately organized, orderly, and clean to provide for sufficient work space for operations.					
g.	Lab free of slip/trip hazards.					
h.	Electrical panels/disconnects clear of obstruction/panel doors closed.					
II.	**Emergency Equipment and Planning**	**Y**	**N**	**N/A**	**C**	**Comments**
a.	Exits and aisles clear of obstruction.					
b.	Emergency equipment clear of obstruction (e.g. fire extinguishers, eyewash stations, showers, spill supplies, fire pull station)					
c.	Fire extinguishers fully charged/inspection up-to-date.					
d.	Appropriate spill supplies are available.					
e.	Emergency instructions posted (Fire & Spill Procedures)					
f.	Eyewash and emergency shower tested and documented.					
III.	**Personal Protective Equipment (PPE)**	**Y**	**N**	**N/A**	**C**	**Comments**
a.	Appropriate PPE is available.					
b.	Lab personnel wear/use proper PPE.					
c.	Shorts/sandals are not worn in the lab.					
IV.	**Electrical Hazards**	**Y**	**N**	**N/A**	**C**	**Comments**
a.	Cover plates are in place.					
b.	Electrical equipment has been safety checked per Hospital Policy.					
c.	Electrical cords are in good condition.					
d.	No extension cords are in use. Extension cords cannot be used as permanent wiring.					
e.	Power strips are used only for computer-related equipment.					

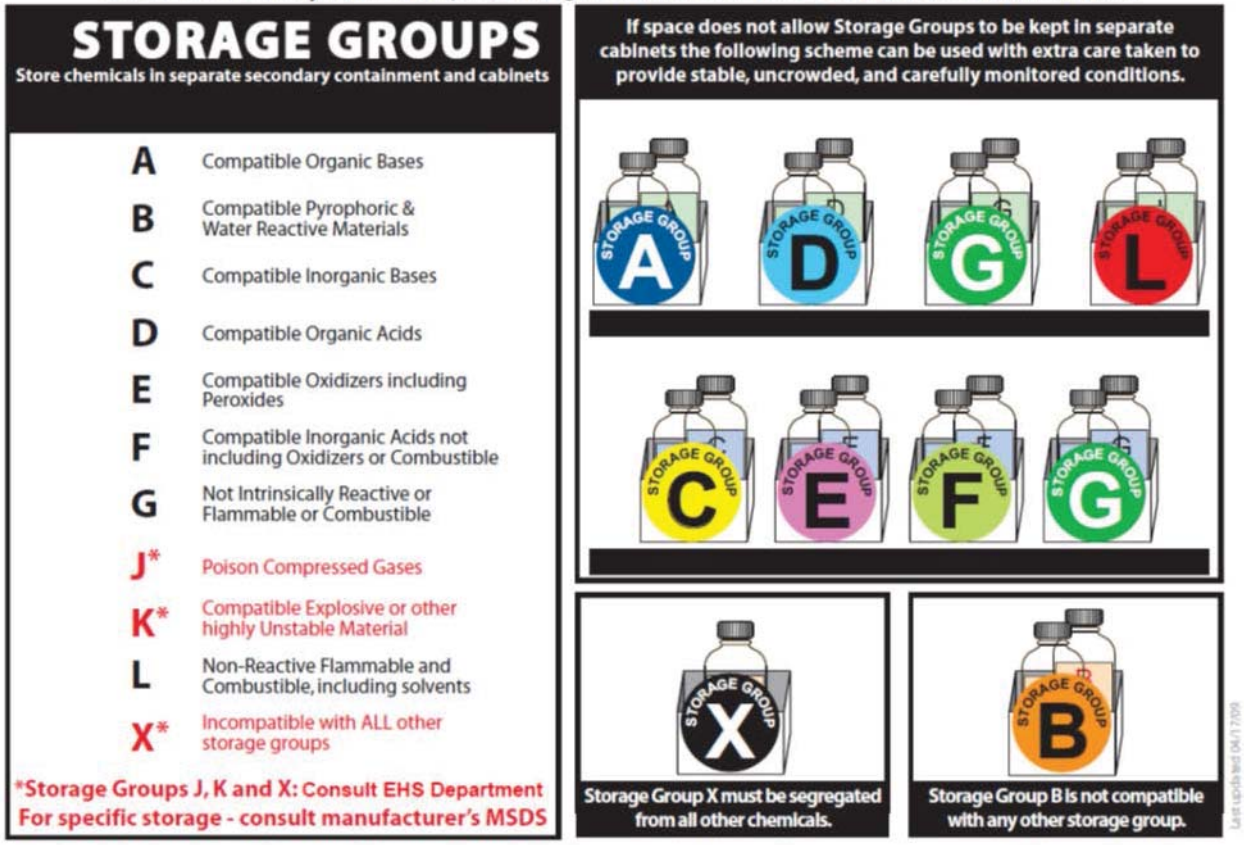
f.	Power strips are not connected in series (daisy-chained).					
g.	GFCI outlets are used in wet areas.					
V.	**Storage**	Y	N	N/A	C	Comments
a.	Heavy items are stored on lower shelves.					
b.	Storage at least 18 inches below sprinkler heads.					
c.	Means available to safely reach items stored above shoulder level.					
d.	Shelving is adequate for loads imposed.					
e.	Chemicals stored by compatibility and hazard class/Incompatible chemicals are segregated.					
f.	Chemical containers in good condition (not corroded, not leaking).					
g.	Chemical containers properly labeled with contents.					
h.	Chemical containers are closed. Containers should have lids or covers & be closed unless actively in use.					
i.	Acids stored in acid cabinet or secondary containment.					
j.	Lab Safe refrigerator used for cold flammable storage.					
k.	Flammable storage cabinets used for flammable storage > 1 liter.					
l.	Hazardous material storage cabinets are properly labeled and in good condition.					
m.	Corrosive chemicals stored at or below eye level.					
n	Chemicals stored away from sinks/drains and/or Secondary containment used near sinks/drains.					
o.	Chemicals stored on floor are in DOT approved carboys, metal containers, or glass containers provided with secondary containment.					
p.	Materials with shelf lives dated upon receipt.					
q.	No outdated chemicals present in lab.					
r.	Have unopened peroxide forming compounds not exceeded their manufacturer's expiration date? For example: dioxane, ethers, furans (e.g. tetrahydrofuran or THF), picric acid, perchloric acid, sodium amide) Are opened peroxide forming compounds labeled with the date they were opened and an expiration date?					
s.	Amount of chemicals on-hand is appropriate to the work being performed (inventory is kept to a minimum).					

