

LABORATORY SAFETY MANUAL
and
CHEMICAL HYGIENE PLAN

UNIVERSITY OF HOUSTON
CLEAR LAKE

SCHOOL OF SCIENCE AND COMPUTER
ENGINEERING

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1.0 INTRODUCTION.

The Occupational Safety and Health Administration promulgated its "Laboratory Standard", 29 CFR 1910.1450, Occupational Exposures to Hazardous Chemicals in Laboratories. The standard mandated that laboratories which handle hazardous chemicals prepare and implement a Chemical Hygiene Plan which is described in this manual. The basis for this standard is that academic laboratories differ from industrial operations in their use and handling of hazardous chemicals. As such, a different approach to addressing this issue is warranted.

This Laboratory Safety Manual serves as a guideline for the School of Science and Computer Engineering's (SCE) compliance with 29 CFR 1910.1450, 29 CFR 1910.1200 and the Texas Hazard Communication Act. All individuals and departments within the School of Science and Computer Engineering engaged in the laboratory use, as defined by this document, of hazardous chemicals must comply with the practices contained in this manual.

The primary objective of this manual is to provide a guide for handling hazardous chemicals and other potentially hazardous materials in SCE laboratories and in related operations. It establishes the basic safety principles for laboratory procedures, equipment and work practices and describes safeguards designed to protect employees, students, and visitors from physical and health hazards in a laboratory environment.

This manual is intended not only to address those universal safety measures necessary for achieving a generally safe and healthful work environment but those issues specific to the School of Science and Computer Engineering. Where the scope of hazards is not adequately addressed by this document, the Principal Investigator and/or Laboratory Supervisor in collaboration with the Chemical Safety Officer and the Laboratory Safety Committee must develop procedures unique to the specific procedure.

This manual will address the following subjects:

- *Standard Operating Procedures*
- *Engineering, administrative and personal protective equipment control measures.*
- *Proper functioning of ventilation hoods and other engineering controls*
- *Training Requirements*
- *A description of circumstances under which laboratory operations would require prior approval prior to starting work*
- *Provisions for medical review*
- *Designation of a Chemical Hygiene Officer and the establishment of a Chemical Hygiene Committee*
- *Provisions for additional protection for work with select carcinogens, reproductive toxins and substances with high degrees of toxicity*

1.1 Environmental Health & Safety Department (EHSD)

The Environmental Health & Safety Department's main purpose is to support the University of Houston- Clear Lake in its mission of higher education and research. The Department's efforts are directed at assisting the institution as a whole in identifying safety hazards and controlling such hazards through protective equipment, hazard mitigation

methods, development and presentation of safety training programs, purchase of insurance and other risk control and risk transfer techniques.

The Environmental Health & Safety Department keeps abreast of relevant safety, environmental, and risk management regulatory requirements and serves as SCE's primary resource in achieving and maintaining regulatory compliance and should be consulted when required.

1.2 School of Science and Computer Engineering (SCE).

School of Science and Computer Engineering supports research and development directed toward producing new knowledge and identifying additional applications of existing knowledge. In support of those functions that are unique to its mission the safety function may be unique and specific. As such, SCE will collaborate with the Environmental Health and Safety Department in establishing policies and procedures that are consistent with the SCE's mission while meeting the University's responsibility in providing a safe and healthful environment.

2.0 CHEMICAL HYGIENE PROGRAM.

SCE's main goal is to provide a safe and healthful laboratory environment to all laboratory staff, students, and visitors associated with it. Accomplishment of this objective is through the establishment of a Chemical Hygiene Program and the implementation of a Chemical Hygiene Plan.

This Plan sets forth procedures, equipment, personal protective equipment and work practices that are capable of protecting students and staff from chemical and physical hazards presented by hazardous chemicals used in the laboratory environment. Additionally, it describes a minimum level of safe practices that are expected from all individuals (faculty, staff, and students) in the SCE involved in the laboratory operations.

2.1 Program Responsibilities.

SCE recognizes the need to use chemicals and other potentially hazardous materials for the purpose of research and teaching. It is committed to ensuring the safety of its students, employees, and visitors, as well as complying with regulatory requirements that impact its facilities and operations.

In providing a safe and healthful laboratory environment, SCE has designated specific responsibilities for developing and implementing the Chemical Hygiene Plan to the SCE Chemical Safety Committee. The primary purpose is to support the SCE's mission and that of the University of Houston, Clear Lake Environmental Health & Safety Department (EHSD). To ensure a successful program, the cooperation of various entities within the School is required. Those entities are responsible for maintaining the integrity of the program and are listed below, as well as their respective responsibilities.

SCE Chemical Safety Committee

The SCE Laboratory Safety Committee has the responsibility of identifying and addressing safety issues occurring under the administrative control of the School of Science and Computer Engineering and for recommending corrective action to the faculty and Dean of the School of Science and Computer Engineering. The Committee shall be composed of:

- a. At least one Faculty Member from each Natural Science Program*
- b. Chemical Safety Officer*
- c. Radiation Safety Officer*
- d. Laser Safety Officer*
- e. Laboratory Supervisor*
- f. Director Environmental Health and Safety, UHCL*

The Committee shall meet no less than twice a year to discuss laboratory safety and chemical hygiene issues. It will work with SCE administrators, laboratory instructors, and staff to develop and implement appropriate chemical safety and hygiene policies. This will include at a minimum the following:

- a. Work with administrators and laboratory staff to develop and implement appropriate chemical safety and hygiene policies and procedures.*
- b. Establish criteria for which laboratory processes or procedures will require evaluation and prior approval.*
- c. Review and approve the use of chemicals that have high chronic toxicity or are considered "cancer suspect" agents.*
- c. Monitor procurement, use, and disposal of chemicals used in the laboratory.*
- d. Ensure appropriate audits are conducted.*
- e. Collaborate with the Laboratory Supervisor, faculty, and the Chemical Safety Officer in the development of safe laboratory procedures used to conduct experiments.*
- f. Establish policies and procedures to be used during special events.*
- g. Remain abreast of the current legal requirements concerning regulated substances.*

- h. Explore opportunities to improve laboratory safety.*
- j. Review and evaluate effectiveness of the SCE Chemical Hygiene Plan.*
- k. Review and update reference material on the hazards, safe handling, storage and disposal of hazardous chemicals found in the laboratory environment.*
- l. Periodically inspect the fume hoods used in the SCE.*

Chemical Safety Officer

The Chemical Safety Officer has responsibility for Chemical Hygiene and provides technical guidance and assistance regarding the Chemical Hygiene Plan to the Department Chair, SCE Laboratory Safety Committee, Professors, Principal Investigators, Laboratory Supervisor, employees, and students.

