Shared Analytical Services Laboratory

Chemical Hygiene Plan

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ENDORSEMENTS

The chemical hygiene plan outlined in this document has been reviewed and approved for use in the Shared Analytical Services Laboratory.

_____	_____
Dr. Larry G. Anderson	Date
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Dr. Timberly Roane	Date
_____	_____
Dr. Dave Albeck	Date

Supervisory Committee
The Shared Analytical Services Laboratory

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A Message From the Laboratory Manager

To the students, faculty, and staff using the Shared Analytical Services Laboratory

Each of you is important and integral to the success of the Laboratory. I, and the rest of the SASL staff, are concerned for your health and welfare, and it is the intent of the Administrators of the SASL and the University to assure that, everyday, you leave this work place in at, least as good health as when you arrived.

It is possible to safely work with all of the hazardous materials found in the analytical laboratory. Our Chemical Hygiene Plan and associated training program will provide you with the information you need to work in the analytical laboratory safely and effectively. The employees of the SASL, along with the research advisors and instructors, will provide you with the training and guidance necessary to ensure your safety in the laboratory.

Jeffery A. Boon
Laboratory Manager
Shared Analytical Services Laboratory

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1 Introduction and Overview -

The ultimate objective of this manual is to ensure the safe operation of the Shared Analytical Services Laboratory (SASL). In order to meet this objective, this manual has been prepared to meet part of the requirements put forth by the Occupational Safety and Health Administration (OSHA) in 29 CFR 1910.

The principal mission of the SASL is to support the educational and research efforts of the students and faculty of the College of Liberal Arts and Sciences, and the University community in general. This support can be broken down into a series of services that the laboratory provides. First, the lab assists graduate students, enrolled in the Biology, Chemistry, Psychology, Anthropology, and MSES programs, with the laboratory portion of their research projects. Second, the lab provides support for the teaching of two undergraduate laboratories, by the chemistry department, each year. Third, the lab provides analytical support for the research efforts of the faculty members from a variety of disciplines, and departments at the University. Finally, the lab initiates, executes, and reports on independent research efforts.

The multi-disciplinary nature of the Shared Analytical Services Laboratory brings together a group of people having a broad range of laboratory experience. Some of the undergraduate and graduate students have little, if any, experience in a chemistry research laboratory. Besides the safety concerns that are inherent in the day to day operation of a chemistry lab, this diversity in the levels of experience is another potential source of safety problems. Finally, the SASL is primarily an instrumental laboratory, with its own associated safety concerns. Taken together, these safety considerations require a comprehensive and well documented safety plan.

The SASL is a small enough organization that it is not practical to create separate chemical safety, hygiene, hazard communication, and waste disposal plans, along with the accompanying committees necessitated by each of these plans. As a result, this plan, and the one set of administrative personnel, will cover all of these aspects.

This manual begins by detailing the organization and management of the laboratory. The responsibilities of the people who either use, or administer the use of the laboratory, will be detailed. The manual then outlines the procedures to be followed in the event of an emergency or an accident. The equipment and procedures required of all personnel will be followed by the safety equipment required of the laboratory and the institution. The manual then steps through the storage and handling of chemicals. Finally the manual details the hazard communications standards, and the training and record keeping procedures for the laboratory.

2 Statement of Responsibilities

The successful implementation of a Chemical Hygiene Plan involves both the management personnel and the users of the Analytical Laboratory. It is important everyone understand the responsibilities of the parties involved.

2.1 Responsibilities of the Shared Analytical Services Laboratory

The Shared Analytical Services Laboratory (also referred to as the Laboratory or the SASL) strives to provide a safe work and educational environment in many ways. Our students and employees are trained for their jobs. Hazards are eliminated or identified. Laboratory glassware and equipment are maintained and handled correctly.

This Chemical Hygiene Plan has been developed to further enhance the safety of the people who work in, and use the Laboratory. The policies of the Shared Analytical Services Laboratory work procedures, chemical procurement, maintenance, medical surveillance, accident response, and other vital health and safety issues are given in this document. The Chemical Hygiene Plan is available to all of the faculty, staff, and students who use the analytical laboratory (also referred to as the users of the laboratory), so they can become familiar with these policies.

- It is the responsibility of the Center for Environmental Sciences to:
- Ensure that all of the necessary facilities for the safe operation of the lab are present and properly maintained
- Properly store and maintain all equipment and supplies
- Properly train the users of the laboratory
- Ensure that the Chemical Hygiene Plan is upto date with regards to all of the current federal, state and local regulations
- Promptly respond to any concerns the users of the laboratory may have
- Correct any situations which either have, or have the potential to, cause an accident
- Maintain hazard information on the materials used and stored in the laboratory
- Maintain updated inventories of the materials used and stored in the laboratory

In summary, it is the responsibility of the Shared Analytical Services Laboratory to provide a safe working environment, and to ensure that all of the users of the Laboratory are either properly trained and/or supervised.

2.1 Responsibilities of the Users of the Analytical Laboratory:

The Shared Analytical Services Laboratory wants to provide the safest work environment possible. Ultimately, however:

YOU ARE RESPONSIBLE FOR YOUR OWN SAFETY! ! !

Accepting this responsibility means you will read, understand, and comply with the SASL safety policies. Everyone is expected to:

- Minimize all chemical exposures
- Avoid unsafe practices
- Report unsafe conditions
- Be familiar with the information on the MSDSs for the chemicals used
- Label chemicals appropriately
- Be familiar with they kinds of hazards in their work area
- Learn what precautions and protective equipment are needed for specific procedures
- Practice good chemical hygiene
- Take responsibility for themselves and coworkers

In summary, the users of the Laboratory should be familiar with all of the procedures, techniques, policies and equipment provided to help them work safely.

3 Organization of Responsibility

The safety of everyone in the laboratory is important to not only the administration of the Shared Analytical Services Laboratory, but also the University of Colorado Denver. The users of the laboratory are encouraged to bring their concerns to their supervisor or any member of the SASL Advisory Committee.

Implementation of the Chemical Hygiene Program is the responsibility of all management personnel. The titles and associated responsibilities of those directly in charge are given below. The organizational chart for the Center for Environmental Sciences for the Chemical Hygiene Program is shown in Figure 1.

3.1 Advisory Committee: The roll of managing safety in the laboratory can not fall to anyone individual. With time anyone person will either miss or simply overlook matters concerning safety. To prevent this, it is necessary to have a committee of people who have oversight of the Chemical Hygiene Program.

This responsibility falls on the Supervisory Committee. The committee will be made up of three faculty members from the College of Liberal Arts and Sciences. One of the members should be a chemist, and the other two should be from the other disciplines making use of the Laboratory. This will bring a range of backgrounds and viewpoints into the positions. Membership of the Supervisory Committee should change periodically.

It is the responsibility of the Supervisory Committee to:

- Ensuring that the chemical hygiene plan is complete and that it is up to date
- Periodically inspect the laboratory to ensure compliance with the chemical hygiene plan
- Oversee the investigation of any accident occurring in the analytical laboratory

The committee and the Laboratory Manager have a precarious relationship. On one hand they need to work together to ensure the safe operation of the lab, but on the other hand the Supervisory Committee must act as an auditor, ensuring the Laboratory Manager is effectively performing his or her duties.