VI.	Compressed Gases and Cryogens	Y	N	N/A	C	Comments
a.	Toxic and hazardous gas cylinders properly ventilated.					
b.	Cylinders stored by hazard class and chemical compatibility.					
c.	Gas cylinders stored upright and properly secured.					
d.	Regulators compatible with gas cylinder					
e.	Carts available and used to transport cylinders					
f.	Valve caps in place when not in use					
g.	Cylinders and dewars properly labeled/identified					
h.	Gases and cryogens dispensed in areas with good ventilation					
i	Dewars vented or have pressure relief devices					
j.	An alarm is present in an unventilated/underventilated room storing significant amounts of liquid nitrogen or other asphyxiant gas.					
VII.	**Chemical Fume Hoods/Biosafety Cabinets**	**Y**	**N**	**N/A**	**C**	**Comments**
a.	Each chemical fume hood/BSC has been tested within the past 12 months (check certification sticker)					
b.	If a fume hood/BSC has not been certified within the past 12 months, was it posted as "Not in Service"?					
c.	Fume hood sash is closed when not in active use.					
d.	Fume hood vents are (baffles) are unobstructed.					
e.	Fume hood is used with sash in appropriate position.					
f.	Chemical storage is limited in actively-used fume hoods.					
g.	Chemicals and equipment are at least 6 inches from fume hood sash.					
VIII.	**Waste Management**	**Y**	**N**	**N/A**	**C**	**Comments**
a.	Chemical waste containers are in good condition and compatible with their contents.					
b.	Waste containers are closed except during transfer.					
c.	For satellite containers of hazardous waste, the containers are labeled with the contents, "Hazardous Waste".					
d.	Incompatiable chemical wastes are segregated.					
e.	Glass waste disposal box is used for disposal of glassware. Box should not contain hazardous materials or liquids. Box should have structural integrity and be < 3/4 full.					
f.	Sharps containers properly used/properly disposed when full. Container should be secure (not able to tip over) and < 3/4 full.					

IX.	Other Note any other additional deficiencies/concerns observed. May also note any best practices/positive findings.

Appendix H: Chemical Compatibility Storage Guide (From Prudent Practices in the Laboratory)

Stanford University Compatible Storage Group Classification System
Should be used in conjunction with specific storage conditions taken from the manufacturer's label and MSDS.



Appendix I: OSHA Hazard Communication Standard – Labels

Under the revised OSHA Hazard Communication Standard, chemical manufacturers/importers must provide a label that includes the product identifier (Product J in the label below), a signal word (either "Danger" or "Warning" – "Danger" indicates a more severe hazard, pictogram(s) indicating the type of hazard, a hazard statement, and precautionary statement for each hazard class and category. Supplier information is also included.

Pictograms – follows the Globally Harmonized System (GHS) of labeling: A symbol descriptive of hazard on white background with red square frame set on point.