The Chemical Safety Officer is essential to the success of the safety program. As such, he/she must effectively carry out the requirements of this Plan and at a minimum, complete the following duties:

- a. Work with the Laboratory Safety Committee, Principal Investigators, and Laboratory Supervisor in developing and implementing SCE chemical hygiene practices and policies.*
- b. Collaborate with Environmental Health and Safety Department in determining the required levels of protective apparel and equipment.*
- c. Conduct or cause to have conducted safety and health audits and inspection when warranted*
- d. Monitor the procurement of new chemicals as well as the collection and disposal of chemical wastes.*
- e. Serve as the Emergency Response Coordinator and work with the Environmental Health and Safety Department when responding to SCE chemical emergencies as needed*
- f. Write, distribute, and update the SCE Chemical Hygiene Plan as appropriate*
- g. Submit the Chemical Hygiene Plan for review and approval to the Laboratory Safety Committee*
- h. When necessary, conduct or cause to have conducted environmental and/or personal monitoring in particular laboratory operation in order to assess the degree of exposure to a chemical when required.*

- i. Ensure the Environmental Health and Safety Department receives copies of MSDS's received.*
- j. Procurement and distribution of new and updated product Material Safety Data sheets (MSDS)*
- k. Conduct risk assessments of all operations involving toxic chemicals and those listed in 29 CFR 1910 Subpart Z.*
- l. Collaborate with the Environmental Health and Safety Department in developing UHCL laboratory safety policies and procedures.*
- m. Work with Principal Investigators in selecting and evaluating control methods*

Radiation Safety Officer

The Radiation Safety Officer provides technical guidance and assistance to the SCE Chemical Safety Committee in evaluating issues relating to Radiation and Laser Safety.

Immediate Instructor/Lab Supervisor

The Immediate Instructor has overall responsibility to:

- a. Conduct periodic routine and formal laboratory safety, emergency equipment, and housekeeping inspections.*
- b. Ensure students, staff and visitors follow the established safety rules and remain familiar with the legal requirements concerning regulated substances*
- c. Ensure the required levels of protective apparel and equipment is available for use*
- d. Evaluate and determine the adequacy of training for use of any material being ordered.*
- e. Ensure that the requisite safety orientation and training to staff relevant to this Chemical Hygiene Plan is provided.*
- f. Respond to chemical emergencies occurring in SCE as needed*
- g. Collaborate with the Chemical Safety Officer in matters relating to use of Personal PPE, chemical exposure, safety training, etc. as appropriate*

- h. Participate in the updating and distribution of the SCE Chemical Hygiene Plan.*
- j. Maintain SCE, Hazardous Chemical List*
- k. Report to the appropriate campus entity when equipment is not functioning properly*
- l. Ensure the proper decontamination of work area following established principles prior to the Physical Plant Staff initiating work in the area.*
- m. Inform Physical Plant staff of hazards that workers would be exposed to when performing maintenance in the laboratory, i.e. infectious agents, radioactive material, chemicals, etc.*

Faculty Members

- a. Are appointed by the Dean, School of Science and Computer Engineering*
- b. Along with the other members of the committee will elect a Chair*

Principal Investigators

- a. Assume direct responsibility for their laboratory's compliance with the Chemical Hygiene Plan*
- b. Collaborate with the Chemical Safety Officer in developing Standard Operating Procedures (SOPs) for laboratories under SCE authority*
- c. Cooperate with the Chemical Safety Officer to ensure program compliance*
- d. Conducting hazard classification of laboratory operations in collaboration with the Chemical Safety Officer*
- e. Ensuring workplace control methods are available and functioning properly and as intended*
- f. Responsible for the recognition of hazards related to the use, storage, and disposal of chemicals in laboratories under his cognizance. Collaborates with the Chemical Safety Officer in the accomplishment of these duties when needed*
- g. Maintain and updated inventory of laboratory chemicals used in laboratories under his/her administrative control*

- h. *Ensuring that all laboratory personnel, including part-time students and visiting professionals scientists trained and/or informed of the safety regulations, as required*

Laboratory Employees, Students, and Visitors

- a. *Follow the general safety rules and guidelines described in the Chemical Hygiene Plan*
- b. *Plan and conduct research safely in accordance with institutional safety procedures*
- c. *Read, understand, and follow SOPs for unique laboratory and high hazard operations*
- d. *Notify the laboratory supervisor of any unsafe or potentially unsafe conditions.*

Physical Plant Operations

- a. *Maintenance or repair problems (mechanical, electrical, plumbing) reported in a reasonable time period*
- b. *When repairs cannot be made in a timely manner then the Principal Investigator should be notified with an anticipated completion date as soon as possible.*
- c. *Ensure the Physical Plant Staff is informed of the hazards that employees may be exposed to when performing maintenance duties prior to the start of work.*
- d. *Upon completion of repairs to safety equipment, (Example: fume hoods, eyewashes, safety showers, etc.) the Physical Plant should notify the Laboratory Supervisor.*
- e. *Collaborate with the Chemical Hygiene Officer and the Environmental Health staff in determining when appropriate PPE is required prior to initiation of maintenance work.*

3.0 STANDARD OPERATING PROCEDURES.

A large percentage of laboratory accidents are due to human error. A way to successfully address this is the establishment of Standard Operating Procedures that are to be used in the laboratory. These procedures represent guidelines to be followed for the handling of hazardous materials.

3.1 General.

3.1.1 General Rules.

- a. *No running, jumping, or horseplay.*
- b. *Do not work alone in a laboratory when the task or experiment being conducted is hazardous.*
- c. *Spills shall be cleaned up immediately. Water spills create slip hazards. Immediate cleanup of spills of liquids on the table top prevents contact with skin and/or clothing.*
- d. *Jewelry, rings, and bracelets should not be worn*
- e. *Never perform any unauthorized work, preparations, or experiments*
- f. *Never remove any chemical from the laboratory without authorization*
- g. *Wear appropriate PPE whenever required (See paragraph 3.3)*

3.1.2 Personal Hygiene.

- a. *Wash hands and areas of exposed skin thoroughly before leaving the laboratory.*
- b. *No sandals, open toed clogs shall be worn.*
- c. *Never pipette by mouth. Use bulb pipettes.*
- d. *No eating, drinking or smoking allowed in the laboratory.*
- e. *No food beverages, tobacco, or cosmetics allowed inside the laboratory.*
- f. *Do not use ice from laboratory ice machines for beverages.*

3.1.3 Housekeeping.

- a. *Each laboratory user is responsible for maintaining the cleanliness of his/her work area. Keep work areas as clean as the work allows while working. Clean the work area completely at the end of the day.*
- b. *Return chemicals to the proper place following use.*
- c. *Keep counter tops neat and clean*

- d. *Stored items and equipment should never project beyond the edge of counter tops or the edge of the front shelf.*

3.1.4 Unattended experiments: *Laboratory experiments should be checked periodically or placed in potentially low hazard condition before leaving them unattended.*

3.1.5 Emergency Information and Warning Signs. *All laboratories shall have posted near the telephone or door entrance, the telephone numbers of persons to call in the event of an emergency.*

Recommended Symbols include:

- a. *The NFPA 704 diamond may also be posted outside each active laboratory for use by fire fighters and safety personnel during emergency situations.*
- b. *Radioactivity work areas, laboratories and containers of radioactive materials must be posted with appropriate warning signs (see Radiation Safety Manual)*
- c. *The universal biohazard warning sign will be used in areas where human blood or other potentially infectious materials are stored or used or where researchers working with or storing bio-hazardous material. Suggested locations for biohazard signs include laboratory entrance, incubator, refrigerator, and waste containers.*

3.2 Facilities.

3.2.1 Eyewash Fountains and Safety Showers. *Chemical laboratories and other chemical work areas should be provided with safety showers and eye wash fountains that are strategically located, in working order, readily identified, and routinely tested.*

3.2.2 Fire Extinguishers/Sprinklers.

- a. *Should be readily available or at a distance of 75 feet from the laboratory.*
- b. *It is required that there is an 18 inch clearance to the ceiling to comply with NFPA codes for sprinkler systems. Minimizing the “stacking” of combustible material will also decrease the fuel package arrangement of the laboratory and help contain the fire to one laboratory unit in the event of a fire.*
- c. *Fire extinguishers should never be concealed from general view or blocked. They must be clearly marked.*