3.2 Laboratory Manager: The Laboratory Manager is responsible for the day to day safety in the lab. The Laboratory Manager must work with administrators and other employees and implement the policies and practices of the SASL. The duties of the Laboratory Manager include:

- Monitoring procurement, use, and disposal of chemicals
- Supervising audits of MSDSs and chemical lists
- Guiding the development of precautionary procedures and assure adequate facilities are available for the kind of chemicals handled
- Know the legal requirements concerning regulated substances
- Revise, review and improve the Chemical Hygiene Program
- Ensuring that the users of the lab are familiar with their responsibilities under the Chemical Hygiene Plan
- Performing periodic inspections of the safety equipment in the laboratory
- Maintaining the documentation required by the Chemical Hygiene Program

In the event of an accident, the Laboratory Manager will:

- Gather whatever information the Chemical Hygiene or Advisory committees may need to perform their functions
- Perform the investigation (overseen by the Chemical Hygiene Committee) of the accident
- Ensure the implementation of any corrective actions deemed to be necessary
- Correct any discrepancies found by the Chemical Hygiene Committee during their inspections.

3.3 Advisors / Research Assistants: The faculty member performing any research in the Laboratory is termed the Research Advisor. The Post-Doctoral or student working for the faculty member is referred to as the Research Assistant. One of the principal responsibilities of a Research Advisor, is to teach the Research Assistant the real world intricacies of working in a chemical laboratory. Because of this, the Research Advisor is responsible for supervising the activities of the research assistant, and is directly responsible for the behavior and safety of the Research Assistant. The Advisor is accountable to the management of the SASL for all safety issues concerning their Research Assistants.

The Research Advisor's responsibilities are to:

- Ensure the research assistant understands and follows the Chemical Hygiene Plan
- Ensure that the assistant knows the proper safety procedures of the lab
- Train the research assistant in both the procedures and use of the equipment being used
- Determine the necessary levels of personal protective equipment
- Ensure that facilities are adequate

The Research Advisor will fill out the safety sheet with the student. The advisor will keep a copy of the form, and the original will be turned into the Laboratory Manager. The original will be kept on file in the SASL.

3.4 Instructor / Teaching Assistant / Students: The relationship between the Instructor, the Teaching Assistant, and the students is similar to that outlined for the Research Advisor and the Research Assistant. Ultimately, the Instructor is responsible for the actions and safety of not only the Teaching Assistant, but also the students enrolled in the laboratory. It is the responsibility of the Instructor to:

- Make sure that the Teaching Assistant is not only familiar with the safety procedure of the laboratory, but is also able to teach the safety procedures to the students
- Make sure that the Teaching Assistant is familiar with all of the potential hazards associated with each of the experiments in the lab
- Ensure the Teaching Assistant understands and follows the Chemical Hygiene Plan
- Ensure that the Teaching Assistant knows the proper safety procedures of the lab
- Train the Teaching Assistant in both the procedures and use of the equipment being used
- Determine the necessary levels of personal protective equipment
- Ensure that facilities are adequate

The Teaching Assistant is the most visible person of authority during the operation of the teaching laboratory. While the other people in the chain are responsible for overseeing the Teaching Assistant, the Teaching Assistant is the person who will be in the lab should an accident occur. It is necessary that the Teaching Assistant be completely familiar and comfortable with the safety procedures of the laboratory.

The responsibilities of the Teaching Assistant include:

- Ensuring that the students are properly trained on the use of the safety equipment, and the emergency response procedures
- Ensuring that proper safety procedures are followed during each laboratory period
- Being familiar with the potential hazards involved with each of the experiments to be performed

Before the beginning of the semester, the Instructor will ensure the Teaching Assistant is aware and understands all of the pertinent information in the Chemical Hygiene Plan. At the end of this session, the Instructor and the Teaching Assistant will fill out a Laboratory Introduction Form. The Instructor will keep a copy of this form, and the original will be turned in to the Laboratory Manager, who will keep it on file.

During the first session of a class, the Teaching Assistant will go through the safety regulations with his or her students. The Teaching Assistant will collect the signed students Introduction Forms. The Teaching Assistant will keep a copy of these forms in a readily accessible location, and the originals will be turned into the Laboratory Manager, who will keep the forms on file.

3.6 Researcher: The independent Researcher is responsible for ensuring the safety of his or her research efforts. The safety review process will aid in the safety of the procedure.

It is the responsibility of the Researcher to:

- Know and understand the contents of the Chemical Hygiene Plan
- Understand the location and use of all of the safety equipment
- Understand the properties and hazards of any procedure performed
- Determine the necessary levels of personal protective equipment
- Ensure that facilities are adequate for the procedure to be performed

The Researcher will be required to fill out a laboratory introduction form which theLaboratory Manager will keep on file.

2.3 Scope and Application: This Chemical Hygiene Plan applies to the **"laboratory use"** of hazardous chemicals in the Analytical Laboratory. According to the OSHA definition, “laboratory use” of hazardous chemicals means handling or use of chemicals in which all of the following conditions are met:

- the handling or use of chemicals occurs on a "laboratory scale"; that is, the work involves containers which can easily and safely be manipulated by one person.
- multiple chemical procedures or chemical substances are used.
- the procedures involved are not part of a production process, nor in any way simulate a production process.
- “protective laboratory practices and equipment” (e.g., fume hoods) are available and in common use to minimize the potential for employee exposures to hazardous chemicals.

At a minimum, this definition covers faculty, students, and employees who use chemicals in the Shared Analytical Services Laboratory.

2.4 Coordination With Other Standards and Guidelines: Although the requirements put forth by the Occupational Safety and Health Administration (OSHA) in 29 CFR 1910 deals only with use of hazardous chemicals, users of the Shared Analytical Services Laboratory may also encounter potential physical, biological or radioactive hazards in the laboratory. In the event that there is a conflict between provisions of various standards, the Laboratory Manager should be contacted to assist in resolving the discrepancy.

3 Information and Training

3.1 Information: It is essential that laboratory employees have access to information on the hazards of chemicals and procedures for working safely. Supervisors must ensure that laboratory employees are informed about and have access to the following information sources:

- The contents of the OSHA lab standard, Occupational Exposure to Hazardous Chemicals in Laboratories, and its appendices (29 CFR 1910.1450).
- The Analytical Laboratory Chemical Hygiene Plan (this document) and Standard Operating Procedures (SOPs).
- The Permissible Exposure Limits (PEL) for OSHA regulated substances.
- Material safety data sheets (MSDS) for any of the chemicals or materials used in the laboratory. Researchers receiving MSDSs directly must give a copy to the Laboratory Manager who will then file the copy.
- A copy of *Prudent Practices in the Laboratory: Storage and Disposal of Hazardous Chemicals*.

All of this information is available at the front (3208) entrance to the lab, and in the office of the Laboratory Manager.

Contact the Laboratory Manager if you have any questions.

3.2 Training: Each Laboratory Supervisor is responsible for ensuring that laboratory employees attend training sessions about the hazards of chemicals present in their laboratory work area, and methods to control exposure to such chemicals. Each employee shall receive training at the time of initial assignment to the laboratory, prior to assignments involving new chemical hazards, and at regular intervals.

3.2.1 Availability: Training is available in the form of:

- Literature describing proper lab practices.
- A video library.
- Group and individual training conducted by lab personnel.

3.2.2 Content: Employee training programs will include, at a minimum, the following subjects:

- Methods of detecting the presence of hazardous chemicals (observation, signage and labeling, odor, real-time monitoring, air sampling, etc.).
- Symptoms of exposures to hazardous chemicals.
- Good laboratory practices, including general techniques designed to reduce personal exposure and to control physical hazards, as well as specific protective mechanisms and warning systems used in individual laboratories.
- The Emergency Plan response actions appropriate to individual laboratories.
- Applicable details of the Chemical Hygiene Plan, including general and laboratory-specific Standard Operating Procedures.
- The waste disposal process.

Appendix D contains a training matrix for laboratory personnel.