- d. *Laboratory workers should routinely inspect for broken seals, damage, and low gauge pressure (depending on type of extinguisher). Where problems are identified, the Environmental Health and Safety Department should be contacted immediately for correction or repairs.*

3.2.3 Aisles, Exits, and Passageways.

- a. *Aisles and exits must be kept free of obstructions at all times. This includes items such as power cords, excessive equipment, and damaged flooring.*
- b. *Consideration should be given to the ease of access and evacuation of disabled students and staff.*
- c. *There should be two or more unobstructed exits for evacuation.*
- d. *The laboratories shall be maintained in such a manner where there is at least 36 inches of clearance between obstructions to exit from the laboratory into the corridor.*
- e. *The corridors must have a minimum of 44 inches of clearance and shall be maintained free of obstructions to ensure clear egress to the nearest stairwell in the event of an emergency.*
- f. *Do not store combustible material such as paper, wooden boxes, pallets under stairwells or in passageways or hallways.*

3.2.4 Telephones. *Telephones should be readily available with telephone numbers clearly posted and access numbers to outside lines clearly posted.*

3.2.5 Electrical.

- a. *All electrical equipment used in the lab shall be approved by Underwriters Laboratory (UL) or Factory Mutual (FM).*
- b. *Overloading of electrical outlets should be avoided. A sufficient number of outlets will eliminate the need for extension cords. Overloading electrical circuits and extension cords can result in a fire.*
- c. *Electrical cords should not be pulled or dragged over hooks, or other sharp objects that may cause cuts in the insulation. Cords should not be placed on connections behind furniture or equipment*

that can be pushed tightly against electric outlets, severely bending the cord and the plug.

- d. *Electric cords should be examined routinely for fraying and exposed wiring. Electrical cords should not be frayed. This suggests damage to the outer jacket which could affect the cord's water resistant integrity. The insulation can then absorb moisture, resulting in a short circuit or excessive current leakage to ground. And, when wires are exposed, they may cause a shock to a worker who contacts them. Replace frayed cords immediately.*
- e. *Household extension cords and multi-use plugs are prohibited.*
- f. *Equipment supplied with a grounded plug requires attachment to a ground source. Removal of the grounding prong interferes with this electrical safety feature and can result in shock or electrocution.*
- g. *Extension cords shall not be used as a substitute for permanent wiring.*

3.3 Personal Protective Equipment.

Personal protection and personal hygiene are two fundamental but important aspects of laboratory safety. The wearing of appropriate personal protective equipment and the practice of good personal hygiene minimizes the potential for exposures to hazardous chemicals during routine use and in the event of an accident.

3.3.1 Clothing:

- a. *Aprons: Non flammable, chemically resistant, non porous aprons offer the most satisfactory protection and should be used for potential chemical splashes.*
- b. *Lab jackets must remain inside the lab.*

3.3.2 Gloves: *Wear appropriate impervious gloves whenever there is a potential for direct skin contact with hazardous chemicals or bloodborne pathogens.*

- a. *Use gloves when handling corrosive, hot, very hot, or very cold materials*
- b. *Inspect gloves before each use*
- c. *Wash gloves prior to removal*
- d. *Replace deteriorated gloves*

- e. *When not in use gloves are to remain inside the lab.*

NOTE: *All glove materials are not equally effective in protection from chemical hazards. Consult with the SCE Chemical Safety Officer for guidance and direction in selecting the appropriate glove which affords the appropriate protection.*

3.3.3 Eye Protection: *Students, staff and visitors in laboratories shall wear safety glasses, goggles, or face shields at all times whenever potential eye hazards exist.*

- a. *Because of the potential for splashing chemicals and flying particles, goggles must be worn in the laboratory when working in the laboratory. Glasses with side shields are not permitted.*

NOTE: *Attendance of classes in laboratory facilities, in and of itself is not considered be hazardous in nature. Therefore, no eye protection is required for students who are attending classes.*

- b. *Face shields are required when working with severely corrosive liquids, glassware under reduced or elevated pressure, with glass apparatus used in combustion or other high temperature operations (i.e distillation, refluxing, toxic chemical transfer) and whenever there is any other possibility of an explosion or implosion.*

NOTE: *Face shields large enough to protect the ears, neck, and face are considered adequate.*

- c. *Contact lenses may be worn provided that the same approved eye protection is worn as required of other workers in the area. Contact lenses can never be used as a substitute for approved eye protection.*
- d. *In cases where Ultraviolet light may be used, UV absorbing protective glasses must be worn.*

3.3.4 Respirators:

- a. *Use appropriate respiratory equipment when air contaminant concentrations are not sufficiently reduced by engineering controls*
- b. *Ensure respirators are inspected periodically and prior to use*
- c. *Respiratory Fit Testing will be accomplished by environmental health Department.*

NOTE: Respiratory Protection Equipment is available through the Laboratory Supervisor or Chemical Safety Officer and is selected in accordance with the Respiratory Protection Standard, 29 CFR 1910.134.

3.4 Laboratory Equipment.

3.4.1 Compressed Gas Cylinders. Compressed gas cylinders are under great pressures, often exceeding 2000 pounds per square inch. Efforts must be made at all times to prevent the accidental and uncontrolled release of energy caused by toppling over and rupturing the valve stem.

As such the following general rules will be observed:

- a. Secure all compressed gas cylinders to a wall or bench top by chain, strap, clamping device, stand, or rack.
- b. Store cylinders containing flammable gas in a well ventilated area and properly labeled.
- c. Separate the full cylinders from the empty ones.
- d. Transport cylinders in appropriate devices and secured.
- e. Inspect the storage area Quarterly making sure connections, regulators, valves, gauges, etc are working properly.

NOTE: Compressed gas cylinders are stored in the Bayou Building, Rm 3134.

3.4.2 Mechanical Equipment Guarding. Some common pieces of lab equipment present physical hazards due to rotating parts, nip points or other mechanical action.

- a. To prevent injury due to entrapment of hair, clothing or other items, it is necessary that these areas remain guarded.
- b. Any piece of equipment with a detached, disengaged or inoperable guard must be prominently tagged and removed from service.

3.4.3 Laboratory Fume Hoods. Use hoods that have been certified for operations that might result in the release of toxic chemical vapors or dust.

- a. Do not place head inside the plane of a fume hood.
- b. Do not allow materials or equipment to block air vents in the hood

- c. *Operations which generate air contaminants greater than their TLV, are malodorous or lachrymatory in nature, or present acute respiratory hazards require the use of the fume hood.*
- d. *Do not use hoods as a waste disposal or storage mechanism except for small quantities (10 ml) of volatile material. Do not store solutions, glassware, testing equipment or other excess material in a laboratory hood.*
- e. *Position the hood sash between 6 and 18 inches for optimum performance*
- f. *Keep hood sash closed when not in active use.*
- g. *Position equipment and materials 6 inches inside the hood sash*
- h. *Elevate large items at least 2" off the hood work surface to facilitate air flow inside the hood*
- i. *Do not use electrical equipment inside the hood. Use only grounded equipment and make electrical connections outside the hood.*
- j. *Use of Perchloric Acid in a hood not designed for its use is prohibited.*
- k. *Confirm adequate hood performance prior to each use by examining the inspection certificate affixed to each hood for status of the inspection date and the results of the inspection. Adequacy of performance is demonstrated using the "Numerical Testing Procedure and/or the "Flow Visualization Method"*
 - 1. *The Numerical Testing Procedure utilizes a calibrated "velometer". It measures the flow rate of air in a rectangular work area that is divided into nine zones.*
 - 2. *The flow rate is measured at the center of each rectangular zone with the sash opening at 18 inches with the velometer inlet located 1 inch behind the plane of the sash.*
 - 3. *The average of the nine measurements must equal or exceed 80 lfpm. A reading of less than 80lfpm is considered not passing and requires maintenance by Plant Operations.*
 - 4. *The "Flow Visualization Method" requires the use of smoke tubes or a pan of "dry ice". This is a qualitative test that measures the direction of flow of the air. The smoke or the dry ice vapors*

must indicate the flow is inward toward the interior of the hood and not escaping the plane of the hood face.

5. Some hoods that have a face velocity reading between 150-180 lfpm may be used for limited operations on a case by case basis. Highly toxic or hazardous chemicals and carcinogens cannot be manipulated underneath this classification of hood.

6. Hood air flow should be inspected and tested at least annually by Environmental Health and Safety and preferably semiannually. Appendix B is a copy of the laboratory hood inspection form.

NOTE: *The American Chemical Society recommends that chemical fume hoods be tested at least semi-annually.*

I. Any hoods that do not meet certification standards are to be taken out of service and not used until repaired.

3.4.4 Biological Safety Cabinets. *Biosafety cabinets should be certified when installed or moved, and annually thereafter. The biosafety cabinet's (BSC) ability to filter out microscopic particles relies on the seals being intact and the HEPA filter free of micro tears or breaks that can easily occur during moving, installation or careless handling. To ensure continued proper operation, each BSC should be tested and certified at least annually.*

3.4.5 Snorkels. *These are flexible ducts that are attached to an exhaust system. Also known as "elephant trunks" these aid in the removal of contaminated or irritating air from the lab to the outside. These types of connections should generally be placed within six (6) inches of an experiment, process, or equipment.*

3.4.6 Lasers. *Class III-A lasers are low intensity and pose minimal risk for physical harm. In the event more powerful lasers are obtained or used by the faculty, American National Standards Institute (ANSI Z136.1-2007, American National Standard for the Safe Use of Lasers will be used to ensure compliance at a minimum.*

Class IIIB or IV must be registered with the Texas Department of State Health Services, in accordance with Title 25 Texas Administrative Code, Section 289.301 and used exclusively in the Laser Lab, B3336, in accordance with the Laser Safety Manual.

3.4.7 Storage Cabinets. *Use of appropriate storage cabinets for each type of hazardous chemical can significantly reduce risks whereas inappropriate storage increases the dangers.*

- a. **Acids.** *Wooden storage cabinets or cabinets with corrosion-resistant coating are best suited for storage of acids and should be used.*
- b. **Flammable Liquids.** *Specially designed fireproof metal cabinets are preferred for storing flammable materials. These cabinets keep flammable liquids below their vaporization temperatures during a fire. The maximum quantity of flammable liquid that can be stored in flammable storage cabinets in sprinklered laboratory facilities are:*
 1. *10 gallons per 100 square feet for Class I flammable liquids or*
 2. *20 gallons for Class I, II, and IIIA flammable liquids combined.*

NOTE: *Non rated steel cabinets are inappropriate. They allow heat to be transferred to the cabinet shelf resulting in rapid vaporization of the liquid, hence bottle breakage and acceleration of the fire.*

3.4.8 Refrigerators.

- a. *Refrigerators are available for use in refrigerating chemicals and other items for laboratory use only. NO FOOD ALLOWED!!!*
- b. *A number of common solvents have flash points close to or below the temperature at which most refrigerators operate (around 39°F or 4°C). Flammable solvents evaporate rapidly, even at lowered temperatures, so they can quickly reach equilibrium inside the small, well-sealed space of a refrigerator. When this “off-gassing” reaches the lower explosive limit (LEL) sources of ignition inside a conventional refrigerator such as the thermostat, interior light, defroster, compressor, or fan can set off an explosion.*
- c. *For storage of substances that are flammable, use only EXPLOSION PROOF Refrigerators. NO FOOD ALLOWED!!*

3.4.9 Glassware and Tubing.

- a. *Use only equipment that is in good condition.*
- b. *Never use chipped, cracked, or damaged glassware.*

- c. *Dewar flasks and other evacuated glass apparatus requires extra care and handling. Shield or wrap them to contain chemicals and glass fragments in case of implosion.*
- d. *Insertion of tubing into stoppers requires lubrication and the use of gloves to protect the hands*
- e. *Support all beakers and flasks with clamps*

3.4.10 First Aid Kits.

- a. *First Aid Kits should be located in conspicuous places in the laboratory, clearly marked, and used for immediate response to minor injuries.*
- b. *A designated party should be responsible for monitoring and maintaining the kit. It should be inspected frequently with the date of inspection recorded in an attached log.*
- c. *Contents should include the following:*
 - 1. *Band Aids, sterile gauze pads, bandages, antiseptic wipes*
 - 2. *Scissors, examining gloves for response to emergencies involving blood and body fluids*
 - 3. *Pocket masks for CPR procedures.*
- d. *Items not recommended for first aid kits include iodine, ice packs, ammonia inhalants, and tourniquets.*

3.5 Laboratory Chemical Labeling and Storage

3.5.1. Chemical Storage. *Every chemical should have assigned to it a definite storage place with amounts required to be kept to an absolute minimum.*

General storage rules include:

- a. *Do not store materials on top of high cabinets or on the floor where they will be hard to reach or on the floor where they can become trip hazards.*
- b. *Minimize storage of chemicals within the laboratory. Store excess chemicals in suitable stockrooms or chemical storage spaces when possible*

- c. *Never return unused reagents to the stock bottles.*
- d. *Stored chemicals should be periodically inspected for deterioration and container integrity*
- e. *Secondary containers, at a minimum must be labeled as to name and the type of hazard (physical or chemical). A chemical hazard requires identification of the target organ/s affected. Examples of the description of a physical hazard include (compressed gas, flammable liquid, water reactive, etc).*
- f. *Chemical storage rooms must be adequately ventilated.*
- g. *Chemicals requiring refrigeration should be sealed, double packaged when possible, and labeled with the name of the material, date placed in the refrigerator, and the name of the person who stored the material*
- h. *Storage rooms wherever warranted should have two exits.*
- i. *Chemicals must be stored by compatibility. (See Appendix D)*

3.5.2 Segregation of Chemicals. *To assure that minimal harm to people and the environment will result from the storage of chemicals in the laboratory, a deliberate and conscious effort must be made to separate chemicals that are incompatible. A basic rule of thumb is to separate chemicals into organic and inorganic families and then into related and compatible groups.*

Additional requirements are as follows:

- a. *Segregate highly toxic and carcinogenic chemicals from less toxic chemicals*
- b. *Separate acids and bases*
- c. *Separate nitric acid and sulphuric acid*

Note: *Refer to Appendix D for a list of incompatible chemicals.*

3.5.3 Chemical Transport.

- a. *Use secondary containment whenever hand transporting chemicals*
- b. *Use safety cans when transporting flammable liquids*

- c. *When transporting chemicals ensure the container used is compatible with the chemical stored within.*
- d. *Ground metal containers or non conductive containers when transporting five or more gallons of flammable liquid.*

3.5.4 Labeling. *All containers received from the manufacturer must be labeled. That includes chemical name, physical and health hazard information, and name and address of the manufacturer. Labels cannot be removed or defaced from the original container unless the contents have been altered or removed.*

Secondary containers that will remain in use for a period of time (storage vials, squirt bottles) should bear an abbreviated label that includes chemical name and hazard warning such as flammable, caustic, sensitizer, carcinogen, absorbed through the skin, etc. The self adhesive plastic labels with the NFPA warning diamond are the preferred label in SCE for these secondary containers.