3.2.3 Training Records: Training given to users of the Laboratory policies, OSHA safety or other items listed in the training matrix must be recorded and kept on file by the Laboratory Manager. Training may be given by someone other than an SASL employee, such as a contractor, or another entity of the University of Colorado system, upon approval by the Laboratory Manager. The Laboratory Manager must receive a copy of the attendance roster for each training session, along with a copy of the topic(s) covered in the training, for record keeping purposes.

3.2 General References: The book ***Prudent Practices in the Laboratory: Handling and Disposal of***

Chemicals (National Research Council, 1995) contains good laboratory operating procedures that may be applicable for general use in the Environmental Sciences Analytical Laboratory. A copy of this book is available for reference with the Chemical Hygiene Plan at the front of the Laboratory, and in the office of the Laboratory Manager.

3.3 Approval of Laboratory Activities: The administration of the SASL do not wish to inhibit research or the educational process by over-restricting laboratory activities. However, there will be times when laboratory operations, procedures, and activities will require approval from the Advisory Committee. Such instances include:

- Operations involving particularly hazardous materials (i.e. reproductive toxins, select carcinogens compounds with a high degree of acute toxicity, p listed compounds) or compounds with unknown hazard properties.
- Operations which incorporate new equipment, procedures or a modification in the facility design.
- Activities which have lead to chemical releases or personal injuries in the past.

Researchers, instructors, and the Laboratory Manager must keep the Advisory Committee informed of these laboratory activities, as well as the safety precautions used in these operations to protect the health of the users of the analytical laboratory.

A written copy of the proposed procedure, the safety issues involved in the procedure, and the proposed response procedures must be submitted to, and reviewed by, the Laboratory Manager. If necessary, the Laboratory Manager may seek comment from the members of the Advisory Committee. The Laboratory Manager will then work with the researcher to perform the work in a safe manner.

4.1 General Laboratory Safety Principles:

4.1.1 Controlling Chemical Exposure: Each laboratory employee shall follow general practices to minimize personal and coworker exposure to the chemicals in the laboratory. The goal is to avoid employee exposure to chemicals above the OSHA PEL as addressed in Section 3.1

Avoiding Routine Exposures: Before laboratory work begins, an employee needs to be familiar with all potential hazards (physical, chemical, biological) associated with the task. Appropriate precautions should be taken to minimize risks and the proper personal protective equipment should be used when necessary.

There will be no testing of chemicals via smell or taste. Mouth suction for pipetting or starting a siphon is forbidden. Loose hair and clothing should be confined when in the laboratory. Horseplay and other behavior which might confuse, startle, or distract workers, will not be tolerated.

Good hygiene is essential. All areas of potentially exposed skin should be washed before leaving the laboratory. Water and a mild soap is the best choice for skin cleansing. Solvents are not good skin cleansers. They remove the natural protective oils from the skin and can cause irritation and inflammation.

Routes of Exposure When a person handles a potentially hazardous material, he or she must understand how this substance can enter the body. Proper precautions can then be taken to prevent contamination; contamination which can lead to extremely serious health problems. Toxic materials usually enter the body one of three ways: via ingestion, skin absorption or inhalation. These, and other significant exposure routes are described in the following paragraphs.

Ingestion: Most cases of toxic chemical ingestion are explained by poor work habits. smoking, drinking, or eating in the work area leads to ingestion of hazardous materials. Poor lunch room facilities or infrequently cleaned work clothing also contribute to this problem. Chemicals may also be inadvertently ingested after they have been inhaled. For example, materials trapped in the upper airways are often swallowed and contribute to exposure through ingestion. Eating, drinking, smoking and cosmetic application is not allowed in areas where chemicals are handled or stored. Glassware or utensils utilized during laboratory procedures should never be used to prepare or store food and beverages. Food and beverages may not be placed within refrigerators, ice chests, and cold rooms or near other equipment that are employed in laboratory operations. Areas where food and drink are permitted shall be clearly marked. No chemicals, chemical equipment, or personal protective equipment (including lab coats) will be allowed in these areas.

Skin Absorption: Many chemicals cause skin irritation, but most do not penetrate through intact skin to reach the bloodstream. Examples of chemicals readily absorbed through the skin are: organically bound lead (i.e. tetraethyl and tetramethyl lead), all forms of mercury, organic phosphate pesticides, aniline compounds and nitrites, to name a few. Chemical contact with the skin is a common cause of laboratory injuries. Often, the result of such skin contact is nothing more than a localized irritation or reddening of skin. However, a number of materials may be absorbed through the skin in sufficient quantities to be harmful. Should chemical contamination of the skin occur, the affected area must be flushed for at least 15 minutes with water and any contaminated clothing removed. Symptoms of skin contamination include burning, itching, or discoloration. Medical attention must be sought after any chemical exposure or if symptoms of exposure occur.

Inhalation: The most significant route for toxic compounds is inhalation of airborne hazardous

materials into the respiratory system. Lungs may have a surface area at least 10 times greater than that of the body's skin. This tremendous surface area greatly enhances the rate at which chemicals may be absorbed.

Depending on the type of chemical and it's physical form (gas, fume, smoke, mist, particle, etc.), there will be some variation in its ability to pass through the lungs into the body. However, of all the routes of entry into the body, inhalation is almost always the most common.

Injection: The skin acts as natural barrier to most chemicals. This protection is lost when a sharp object punctures or tears it. Contaminated needles are a common mode of entry of toxic materials into the bodies of health care workers. Accidental injections of toxic materials do not occur frequently. But when such an incident does occur, a significant dose of toxic substance can directly enter the blood stream.

Eyes: Few substances are safe or innocuous when in contact with the eye. The eye's sensitivity to chemicals is such that irritation, pain, impairment of vision, or even loss of vision can result. Chemical contact with the eyes can be disastrous. The eyes are extremely sensitive to contaminants. Most substances will cause pain and irritation when in contact with the eyes; many will cause burns, loss of vision, or complete blindness. Also, the eye tissue absorbs many chemicals quite rapidly. Any time the eyes are chemically contaminated, they must be flushed a minimum of 15 minutes with water and medical attention sought immediately.

General precautions that should be followed to achieve this goal during the handling and use of all chemicals are as follows:

- A chemical mixture, with unknown hazards, shall be assumed to be *as toxic as its most toxic component*. Possibilities for chemical substitution should be investigated to reduce this risk.
- Botanicals and/or biomass hazards will be handled on a case-by-case basis at the discretion of the Department Director.
- Be familiar with the *signs & symptoms* of over-exposure for the chemicals you work with and the precautions necessary to prevent over-exposure.
- In case of a power failure, all employees should close their fume hood sashes and evacuate the lab areas and wait for further information.
- Eating (including chewing gum), drinking, and use of tobacco products are prohibited in the laboratory or in areas where hazardous materials are present.
- Hands must be thoroughly washed after working with chemicals.
- When working with hazardous materials, it is very important to wash hands *prior* to using the restroom.
- Storage, handling and consumption of food or beverages must not occur in chemical storage areas and refrigerators or with glassware or utensils that are also used for laboratory operations.
- Each employee shall do their part to keep the work area neat and uncluttered.
- All chemicals and equipment shall be labeled with appropriate hazard warnings as discussed in the Hazard Communication Program.
- Mouth suction for pipetting or starting a siphon is prohibited.
- Skin contact with all chemicals shall be avoided. Employees shall wash exposed skin prior to leaving the laboratory.
- Visitors and children of employees are not allowed in labs where hazardous substances or operations are present.

Additional specific precautions based on the toxicological characteristics of individual chemicals shall be implemented as deemed necessary by the Lab Supervisor.

4.1.2 Laboratory Equipment: The following rules shall apply to the use of laboratory equipment:

- All laboratory equipment shall be used only for its intended purpose.
- All glassware will be handled and stored to minimize breakage.
- All broken glassware will be immediately disposed of in the broken glass container.
- All pressurized/evacuated glass apparatus shall be shielded to contain chemicals and glass fragments should explosion/implosion occur.
- Hazardous waste containers shall be properly labeled as required by the Hazardous Waste Procedure.
- All laboratory equipment must be inspected by the user for hazards before use and replaced or repaired as necessary.