3.5.5 Controlled Substances. *Whenever and wherever controlled substances are used, they must be secured in accordance with the Texas Legislature Chapter 481 Texas Controlled Substances Act which includes the following criteria:*

- a. *Establishing adequate security to prevent unauthorized access to controlled substances and dangerous drugs. This includes a preliminary security inspection. The SCE Safety Committee will coordinate with Environmental Health and other UHCL authorities in this endeavor.*
- b. *Not allowing any individual access to controlled substances and dangerous drugs storage areas except those authorized for efficient operations during the course of business activities.*
- c. *Storing controlled substances and dangerous drugs listed in schedules I, II, III, IV, and V in the securely-locked substantially-constructed cabinets or security cabinets or safes.*

3.5.6 Outdated Chemicals. *Out-dated expired, unknown chemicals should be promptly disposed of by the appropriate means. Many materials, as they age, become unstable, possibly forming explosive by-products or undergoing rapid and violent decompositions. Other materials simply lose purity as contaminants are introduced or residues form. Chemicals that may no longer be used, that are of questionable purity, or that their expiration dates have been passed should be removed from the lab.*

3.6 Waste Management and Disposal.

Effective hazardous waste management is a comprehensive cradle to grave process. It is an integrated effort which involves the collection, segregation, storing, shipping of wastes, and training and is governed by the Resource Conservation and Recovery Act of 1976 (RCRA).

UHCL is classified as a Small Quantity Generator under the provisions of RCRA with the overall responsibility of waste management resting with the Environmental Health and Safety Department. SCE will ensure that its actions and procedures are consistent with EHSD's goal of minimizing harm to the staff, students, visitors, and the environment. SCE's waste management and disposal efforts will involve segregation, storing, and shipping of waste and include both non hazardous and hazardous chemicals.

3.6.1 Non Hazardous Waste Disposal. *Non-hazardous waste disposal involves the disposal of uncontaminated broken and unbroken glassware, chemicals involved in routine titrations or and experiments/tests tests that do not involve hazardous chemicals, and laboratory debris, i.e. tissues, paper towels, disposable gloves involved in routine non-hazardous laboratory experiments.*

- a. *Broken glass is to be placed in a labeled container and accumulated for disposal. Broken glass in proper containment packaging is disposed of in dumpsters which ultimately goes to a Class II landfill.*
- b. *Laboratory debris such as paper towels, tissues, disposable gloves involved in laboratory experiments not involving chemicals identified as hazardous is disposed of as ordinary rubbish and disposed of in a Class II landfill.*
- c. *Autoclaved wastes from biology laboratories and the Health Center may be disposed of as non-hazardous waste. Please see 3.6.2d3 and 3.6.2d4 below.*
- d. *Intact empty chemical containers not containing acutely hazardous chemicals may be labeled as empty and disposed of in a Class II landfill*
- e. *Treated liquid wastes is considered non-hazardous and can be disposed of through the sanitary sewer.*
- f. *Chemicals found to be non-hazardous are permissible for sanitary sewer disposal. These chemicals usually involve chemicals where titrations were performed or where tests or experiments with non-hazardous chemicals as defined by 40CFR Part 261 Section 3 were performed.*

3.6.2 Hazardous Waste Disposal. 40 CFR, Parts 261-262 governs hazardous chemical disposal.

- a. Storage. Storage rooms are located in the Bayou Building, Room 3520. Room 3520 AA is designated for solvent storage and 3520 AB is designated for dry storage. The following rules must be adhered to:
1. These storage rooms must be adequately ventilated so as to eliminate the accumulation of pockets of undisturbed air.
 2. Containers must be closed at all times except when waste is being added
 3. Containers must be compatible with contents
 4. Properly identified with appropriate waste tags
 5. Inventory sheets must be available for each container
 6. Label waste containers with the word "Waste" and properly identify with the appropriate waste tag.
 7. Accumulation start dates should be marked on the container
- b. Segregation. Hazardous chemicals are to be placed in accumulation drums marked with the EPA Hazardous Waste label which indicates the type of waste in the accumulation drum. The inventory sheet for the appropriate container is completed with the following information: type of waste, amount, and date.
- See Appendix D for chemicals and their corresponding incompatible chemicals.
- c. Transport.
- 1 Use secondary containment whenever hand transporting chemicals
 2. Use safety cans when transporting flammable liquids
 3. When transporting chemicals ensure the container used is compatible with the chemical stored within.
 4. **NOTE:** In the event five or more gallons of a flammable liquid are to be transported, metal containers or non-conductive containers must be grounded.

d. Disposal.

1. Chemical Wastes. Full containers of hazardous chemicals are to be sealed and arrangements for disposal for a licensed waste handler
 - a. For Intact, empty chemical containers (affix an "Empty" label to the bottle, then dispose of as trash)
 - b. Empty chemical containers that held acutely hazardous chemicals should be considered a hazardous chemical waste and disposed of as such
 - c. Pasteur pipettes and glassware contaminated with potentially infectious materials should be disposed of in sharps containers
 - d. Discarded unbroken useable glassware cannot be resold as recycled glassware. It must be rendered unusable and disposed as in a Class II landfill.
 - e. Procedures for disposing outdated chemicals that become unstable upon expiration, should be evaluated for proper procedure for disposal.
2. Radioactive wastes. These wastes include radioactive liquids and solids, scintillation vials and plates, disposable gloves, plastic ware, and contaminated wipes.

These wastes are to be transferred periodically by a waste disposal contractor licensed to receive and dispose of radioactive wastes. A more exhaustive discussion on storage, handling and disposal can be found in the UHCL Radiation Safety Manual, pages 17-27.
3. Untreated Biohazard Wastes. These wastes include wastes from biological laboratories and from the UHCL Health Center. These wastes are comprised of:
 - a. Human blood, serum, plasma, blood components, bandages containing body fluids.
 1. Items contaminated with these constituents can be incinerated, sterilized, or chemically treated and rendered biologically inert. They

can then be disposed of as MUNICIPAL WASTE in a Class II landfill.

2. The biohazard bag containing the inert material shall be placed in an unmarked bag before disposing it as MUNICIPAL WASTE.

b. Items such as disposable scalpels, broken capillary tubes and broken glass contaminated with human blood or body fluids, hypodermic syringes with attached needles; glass pipettes and broken glassware contaminated with potentially infectious material. Needles, syringes, scalpel blades, blood drawing tubes.

1. These items are to be collected in a "SHARPS" container or other puncture resistant container that is color coded or labeled with the universal biohazard symbol.

2. These items are steam sterilized and rendered biologically inert and disposed of as MUNICIPAL WASTE.

4. Treated Biohazard Wastes. These wastes are Biohazard Wastes that have been treated and rendered biologically inert through incineration, steam sterilization, or through chemical disinfection as discussed in 3.6.2d3 above.

They are placed in an unmarked bag before disposing as a municipal landfill.