4.1.4 Chemical Labeling: When chemicals are dispensed or transferred to non-original containers, the new container(s) must be clearly labeled with the information listed below. The new label should cover the old label, or the old label must be removed so there is no confusion as to the contents of the container. This labeling requirement does not apply to chemicals used by the transferring person during the same work day. Refer to the Hazard Communication Program for further details.

Required labeling information includes:

- Chemical/product name.
- Transfer date (important for unstable chemicals).
- Initials of the transferring person.
- Hazard warning terms (i.e., Danger, Highly Toxic, Corrosive, etc.). Use the NFPA or HMIG labeling systems.

4.1.5 Planning for Emergencies: Before work with laboratory chemicals begins, plans for various emergencies will be developed. The circumstances to be covered include fire, chemical spill, and personnel exposure. In addition, the following work practices will be observed:

- Spill containment should be established for operations/processes in which regulated hazardous liquid(s) are used in an area where a release could escape to a floor or sink drain.
- Fume hoods generally provide spill containment for smaller operations. See the section on Sewer Discharge Prohibitions.
- Accidental sewer discharges of hazardous materials must be reported to the EHS department immediately.
- Minimize the need for employees to work alone.
- Make sure the tools are provided for working safely.
- Try to be in easy communication of other people while handling hazardous chemicals.
- The supply of emergency equipment will be checked on a monthly basis by the Lab Supervisor while completing the monthly laboratory inspection sheet.

General information for emergency response is given in Section 7.

4 Control Measures

4.1 General Criteria: The procedures and practices discussed in this Chemical Hygiene Plan are intended to assist in limiting laboratory workers' exposure to OSHA-regulated and other potentially harmful substances. Laboratory workers must not be exposed to hazardous chemicals in excess of the Permissible Exposure Limits (PEL) specified in Subpart Z (Toxic and Hazardous Substances) of the OSHA regulations.

PELs refer to airborne concentrations of substances and are averaged over an eight-hour day. A few OSHA regulated substances also have "action levels". Action levels are air concentrations below the PEL that, when exceeded, require companies to take certain actions such as medical surveillance and workplace monitoring. The OSHA list of Toxic and Hazardous Substances with Action Levels is in Appendix E.

An employee's workplace exposure to any regulated substance *must be monitored if there is reason to believe that the exposure may exceed an action level or a PEL*. If, as indicated by workplace exposure monitoring, exposures to any regulated substance routinely exceed an action level or permissible exposure level, control measures must be implemented.

If you suspect exposure concentrations exceed allowable levels (PELs), please contact your supervisor or the EHS Department immediately.

4.4.1 Professional Judgement: The Lab Supervisor can use professional judgement to assess the nature of chemical exposure resulting from a lab procedure and prescribe engineering controls and personal protective equipment to be used during the procedure. This judgement will be made by use of Standard Operating Procedures (if available) and/or MSDS for the chemicals. Contact the Laboratory Manager if you have any questions or concerns with workplace exposures.

4.1.2 Air Sampling: Air sampling for evaluating employee exposure to chemical substances will be conducted on an as needed basis (to be determined by Lab Supervisors / Directors and the Laboratory Manager). Air sampling must be conducted if there is reason to believe that exposure levels for regulated substances that require periodic workplace sampling exceed the action level or, in the absence of an action level, the PEL.

Air sampling will be conducted according to established industrial hygiene practices. It may be conducted by qualified laboratory employees, or outside consultants. Records of air sampling studies performed in the laboratory will be kept by the Laboratory Manager.

4.2 Criteria for Implementation of Specific Control Measures: Engineering controls, personal protective equipment, hygiene practices, and administrative controls each play a role in a comprehensive laboratory safety program. Implementation of specific measures must be carried out on a case-by-case basis, using the following criteria for guidance in making decisions.

4.2.1 When to Use Fume Hoods: The laboratory fume hood is the major protective device available to laboratory workers. It is designed to capture chemicals that escape from containers or apparatus and to remove them from the laboratory environment before they can be inhaled. *A fume hood should never be used to evaporate chemicals as a means of disposal*. In determining whether a fume hood is necessary for a particular operation, the following chemical characteristics should be considered: physical state (solid, liquid, gas), volatility, toxicity, flammability, extent of potential eye and skin irritation, odor, and the potential for producing aerosols.

A fume hood should be used if a proposed chemical procedure may exhibit any of the above characteristics to a degree that:

- airborne concentrations might approach the *action level* or permissible exposure limit,
- flammable vapors might approach one tenth of the lower explosion limit,
- materials of unknown *toxicity* are used or generated, or

- the *odor* produced is annoying to laboratory occupants or adjacent units.

Procedures that can *generally* be carried out safely outside the fume hood include those involving:

- water-based solutions of salts, dilute acids, bases, or other reagents,
- very low volatility liquids or solids,
- closed systems that do not allow significant escape to the laboratory environment, and
- extremely small quantities of otherwise problematic chemicals (for example, using a quantity so small that the PEL can not be exceeded). The procedure itself must be evaluated for its potential to increase in volatility or produce aerosols.

4.2.2 When to Use Safety Shields or Other Containment Devices: Safety shields, such as the sliding sash of a fume hood, are appropriate when working with highly concentrated acids, bases, oxidizers or reducing agents. All of these have the potential for causing sudden spattering or even explosive release of material. Reactions or processes carried out above or below ambient pressure (vacuum or high pressure) also require safety shields, as do reactions that are carried out for the first time or are significantly scaled up from normal conditions.

Other containment devices, such as vented glove boxes and vented gas cabinets, may be required when it is necessary to provide an inert atmosphere for the chemical procedure taking place, when capture of any chemical emission is desirable, or when the standard laboratory fume hood does not provide adequate assurance that overexposure to a hazardous chemical will not occur.

The presence of biological or radioactive materials may also mandate certain special containment devices.

Local exhaust ventilation may be required for equipment that produces or exhausts toxic or irritating materials to the laboratory environment.

Ventilated chemical storage cabinets or rooms should be used when the chemicals in storage may generate toxic, flammable or irritating levels of airborne contamination.

4.2.3 When to Use Personal Protective Equipment (PPE): Protective equipment (gloves, lab coats, etc.) must not be worn in public areas, such as lunch rooms and meeting rooms, in order to prevent the spread of chemical or biological contamination from laboratory areas.

4.2.3.2 **Clothing:** Although often not considered a part of th Personal Protective Equipment, the importance of wearing clothing appropriate to working in a chemistry laboratory can not be over emphasized. Long clothes or a long lab coat are required for work in the lab. Shorts or skirts are not to be worn in the laboratory. Realize that natural fibers are much more resistant to chemicals that most synthetics. Closed-toe shoes should be worn at all times in areas where chemicals are stored or used. Sandals are unacceptable. Rubber boots or plastic shoe coverings may be employed if additional foot protection is advisable, as in the case of cleaning up a chemical spill.

4.2.3.1 Eye Protection: Appropriate eye protection is required for all personnel and visitors whose eyes may be exposed to chemical or physical hazards. A policy that goggles must be worn at all times in the laboratory tends to cause people to end up not wearing the goggles even when they are needed. To guard against complacency of wearing eye protection, a policy requiring users of the laboratory to evaluate the risks of a procedure, and to wear the suitable eye protection. No matter what type of eye protection is used, it must conform to the ANSI Z87.1-1989 Standard.

Side shields on safety spectacles provide some protection against splashed chemicals or flying particles, but goggles or face shields are necessary when there is a risk of eye

contact.

Note: *Contact Lenses* may not be worn at any time in the laboratory. Gases and vapors may become concentrated in and under the lens, causing permanent eye damage. Soft lenses can absorb solvent vapors and adhere to the eye, making removal for irrigation at the eyewash fountain difficult, if not impossible.

If eye protection is warranted, prescription lenses not meeting the ANSI Z87.1 specifications (any glasses meeting the standard are required to be stamped "ANSI Z87.1") mus be supplemented with protection meeting the standard.

In Practice, on the inside of the yellow and black striping, eye protection must be worn. While using chemicals, goggles must be worn. If the chemicals in use have a high vapor pressure, the goggles should be unvented, otherwise they may be vented. While handling hazardous materials such as concentrated acids and bases, a full face shield must be worn. If unshielded lasers are being used in the lab, goggles or glasses which absorb at the wavelength the laser emits must be worn by everone in the lab, whether they are involved in the experiment or not.

4.2.3.3 Face Shield:

4.2.3.2 Lab coats: Laboratory coats protect employees from small spills and splashes that may occur in laboratory-scale work. Laboratory coats must be removed if they become significantly contaminated. They must also be removed when leaving the laboratories. Laboratory coats are not permitted in common areas, such as libraries, break rooms or cafeterias. Plastic or rubber aprons will provide better protection from corrosive or irritating liquids. However, a plastic apron can accumulate static electricity and should not be worn around flammable liquids.

4.2.3.3 Gloves: Gloves made of appropriate material are required to protect the hands and arms from thermal burns, cuts, or chemical exposure that may result in absorption through the skin or reaction on the surface of the skin. To minimize cross-contamination, gloves should be removed before exiting the lab. Do not open doors (or touch door knobs) with gloves on. It is also a good practice to wash your hands after removing gloves, especially if the gloves have been in contact with chemicals. Gloves should be inspected for discoloration, punctures and tears. Gloves should be replaced if there is any concern their protection has been breached.

Gloves should be carefully selected using guides from the manufacturers or by consulting with a vendor's technical support or the Laboratory Manager. General selection guides are available in most safety catalogs; however, glove resistance to chemicals will vary with the manufacturer, model and thickness. Therefore, review a glove-resistance chart from the manufacturer you intend to buy from, before purchasing gloves.

4.2.3.4 Respiratory Protection: Respiratory protection is generally not necessary in the laboratory setting and must not be used as a substitute for adequate engineering controls. Availability of respiratory protection for emergency situations may be required when working with chemicals that are highly toxic and highly volatile or gaseous. If an experimental protocol requires exposure above the action level that cannot be reduced, respiratory protection will be required.

Respiratory protective equipment may be used when effective engineering controls are not available. There are several kinds of respirators: air purifying chemical cartridge respirators, dust and mist masks, supplied air respirators and self contained breathing

apparatus. Laboratory supervisors should determine if respiratory protection is needed for the chemicals being used and what type of respirator is best suited to the task. Employees should ask laboratory supervisors or safety officers if they have questions concerning the use of respiratory protection. All employees who use respirators must have annual training on the correct procedures for selection, use and storage of respiratory protective devices.

4.2.3.5 Hearing Protection: When working in areas where the noise level is above 85 dB, hearing protection must be worn. Areas where noise levels regularly or continuously exceed 85 dB are posted with a yellow "Caution - Hearing Protection Required" sign.

Guidance: There are generally not any areas where the noise levels are regularly above 85 dB. Therefore you must make a judgment about whether hearing protection is necessary during a particular operation. If you notice that you must raise your voice to communicate with someone within three feet of you, you should wear hearing protection. If you suspect that noise levels exceed OSHA limits, contact theLaboratory Manager so monitoring can be conducted in your work area to determine if noise exceeds OSHA action levels.

Labels and Signs: Labels are the primary source of information concerning the hazards associated with chemicals found in the laboratory environment. Often, it is the only means the employee will use for obtaining information about the chemicals that are being used in laboratory processes. Therefore, it is vital that users of the analytical laboratory know what to look for in a label. Laboratory workers should always read labels thoroughly before handling materials.

The American National Standards Institute (ANSI) standard (Z129.l-l988) recommends the following information on a commercial chemical product label:
* Identity of product and hazardous constituents.
* Signal word -DANGER!, WARNING!, or CAUTION!
* Statement of hazard
* Precautionary measures
* Instructions in case of contact or exposure
* Target Organs
* Antidotes
* Notes to physicians
* Instructions in cage of fire, spill, or leak
* Instructions for contain handling and storage
* other useful information
* Name, address and phone number of manufacturer

The Occupational Safety and Health Administration (OSHA) HAZARD COMMUNICATION STANDARD (29 CFR 1910.1200) requires that all chemicals manufactured imported or distributed in the United States be "labeled" with adequate information for workers to properly protect themselves during normal use and foreseeable emergencies. All containers must be labeled. Small laboratory containers must be labeled with (at least) the following information:
* The name of the chemical within the container
* The associated hazards
* The name of the person responsible for the container and the date it was filled

Large laboratory containers must also be labeled. The only suggested exceptions to these procedures are containers holding 100 ml or less of a substance. This substance must be used during the work period in which the subdivision occurred by the person making the subdivision. The container cannot be left unattended by the worker who made the subdivision. Before the person who made the subdivision leaves the laboratory, the subdivision must be properly disposed of. A subdivision must never be returned to the original container.

All of the cabinets used for the long term storage of chemicals will have signs on them indicating the type of materials that may be stored in them. Page XX of the Chemical Hygiene Plan outlines the compatible and incompatible compounds for storage in each of the cabinets.

5 Engineering Controls

Define engineering controls here

The engineering controls (e.g., ventilation system) installed in the laboratory are intended to minimize employee exposure to chemical and physical hazards in the workplace. These controls must be maintained in proper working order for this goal to be realized.

Modification of engineering controls is not allowed by anyone other than a qualified proffesional working in conjunction with. Improper function of engineering controls must be reported to the Lab Supervisor immediately. The system may be taken out of service until proper repairs have been executed. If an engineering control system is taken out of service, all employees involved in the affected work area must be notified and warning signs posted.

5.1 **Ventilation:** Ventilation should be adequate to provide noncontaminated air for workers. Laboratory supervisors should be consulted when such as vacuum pumps or distillation columns, which have the employees are unsure if the type of ventilation available is suited for work with a particular compound or process. Apparatus, which have the potential to discharge toxic compounds must be vented into local exhaust devices.

5.1.1 Laboratory Hoods: Use of lab hoods must be conducted following the guidelines listed in *Fume Hood Safe Work Practices*. Prior to the purchasing and use of new chemicals (with hazards differing from those chemicals normally in use), the adequacy of the hood system shall be determined by the Lab Supervisor.

If questions arise as to the adequacy of the ventilation system, notify the Laboratory Manager.

Bio-hoods and laminar flow hoods are intended for biological hazards only and must not be used for containment of hazardous chemical vapors.

Hoods are one of the most commonly used engineering controls to remove the hazards of airborne chemical contaminates. Hoods must be used when laboratory activities may result in a release of toxic chemicals or dust. They should be checked for adequate performance before use and kept closed whenever adjustments in the hood are not being made. The quantity of materials stored in the hood must be minimized so that air flow and vents are not blocked. A hood containing toxic chemicals will be left on if it is not in active use, or if there is a possibility that sufficient ventilation will not be maintained if it is turned off.

The fume hoods will be inspected by AHEC every so often. They will notify theLaboratory Manager before the hoods are shut off. The hoods will be tagged that they are off, and the tags will only be removed, by theLaboratory Manager or the servicing agent, after the hoods have been turned on. No work will be performed in the hoods while they are turned off.