3.6.3 Contingency Planning and Emergency Response. The Resource Conservation and Recovery Act (RCRA) requires generators of hazardous waste to have measures and contingency plans in place for responding to emergencies. UHCL is classified as a Conditionally Exempt Small Quantity Generator. The emergency response and contingency plan requires at least one employee with the responsibility for coordinating emergency response measures. This employee is referred to as the emergency response coordinator. That responsibility rests with the UHCL Environmental Health Officer.

Within SCE, the responsibility of emergency response rests with the Laboratory Supervisor. The Laboratory supervisor collaborates with the Environmental Health and Safety Officer and the SCE Chemical Hygiene Officer in addressing these issues.

General concerns to be addressed are accidents, small spills, releases and subsequent clean up.

- a. *Small Spills and Releases involving:*
 1. *Eye Contact: Flush eyes with tepid water for a minimum of 15 minutes at the eyewash station. Care should be taken to lift the eyelid occasionally. Seek immediate medical attention at the campus clinic.*
 2. *Skin contact: Promptly flush contaminated skin with tepid water for a minimum of 15 minutes using the safety shower. Remove "contaminated clothing". Seek immediate medical attention at the campus clinic.*
 3. *Vapors: Procedures where vapors are of concern will be routinely conducted in a laboratory exhaust hood. Upon occurrences where vapors and fumes are inadvertently released, efforts should be made to contain the vapor inside hood and exhausted to the exterior of the building.*

- b. *Large Spills and Releases: require immediate notification to the EHSD, Chemical Safety Officer, Campus Police and the Student Clinic. The following general rules should be followed immediately in the event of a large spill:*
 1. *Activate the alarm/Notify occupants*
 2. *Immediately contact:*
 - a. *Police Department 281-283-2222*
 - b. *EHSD- 281-283-2106*
 - c. *Chemical Safety Officer*
 - d. *Health Clinic Nurse- 281-283-2626*
 - e. *Plant Ops and Custodial Staff-281-283-2239*

- c. *Cleanup. As soon as practicable, begin cleanup using appropriate gloves, protective eyewear, apron/coveralls/boots and respirator if needed. If there are any questions regarding proper response, confer with Chemical Safety Officer.*

- d. *Dispose of spill debris as hazardous waste.*

NOTE: Adjustments in protocols should be made to correct any problems encountered as appropriate.

3.7 Special Handling of Chemicals.

The Laboratory Standard requires that provisions for additional protection for work with select carcinogens, reproductive toxins and substances with a high degree of active toxicity. The Principal Investigator shall confer with the SCE, Chemical Safety Officer and jointly collaborate with the UHCL Environmental Health and Safety Department to develop supplemental safety rules and procedures that are to be followed when using these types of chemicals..

Procedures for work shall adequately address at a minimum the following:

- a. Restricted access area for storage
- b. Protective clothing requirements
- c. Controlled area for use. i.e. laboratory hoods, glove boxes
- d. Waste disposal
- e. Spill contingencies
- f. Decontamination of equipment and personnel
- g. Medical monitoring

NOTE. Prior approval must be sought from and provided by the SCE Safety Committee prior to proceeding with the laboratory investigation and purchase of materials for any of the below classification of chemicals.

3.7.1 Chemicals of Moderate Chronic or High Acute Toxicity.

- a. Minimize exposure to toxic substances by any route using all reasonable precautions and appropriate PPE
- b. Use and store these items in areas with restricted access.
- c. Use special warning signs to alert users of the hazards and safe handling procedures.
- d. Use these types of chemicals in hoods that have been evaluated to confirm adequacy of performance. Trap released vapors to prevent their discharge into the hood exhaust.

- e. *Maintain records of the amounts of materials on hand, amounts used, and the names of individuals working with these chemicals.*
- f. *Prepare the work area for accidents and spills prior to chemical handling.*
- g. *Ensure two people are present at all times when working with these chemicals.*
- h. *Cover the work area with containment devices such as plastic sheeting and absorbent.*
- i. *Prepare a waste disposal receptacle for waste chemicals and containment materials.*
- j. *In case of a major spill outside of the hood, evacuate the area. Cleanup personnel must wear suitable protective equipment.*

3.7.2 Chemicals with High Chronic Toxicity.

- a. *Restrict all transfers and work with these substances to a controlled area such as a restricted access hood, glove box or a selected portion of the laboratory that was designated for use of highly toxic substances.*
- b. *Prepare a plan for the use, disposal and decontamination of equipment prior to the introduction of these chemicals into the area. The Chemical Safety Officer and the SCE Safety Committee must approve the plan.*
- c. *Decontaminate the work area after use.*
- d. *Remove PPE and dispose of in labeled designated containers.*
- e. *Wash hands, forearms, face, and neck after PPE removal.*
- f. *Laboratory personnel decontaminate area prior to allowing housekeeping staff access to conduct routine cleaning.*
- g. *Consult a physician concerning desirability of medical monitoring. Initiate as appropriate.*
- h. *Maintain records of the amounts of the amounts on hand, amounts used and names of personnel working with these materials.*
- i. *Prepare the work area prior to chemical handling.*

- j. *Ensure two people are present at all times when working with highly toxic materials.*
- k. *Cover the work area with containment devices, i.e., plastic sheeting and absorbent.*
- l. *Prepare a waste disposal receptacle for the waste chemicals and containment material. Consult with the Chemical Safety Officer for appropriate guidance on disposal.*
- m. *Should a major spill occur outside of hood, evacuate the area. Assure that cleanup personnel wear suitable protective equipment.*

3.7.3 Carcinogens. *When carcinogens are used in a laboratory, access to the laboratory will be strictly restricted to personnel trained in safe handling of highly toxic material. Appendices G and H are lists of Human Carcinogens and Suspected Human Carcinogens.*

- a. *Access and use shall be controlled and monitored.*
- b. *Maintain records of the amounts of the amounts on hand, amounts used and names of personnel working with these materials.*
- c. *Prepare a plan for the use, disposal and decontamination of equipment prior to the introduction of these chemicals into the area. The Chemical Safety Officer and the SCE Safety Committee must approve the plan prior to purchase.*
- d. *The SCE Chemical Safety Officer shall maintain records of the amounts of chemicals on hand, amounts used and names of personnel working with these materials.*

3.7.4 Radionuclides. *Work with radionuclides shall be performed according to the procedures detailed in the UHCL Radiation Safety Manual.*

3.7.5 Nanotechnology. *For novel chemicals and nanoparticles of unknown toxicity the principle of ALARA (As Low as Reasonably Achievable) will be adhered to in an effort to minimize exposure.*

3.8 Exposure Monitoring and Medical Consultation.

3.8.1 Exposure Monitoring. *Exposure monitoring will ordinarily be conducted by the Environmental Health and Safety Department under the following circumstances:*

- a. *Whenever there are exposures to chemicals regulated by a specific*

OSHA Standard that require monitoring, the monitoring will be done according to that standard.

- b. Whenever the facts determined by an exposure assessment causes there to be a reason to believe that exposure levels for a particular hazardous substance exceed the action level or the PEL.*
- c. Whenever there may be evidence of possible chronic exposure to chemicals*
- d. Whenever a risk assessment for highly toxic chemicals listed in 29 CFR 1910 Sub Part Z suggest that monitoring is necessary*

3.8.2 Medical Consultation and Treatment. *Whenever circumstances suggest a reasonable suspicion of exposure a medical consultation is warranted and should be provided.*

- a. The criteria for reasonable suspicion of exposure include:*
 - 1. A hazardous chemical leak or spill or an uncontrolled release*
 - 2. Skin or eye contact with a hazardous chemical*
 - 3. Manifestation of symptoms such as headache, rash, nausea, coughing, tearing, irritation or redness of eyes, irritation of nose or throat, loss of motor dexterity or judgment, etc., and some or all of the symptoms disappear when the person is taken away from the exposure area or breathes fresh air. Upon reentry, the symptoms manifest themselves again.*
 - 4. Two or more persons in the same laboratory work area have similar complaints.*
 - 5. There may have been a failure of any of the equipment, i.e. clamped apparatus, fume hoods.*
- b. Ambulatory Treatment.*
 - 1. Staff Employees. Whenever there is a suspected or actual exposure, these incidents should be treated as Workers' Compensation claims. Follow the appropriate steps required by Texas Department of Insurance, Workers Compensation Division*

2. Students. *Students who may have been exposed will be informed in writing of concerns for exposure and directing them to seek medical consultation with a licensed physician or utilize the services of the student clinic.*
- c. *Emergency Treatment. In an emergency, all staff and students are seen at the student clinic and evaluated for treatment or further disposition.*
- d. *Treatment Information. Whenever a laboratory worker is referred to a medical treatment facility for treatment, the following information should be conveyed to the physician:*
 1. *The identity of the hazardous chemical or chemicals exposed to, usually a copy of the latest MSDS.*
 2. *A summary of exposure conditions.*
 3. *Any signs and symptoms that the lab worker may exhibit.*

3.9 Special Events.

Whenever the occasion arises where an event is scheduled as a demonstration, special presentation, science fair, etc., precautions must be taken to protect all in attendance including the presenters. While each event is unique, at a minimum the following guidelines must be followed:

- a. *Know the properties of the chemicals being used by referring to the Material Safety Data Sheet.*
- b. *Have on hand appropriate eye and face protection when appropriate.*
- c. *Arrange to have at least one fire extinguisher present and available.*
- d. *Provide for a safety shield where there is the remotest possibility for explosion.*
- e. *Identify at least 2 individuals to assist in fire department evacuation duties.*
- f. *Use fire retardant decorations where feasible.*
- g. *Seek assistance from police to keep passageways clear.*
- h. *Use extension cords in accordance with the fire code and tape securely to the floor to reduce tripping hazards.*

- i. Obtain authorization by the SCE Safety Committee prior to sponsoring an event or conducting a demonstration.

3.10 Administrative.

3.10.1 References. Every laboratory using hazardous chemicals, radioactive, or biological hazards must have a copy of the respective Laboratory Safety binder/manual in the lab or otherwise readily available. Safety manuals available shall include at a minimum:

- a. American Chemical Society Publication, *Safety in Academic Chemistry Laboratories*
- b. School of Science and Engineering, *Laboratory Safety Manual*
- c. *Radiation Safety Manual (For Radiation Laboratories Only)*
- d. *Material Safety Data Sheets*
- e. *Material Safety Data Sheets are routinely maintained by the SCE Laboratory Supervisor in the Chemical Safety workstation in Bayou Building 3520 and the Laboratory Supervisors Office along with the Chemical Inventory and the SCE Laboratory Safety Manual.*

3.10.2 Training. A major provision of the 29CFR 1910.1450 is a requirement for staff training. Information regarding the general and specific hazards identified in the workplace must be conveyed to the laboratory staff. All laboratory students and staff must receive training at the time of assignment to the laboratory area that they are assigned where hazardous chemicals are being used and again before assignments where new exposures could occur.

Training should consist of:

- a. *Introduction of the SCE's Chemical Hygiene Plan.*
- b. *Review Standard Operating Procedures.*
- c. *Location and use of Key References outlined in section 3.10.1 above.*
- d. *General laboratory safety rules.*
- e. *Spill response procedures and the location and identification of spill response equipment.*

- f. *The physical and health hazards of Particular Hazardous Substances or unusual hazards being used in the laboratory.*
- g. *Hazardous materials labeling, storage, and signage.*
- h. *Hazardous waste disposal practices.*
- i. *Signs and symptoms of chemicals used in the laboratory.*

3.10.3 Inspections. *Laboratory inspections are useful tools in assisting SCE monitor safety conditions in the laboratory. While the primary function of inspections rests with the Environmental Health and Safety Department staff, inspections shall be routinely conducted to further ensure ongoing safe operations and minimize risk to the laboratory worker and student whenever and wherever possible.*

A check list has been developed to assist in monitoring various functions and activities in the laboratory. See Appendix A.

3.10.4 Recordkeeping.

- a. *Accidents shall be reported to the SCE Chemical Hygiene Officer.*
- b. *Records of accidents, spills, and exposures should be written and retained with copies sent to EHS.*
- c. *Training records should be maintained with copies forwarded to EHS.*
- d. *Inventories and usage of high risk substances should be kept with copies forwarded for inclusion in their files.*
- e. *Medical records should be retained by the institution for 30 years.*

3.11 Inclement Weather. *In the event of Hurricane or other Natural Disaster, The Hurricane and Natural Disaster Procedure should be consulted for guidance and direction.*

4.0 CHEMICAL EXPOSURE CONTROL.

29 CFR 1910.1450 requires that the employer determine and implement control measures to reduce employee exposure to hazardous chemicals.

4.1 Implementation of Control Measures.

Fundamental to implementation of chemical control is the identification and evaluation of the hazard. Knowledge of the chemicals, their routes of entry into the

body, and their toxicological effects serves as the foundation for determining the types of controls needed to maximize exposure control.

Additional factors considered to a lesser degree include:

- a. Quantities of chemicals used.*
- b. Composition of the mixtures which may contain special hazards.*
- c. Previous history of accident or illness.*
- d. Physical and chemical properties of the chemical.*
- e. Exposure control currently utilized.*
- f. Stability of the chemical.*
- g. Available toxicological and health data.*

Formulation of the types of chemical exposure control requires the examination of any of the aforementioned factors in the context of the route of entry and the chemical as well as toxicological effects. Therefore, the fundamental criteria that will be used to determine and implement control measures will be the hazard evaluation which at a minimum will include identification of the chemical, route of entry, toxicological effect on the target organ, and the potential for exposure.

*Other factors will include items **a** through **g** above as appropriately determined during the evaluation and analysis by the SCE Chemical Safety Officer in collaboration with the UHCL Environmental Health and Safety Officer and faculty.*

4.2 Control of Extremely Hazardous Chemicals.

Special handling will be determined by and analysis of the chemical as stated above and based on the results of that analysis recommendations would include:

- a. Application of a written standard operating procedure.*
- b. Establishment of designated handling areas.*
- c. Posting of warning signs.*
- d. Exposure monitoring.*
- e. Use of laboratory fume hoods.*
- f. Use of respiratory protective equipment.*

- g. *Special hygiene requirements.*
- h. *Use of protective clothing.*
- j. *Use of decontamination procedures.*
- k. *Procedures for removal of contaminated material.*

5.0 LABORATORY SURVEILLANCE.

The Environmental Health and Safety Department has the primary responsibility of conducting safety audits and performing hazard assessments of laboratory operations at UHCL. SCE will take a proactive approach to safety by conducting periodic “walk-through” surveys to ensure laboratory safety practices remain consistent with safety objectives and that an acceptable level of safety is consistently maintained. Paragraph 3.0 above outlines the criteria in which the laboratory safety surveys may be conducted by the SCE staff.