5.1.2 Local Exhaust Ventilation: The following procedures apply to the use of local exhaust ventilation (elephant trunks, snoods, etc.):

- The openings of local exhaust systems must be as close as possible to the source of the contaminants.
- Local exhaust fans shall be turned on when exhaust hoods are being used.
- After using local exhaust, operate the fan for an additional period of time sufficient to clear residual contaminants from the duct work.
- The ventilation system will be inspected annually by the Laboratory Manager, the Facilities department or a sub-contractor.
- Prior to a change in chemicals or procedures, the adequacy of the available ventilation systems shall be determined by the user.

If suspicions arise as to the adequacy of the ventilation system, notify the Laboratory Manager.

5.2 **Natural Gas Shutoff Valve:**

5.3 **Electrical Circuit Breaker Panel**:

5.4 Chemical Storage Cabinets: Storage cabinets for flammables and acids and bases will be ventilated. The cabinets must provide a spill containment system appropriate to the chemicals stored in them. Installation and placement of chemical storage cabinets must also meet the local fire codes.

storage: Highly toxic chemicals and materials in opened containers must be placed in unbreakable secondary containers. periodic examination of stored chemicals to determine whether the chemical or its container has deteriorated is prudent. Stockrooms and storerooms should not be used as preparation or repackaging areas. The analytical laboratory is open during normal working hours and are controlled by Laboratory Manager.

Chemical storage in laboratories must be carefully planned. Restricted quantities may interfere with laboratory activities. Unrestricted amounts can lead to accumulations of toxic, flammable, reactive and other hazardous compounds that could pose a safety threat not only to the laboratory, but to the entire facility. Every chemical in the laboratory should have a definite storage location and be returned to that location after each use. storing chemicals on bench tops is unwise. These compounds are not protected from potential exposure to fire and are easily knocked over. Storage in hoods should be avoided, because this practice interferes with the air flow in the hood. The best storage areas are those which prevent exposure of chemicals to heat or direct sunlight. periodic inventories of laboratory chemicals will show which items are unneeded, unused or which have deteriorated. These materials can then be discarded or sent back to the stockroom.

In the analytical laboratory chemicals are separated into seven groups. All of the chemicals in anyone group are compatible with one another, but may or may not be compatible with other groups. These groups are:

I. Mineral Acids (Hydrochloric, Sulfuric, Nitric)
II. Strong Volatile Bases (Ammonium Hydroxide, organic amines)
III. Strong Oxidizing Agents
IV. Strong Reducing Agents
V. Strong Organic Acids
VI. Relatively Inert but Volatile Organic Compounds
VII. Relatively Inert Inorganic Compounds

Class I and Class III chemicals may be stored together.
Class I chemicals may not be stored with Class II, IV, or VI chemicals.
Class III chemicals may not be stored with Class II, IV, V, or VI chemicals.

In the analytical laboratory the standard storage scheme is for Class I and III chemicals to be stored in cabinet number 1. This cabinet is located under the left fume hood. Class II chemicals are to be stored in cabinet number 2. Class V chemicals are to be stored in cabinet number 3. Class VI chemicals are stored in cabinets 5 and 6. Class VII chemicals are stored in cabinet numbers 7 and 8. Class IV chemicals are stored on the bottom left hand shelf of cabinet 8.

5.5 Bio-safety Cabinets and Glove Boxes: The exhaust air from bio-safety cabinets and glove boxes will pass through scrubbers, HEPA filters, or other treatment before being released into the regular exhaust system. Bio-safety cabinets will be certified annually and each time they are moved. This certification is arranged by theLaboratory Manager.

5.6 Refrigerators: Approved explosion-proof refrigerators are available; do not store flammable materials in un-approved refrigerators. In addition, prior to placing materials in storage (refrigerators, cabinets, etc.) ensure that they are properly labeled and effectively sealed. Erlenmeyer flasks are not appropriate storage containers.

5.7 Emergency Equipment: Sink eye wash stations should be flushed weekly by potential users in the lab. This will ensure that the eye wash is working should emergency use become necessary. All eyewashes and safety showers are flushed twice per month by the Facilities department. Fire extinguishers are checked monthly by the EHS department. Annual fire extinguisher service is provided by a contractor. Fire extinguisher training is scheduled periodically by the EHS department.

Environmental Safety Considerations
safety equipment required for the analytical laboratory includes:

* An easily accessible drench-type safety shower
* A fire extinguisher
* An eyewash fountain
* Respiratory protection
* A fire alarm, located nearby
* An easily accessible telephone for emergency use
* Supplies for the response to chemical spills
* Supplies for the response to mercury spills
* A ventilation system suitable for the chemicals in use

5.7.1 Emergency Eyewash Station: The eyewash stations are filled with a saline solution. If any irritant enters the eye, the eye wash stations should be used. Although the eye was station is meant to be used by one person, the wash will be much more effective if the person is assisted by someone else. The head is tilted down to the bottle which is resting on the table. The eye is held open. the bottle is evenly squeezed, delivering the solution to the open eye. Holding the eye open, the person must roll their eye in all directions to remove any of the irritant from around the edges of the eyeball. After both of the bottles are used, the person should be taken to the bathroom where the eyes should continued to be flushed for at least 15 minutes. The person should go to either the emergency room or their family physician if the situation is not very serious.

The eyewash solutions will be changed every three months, and the station will be inspected for cleannliness, and proper operation. The solution contained in the bottles is "eyesaline" solution from Lab safety Supply Inc.

5.7.2 Drench Shower: Any time a spill or splash involves any major portion of the body, or clothes, it is imperative that the emergency drench shower be used. Since the water is very cold, and the person is likely to be confused or dazed, the shower will be more effective if the person is assisted by someone else. The Assistant will have to hold the person under the running water while the victim removes their clothes. It is important that modesty or embarrassment dose not stop the person from getting undressed under the shower. The chemicals that are trapped in the clothing of the victim can cause severe and permanent injury even after the use of the drench shower. The fire blanket is next to the shower, and can be used to cover the victim.

After the drench shower has emptied its contents on the victim, the victim should go to one of the bathrooms on the third floor (indicated on Figure 2) and continue to shower. Someone must go with the person to ensure that they remain conscious, and to provide any assistance necessary. If necessary, follow the emergency response procedures to transport the person to a hospital, otherwise the person must go to their normal physician as soon as possible.

The drench shower will be inspected every 3 months. The shower will actually be released into a bucket to ensure that the shower is operational. The shower will also be inspected for cleanliness, and to ensure that the area is unobstructed.

5.7.3 Fire Blanket: The fire blanket can be used to smother a fire on the ground or on a person. If it is needed for a person, wrap the person in the blanket, and have them roll around on the floor while

you help to smother the fire. The fire blanket should be inspected every 3 months to ensure that it is present, and in good repair.

5.7.4 First Aid Kit: The first aid kit is for every bodies use. The kit contains band aids, aspirin, and ointments for minor burns. The first aid kit should never be used in the place of proper medical attention. The first aid kit should be inspected every 3 months. The supplies that should be contained in the kit are:

5.7.5 Fire Extinguishers: Due to the presence of large quantities of flammable solvents, as well as electronic equipment and open flames, fires are a common accident in a chemical laboratory. Proper training and preparation is essential to stop a small fire from becoming a major incident. Fires and the extinguishing of fires can best be thought about by the fire triangle theory. In order for combustion to occur, a fuel, oxygen, and heat must be present. If anyone of these items is missing, a fire will not be able to start or continue to burn. A fire is extinguished by removing one of these elements of the fire.