6.0 LABORATORY HOODS.

The Laboratory Standard requires that fume hoods and other protective equipment are functioning properly and specific measures be taken to ensure proper and adequate performance of such equipment. The Environmental Health and Safety Department and Plant Operations has the responsibility of ensuring adequate performance of Laboratory Fume Hoods is maintained at all times.

The Environmental Health and Safety Department should test the air flow in these hoods at least annually. In cases where highly toxic or hazardous materials are used, testing should be performed more frequently to ensure adequate operation at all times.

When the measured air flow does not meet the recommended standards, the Plant Operations staff is notified and steps are taken to repair the hoods.

6.1 Laboratory Fume Hoods.

Within the SCE, the Laboratory Supervisor/Principal Investigator will inspect the laboratory fume hoods periodically to determine if these hoods are operating within recommended standards. This is done by noting and documenting the flow rates displayed on the monitoring devices located at the front of the laboratory fume hood. Should the flow rates be greater or lower than the 60-120 lpm range, the Environmental Health and Safety Department will be notified and requested to further assess the issue.

Where there are older hoods that do not have electronic monitoring devices, a qualitative test may be used to determine if flow exists in the hood. This may be accomplished by taping a Kim-wipe to the edge of the face of the hood within the recommended sash height and note the movement when the hood exhaust fan is turned on. Where there is an indication of little or no flow, the Environmental Health and Safety Department will be notified and further assessment be requested.

6.2 Biological Safety Cabinets.

Biological safety cabinets should be certified when installed or moved, and annually thereafter. The biosafety cabinet's (BSC) ability to filter out microscopic particles relies on the seals being intact and the HEPA filter free of micro tears or breaks that can easily occur during moving, installation or careless handling. To ensure continued proper operation, each BSC should be tested and certified at least annually

7.0 HAZARDOUS CHEMICAL ACQUISITION AND USE.

The Laboratory Standard requires that the circumstances by which a laboratory operation or procedure need prior approval must be determined and established. The SCE Chemical Safety Committee in consultation with the environmental Health and Safety Department is responsible for determining under what circumstances a laboratory operation or procedure will require prior approval.

The principal investigator/laboratory supervisor is responsible for seeking and obtaining approval.

8.0 MEDICAL CONSULTATION.

There may be times when the SCE Staff may suspect that a student or staff has been exposed to a hazardous chemical to such a degree and in such a manner that might have caused harm to the victim. Whenever circumstances suggest a reasonable suspicion of exposure, a medical consultation is warranted and should be provided.

The SCE Chemical Safety Officer will investigate or cause to have investigated the circumstances surrounding the possible exposure, and report findings to the Safety Committee, keeping in mind that the purpose of the exposure assessment is fact finding only.

Criteria for reasonable suspicion of exposure include:

- a. *A hazardous chemical leak or spill or an uncontrolled rapid release*
- b. *Skin or eye contact with a hazardous chemical*
- c. *Manifestation of symptoms such as headache, rash, nausea, coughing, tearing, irritation or redness of eyes, irritation of nose or throat, loss of motor dexterity or judgment, etc., and some or all of the symptoms disappear when the person is taken away from the exposure area or breathes fresh air. Upon reentry into the area, the symptoms manifest themselves again.*
- d. *Two or more persons in the same laboratory work area have similar complaints.*

9.0 WORK WITH PARTICULARLY HAZARDOUS SUBSTANCES.

The laboratory standard requires provisions in the Chemical Hygiene Plan to include procedures for addressing personal protection for those employees working with particularly hazardous substances. The Chemical Safety Committee along with the

Chemical Safety Officer should be consulted and approval sought from the Committee before work with these substances is initiated. A minimum set of guidelines that should be followed once approval has been granted include:

- a. Quantities of these chemicals should be minimized as should their concentrations in solutions or mixtures*
- b. Work with acutely toxic chemicals should be performed within a functioning laboratory fume hood, ventilated glove box, sealed system or other system designed to minimize exposure*
- c. Compressed gas cylinder containing toxic gases should be stored in ventilated areas*
- d. The ventilation efficiency of the laboratory fume hood, ventilated glove box, or other sealed system should be monitored more frequently than the standard annual evaluation. The Chemical Safety Committee will consult with the EHS Department and determine the frequency depending upon frequency of use, amount of usage and the hazard level of the chemical*
- e. Each laboratory utilizing highly hazardous substances must designate an area for this purpose and mark the area with “**DANGER**”, followed by identification of the specific agent, “**AUTHORIZED PERSONNEL ONLY**”.*
- f. All laboratory workers who work in these types of labs will be given training regarding the deleterious effects of the chemicals as well as the signs and symptoms regarding exposure. No exceptions, whether they work with the chemicals or not. Training will be the responsibility of the Laboratory Supervisor and/or the Principal Investigator in consultation with the Chemical Safety Officer*
- g. Appropriate personal protective equipment will be provided at no expense to the laboratory worker*
- h. All wastes contaminated with highly hazardous substances should be collected and disposed of in a timely manner. The SCE Safety Officer and the Environmental Health and Safety Officer shall be consulted in determining the adequacy of the existing procedures and if inadequate, how best to achieve proper disposal*
- i. The designated working area shall be thoroughly and appropriately decontaminated and cleaned at regular intervals. Personnel performing the cleaning shall have received appropriate training prior to initiating decontaminating steps and should be documented*
- j. Special precautions shall be undertaken to prevent an unplanned release. The Chemical Safety Officer and the Environmental Health and Safety Officer should be consulted on how to best accomplish this*

- k. *Emergency response planning for releases shall be prepared by the Laboratory Supervisor in consultation with the SCE, Chemical Safety Officer and the Environmental Health and Safety Officer*

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3. Code of Federal Regulations. Title 29, Part 1910.126 Storing and Handling of Hazardous Materials. US Department of Labor
4. Code of Federal Regulations. Title 29, Part 1910.132 through 139. Personal Protective Equipment. (Eye, Head, Hand, Respiratory Protection). US Department of Labor
5. Code of Federal Regulations. Title 29, Part 1910.151. Medical Services and First Aid, (Emergency Eyewashes and Showers). US Department of Labor
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University of Houston-Clear Lake, Houston, TX
17. Safety in Academic Chemistry Laboratories. American Chemical Society,
Washington, D. C. 2007

APPENDICES

- A Laboratory Safety and Storage Inspection Form
- B Laboratory Hood Inspection Form
- C Chemical Incompatibles List
- D Container Compatibility Chart
- E Prior Approval Request Format
- F Chemicals Known as Human Carcinogens Non Hazardous Chemicals List
- G Chemicals Anticipated to be Human Carcinogens
- H Recommended Components of a Laboratory Spill Kit
- I NS Laboratory Responsible Persons
- J Laboratory Waste Handling Procedures
- K UHCL Laboratory Standard Operating Procedures
- L List of Non Hazardous Chemicals
- M EPA List of Acutely Hazardous Chemicals
- N EPA "U" List

WEB LINKS

American National Standards Institute	www.ansi.org
Compressed Gas Association	www.cganet.com
Environmental Protection Agency	www.epa.gov
Compressed Gas Association	www.cgnet.org
Occupational Safety and Health Administration	www.osha.gov
National Academy Press	www.nap.edu
American Chemical Society	www.acs.org