There are four types of fires, which are characterized from one another by the type of fuel that is involved. Type A fires involve the combustion of solid organic material, including wood, paper, cloth, etc. The mnemonic for remembering Type A fires is "A" for ashes, because ashes will always be a result of this type of fire. Type B fires result from the combustion of a liquid, including gasoline, solvents, gases, etc. The mnemonic for remembering Type B fires is "B" for barrel. Type C fires involve electrical circuitry. The mnemonic for Type C fires is "C" for circuit. Type D fires involve the combustion of active metals. This is a very specialized fire, and is also the most difficult to extinguish.

There are five general types of extinguishers. Halon, Carbon Dioxide, Tri- Class Dry Chemical, Regular Dry Chemical, and Combustible Metal extinguishers. The type of extinguisher used to fight a fire is determined by the type of the fire. Some extinguishers are able to be used effectively on two or three types of fires. All of the Extinguishers have advantages and disadvantages. These will be discussed, and then the reasoning for the choice made will be discussed.

Halon extinguishers use Halon 1211 (XXXX Chemical) as the extinguishing media, and will work on types A, B, and C fires. The halon extinguisher works by suppressing the radical formation required for combustion. It offers a light weight extinguisher that will put out most types of fires, and will not harm electrical equipment. Halon 1211 presents a moderate personnel hazard on discharge, as well as harming the environment. The halon extinguishers will not work on deeply rooted fires.

Regular Dry Chemical extinguishers use a sodium bicarbonate based extinguishing medium, and work of type B, and C fires. Tri-Class dry Chemical extinguishers use an ammonium phosphate based extinguishing medium, and work on type A, B, and C fires. The Dry chemical extinguishers work by displacing the oxygen required for combustion. Dry chemical extinguishers offer the lowest cost extinguishing option, and although there is a minor health hazard, dry chemical extinguishers are the safest for the personnel to use. Although it will extinguish the fire, dry chemical extinguishers will cause further damage to electrical equipment. Dry chemical extinguishers will also require substantial cleanup after use.

Carbon Dioxide extinguishers work on type B, and C fires. The carbon dioxide extinguisher works by both depriving the fire of oxygen required for combustion, and by cooling the fuel. Carbon dioxide extinguishers work on hidden fires. Carbon dioxide extinguishers are appreciably toxic to personnel, and can cause static and thermal shock to semiconductor containing electronic equipment.

Combustible metal extinguishers are a specialized type of extinguisher, that will only work on type D fires. The only extinguisher that will put out a type D fire is the combustible metal

extinguisher. For this reason if active metals are to be used or stored in the laboratory, a type D extinguisher will be required.

Fire extinguishers will be placed at the three exits from the lab. This will allow for evacuation if the fire is not successfully extinguished. In accordance with OSHA regulations, signs, that can be seen from all angles, will be placed above each of the extinguisher stations. Only extinguishers with external pressure gauges will be used in the laboratory, allowing for the periodic inspection of the extinguishers.

The fire extinguishers will be inspected every 3 months. The extinguishers should be present, and fully charged. The area surrounding the extinguishers should be clear of obstructions, and the signs over the extinguishers should be visible from around the room.

5.7.6 Chemical Spill Response Station: The chemical spill response station is stocked with several sizes of "Halozorb" absorbent pillows. These pillows will effectively absorb organics and all acids including solutions containing hydrofluoric acid. (NOTE: While these pillows will absorb many compounds, they do not neutralize any of the compounds. Proper care should be taken at all times while handling, storing, and disposing of the used pillows.) The spill response station also includes two rubber suits, gloves, goggles, and shoe covers.

The use of the spill response stations was described in the section dealing with the emergency response procedures. The kit will be inspected every 3 months to ensure that it is well stocked. Any replacement pillows or safety equipment may be found in the "Lab Safety Supply, Inc." catalog.

5.7.7 Mercury Spill Response Station: The mercury spill response station is equipped with a hand operated vacuum pump, several metal coated amalgamating sponges, and amalgamating powder, and some mercury vapor indicating strips.

The use of the mercury spill response stations was described in the section dealing with the emergency response procedures. The kit will be inspected every 3 months to ensure that it is well stocked. Any replacement pillows or safety equipment may be found in the "Lab Safety Supply, Inc." catalog.

6 Laboratory Operations

6.1 Behavior: Behavior in keeping with the surroundings of the chemical laboratory are required at all times. No rough housing, playing, or joking around will be tolerated in the laboratory. No playing with the wash bottles, water faucets or air lines is allowed. Users of the lab should keep their work area neat and organized at all times. All users of the analytical laboratory must be familiar with the contents of the Chemical Hygiene Plan, and follw the procedures and guidlines outlined in it.

Smoking: No smoking is not allowed in any University building, and is definitely not allowed in any portion of the laboratory.

Eating and Drinking: No food or beverages will be consumed in the portion of the lab that is taped off by the yellow and black warning line.

Radios: The use of radios or personal stereo systems (walkman, etc. prohibited in the analytical laboratory.

Working Alone and unattended Operations: At no time is a student allowed to work with chemicals while unsupervised, and other users of the laboratory must not work alone in a laboratory if the procedures being conducted are hazardous. If a reaction or other operation is to be unattended for any length of time, the person responsible for the experiment must:

1. Leave the lights in the laboratory on
2. Place an appropriate sign on the door
3. Provide for containment of the chemicals involved being used, should an event such as a power or water failure occur

6.2 Housekeeping: Fewer accidents occur in laboratories which are kept neat and orderly. Work areas must be kept clean. Chemicals and equipment must be properly labeled. Cleanup should follow the completion of any operation or at the end of each day. Wastes will be deposited in the appropriate containers; spilled chemicals should be cleaned up immediately in accordance with the procedures outlined in the Chemical Hygiene Plan. Floors need to be cleaned regularly. Accumulated dust, chromatography adsorbents, and assorted chemical particulates pose respiratory hazards. Stairways and hallways cannot be used for storage. Access to exits and emergency equipment should never be blocked.

6.3 Use of Glassware: Accidents involving glassware are a leading cause of laboratory injuries. Glassware should be handled carefully and stored properly. Damaged items need to be repaired or discarded. Hand protection must be worn when picking up broken glass, inserting rubber stoppers or corks into glassware, or when placing rubber tubing on glass hose connections. Glass- blowing should not be done unless proper facilities are available.

There are special precautions to consider before using evacuated glass apparatus. If there is an implosion of this type of glassware, serious injury can occur. Proper handling of evacuated equipment, as well as the use of shields or wraps, will minimize the risks associated with implosion.

Proper instruction on the use of specialized glassware must be obtained. For example, separatory funnels containing volatile solvents should be vented occasionally because they may be under considerable pressure. Reaction apparatus and distillation equipment which is positioned and clamped carefully will provide a set-up which is moved minimally during laboratory procedures.

Equipment must be used only for its intended purpose. Students, teaching assistants, and research assistants should ask their supervisors if they are unsure how to handle equipment or if they feel items are not being used properly.

6.4 Handling of Chemicals: Laboratory employees are exposed to many kinds of potential hazards. Laboratories in which chemicals are used usually contain substances with known hazards. In addition, new compounds are often developed which have the potential for being extremely hazardous to human health or

the environment. Though laboratories generally handle only small amounts of these materials over a short period of time, safety precautions and good chemical hygiene must always be of primary interest to all laboratory personnel. Chemicals must be treated with respect. A good general rule is to assume all chemicals are hazardous, because, given the right set of conditions, all chemicals are!

6.5 Use of Compressed Gases: Typical compressed gas cylinder routinely have pressures of 2500 -3000 psi. Because of this, cylinders of compressed gases should be handled as potential explosives, even if the material in the cylinder is innocuous. All cylinders should be properly labeled as to the contents. A tag should be placed on the cylinder stating whether the cylinder is new, in use, or empty. The delivery of a cylinder should never be accepted if the cylinder is improperly labeled, if the cap is not in place, or if there are any obvious dents or areas of rust on the cylinder.

Cylinders should be chained or strapped down at all times, even if they are empty. If the cylinder contains a flammable gas, the cylinder must either be chained or the strap must be fire proof. Oxidizing and reducing gases should not be stored together. The cylinders should have the cap in place while being moved or stored. The cylinders should never be exposed to heat in excess of 50 C. The cylinders should be moved with a cart designed explicitly for the purpose. Always leave a slight pressure in the cylinder, even when considered empty. Use only an appropriate regulator on any cylinder, and never use Teflon tape on the high pressure side of the regulator. Never use an adaptor or change the high pressure side of a regulator.

6.5 Procurement: Good chemical hygiene practices actually begin with the personnel who order chemicals and those who approve the purchase orders. These people must be aware of the potential hazards associated with the substances ordered. They also need to consider if the laboratory facilities and staff are available to handle these materials. MSDSs should be requested at the time the chemical is ordered. The shipment of the chemical should not be accepted without an accompanying MSDS.

Before a compound is received, information on its proper handling, storage and disposal should be given to everyone involved, including stockroom or storeroom personnel. No container will be accepted without an adequate identifying label. storage in stockrooms or storerooms depends on the quantity of chemicals in the area and the nature of their hazards. Toxic substances should be segregated in well identified areas with local exhaust ventilation. Facilities for water-sensitive chemicals must be designed to prevent accidental contact with water. Cylinders of compressed gases should be stored in well- ventilated, dry areas. Maintaining a central storage area for flammable chemicals will minimize the fire hazard.

No chemical should be ordered without knowledge of its hazard properties.

The facility must have the proper equipment to handle all substances used at the CES and staff must be familiar with how these compounds are to be treated. Labels, MSDSs, reference sources and technical advice should be utilized in the determination of the most safe and efficient manner to handle laboratory compounds.

6.8 Distribution: The method of transporting chemicals from the stockroom to the laboratory should reflect the quantity and hazard of the chemicals being used. When chemicals are hand-carried, the chemical container must be placed in an outside container or bucket. This is known a secondary containment. A good practice is to transport all chemicals on freight elevators, if possible, to avoid chemical contamination of people on passenger elevators.

6.1 Work with Particularly Hazardous Chemicals: The OSHA Lab Standard requires that special consideration be given to use of chemicals or procedures with particular hazards. When laboratory procedures include the use of particularly hazardous chemicals, special precautions shall be implemented as deemed necessary by the Lab Supervisor. These precautions will be developed for work with *select carcinogens, reproductive toxins and substances that have a high degree of acute toxicity*. Examples of such chemicals or procedures are listed in Appendix A of this CHP. When developing these precautions, consider including provisions for the following in the special procedures:

1. Establishing a designated area for the use of the high hazard chemicals.
2. Signs and access control for the work area where the chemical is used.
3. Special precautions including use of containment devices such as glove boxes.
4. Isolation of contaminated equipment.
5. Practicing good laboratory hygiene.
6. Prudent (safe) transportation of very toxic chemicals.
7. Planning for accidents and spills.
8. Special storage and waste disposal practices.

Prudent Practices provides detailed recommendations for work with particularly hazardous substances. A Process/Project Analysis checklist is available in Appendix A for reviewing applicable operations.

Particularly Hazardous Substances: The CES has made special provisions for our employees who work with particularly hazardous compounds. Specific safety recommendations are given in the following sections for reproductive toxins, chronic toxins, (i.e. carcinogens), and compounds with a high degree of acute toxicity.

Work involving these compounds must be done in "designated areas". Designated areas are those set aside for work with compounds which are potentially particularly hazardous. The designated area can be an entire laboratory, a section of a laboratory, or a hood. A sign must be posted indicating that a designated area exists and the type of hazard associated with the area.

Use of containment devices is vitally important when working with particularly hazardous materials. Hoods and glove boxes are effective in reducing employee exposure to hazardous materials. When these devices are used for particularly hazardous compounds, a sign must be posted as to the identity of the substances contained within them and the nature of the associated hazards. Laboratory managers and employees working with particularly hazardous materials should also be familiar with the specific procedures for waste removal and decontamination for the materials they handle. Some general guidelines for handling particularly hazardous chemicals are provided in the following sections.

Allergens: One group of compounds which laboratory employees may consider handling with additional caution are allergens. Symptoms of chemical exposure to some materials may be similar to allergic reactions. Compounds such as diazomethane, chromium, nickel, dichromates, formaldehyde, isocyanates and certain phenols are considered allergens. Exposure to allergens can produce skin or lung hypersensitivity and is best avoided by wearing suitable gloves to prevent hand contact when working with these chemicals or other compounds of unknown allergenic activity.

Reproductive Toxins: Reproductive toxins are substances which cause harm to the human reproductive system. Not only the female reproductive system may be threatened by exposure to these compounds, but the male reproductive system may be affected as well. Exposure to these compounds may lead to infertility, menstrual disorders, and birth defects.

One class of reproductive toxins which should be given serious consideration are the embryotoxins. Embryotoxins are substances which adversely effect the fetus carried within the exposed mother during her pregnancy. This category of chemicals include organomercurials, lead compounds, and formamide. Exposure to these compounds during pregnancy can lead to spontaneous abortions, birth defects, and health problems for the mother and child which may not be evident until after delivery.

The period of greatest susceptibility to embryotoxins is during the first 8 to 12 weeks of pregnancy. During this time, a woman may not realize she is pregnant. Therefore, women of child-bearing age need to avoid skin contact with ALL chemicals.

Women and men should use the following procedures whenever they work with reproductive toxins:

1. Consultation with managers, medical personnel or safety personnel is extremely important. Special procedures will be used or signs posted whenever it is warranted. A designated area must be set aside for work with

reproductive toxins. In cases where a reproductive toxin is routinely used, the operation should be reviewed annually or whenever a change in procedure is made.

2. Reproductive toxins that need special controls must be stored in a well ventilated area. The material should be stored in an unbreakable secondary container. The containers will be labeled as to the nature of the reproductive hazard.
An example of such a label is below.
EMBRYOTOXIN: READ SPECIFIC PROCEDURES FOR USE.

3. All employees need to guard against spills or splashes. Appropriate safety apparel, especially gloves, will protect everyone from reproductive toxin exposure. These compounds should only be used in areas with good ventilation. Managers will be notified of all accidental releases of reproductive toxins and of all personal contaminations involving these compounds. Physicians should be consulted when necessary.

Men working with reproductive toxins must practice good chemical hygiene to prevent chemical contamination of women outside the laboratories. Men, as well as women, should wash their hands or take a shower after working with reproductive toxins. Clothing worn during operations involving these substances should not be washed with household laundry. All men, and especially those that live with women of child-bearing age should follow all steps of the preceding procedures.

Chemicals of High Acute Toxicity: Before beginning an experiment or other laboratory operation, all workers must review the hazards associated with the chemicals to be used. After this review, they may discover that the materials with which they will work have a high, acute toxicity. Chemicals with these degrees of toxicity include diisopropyl-fluorophosphate, hydrofluoric acid and hydrogen cyanide.

The procedures described below are designed for work with such compounds. The aim of these precautions is to minimize exposure by all possible routes of entry.

- Gloves and laboratory coats will protect the hands and forearms from skin contact with these materials.
- Operations with volatile toxic substances or procedures which could generate toxic aerosols or vapors are best conducted in a hood or other suitable containment device.
- Designated areas are to be established for these chemicals. These compounds must be stored in areas of restricted access and special warning signs posted in that location.
- Laboratory employees should wash hands and arms after using these materials.
- Records must be maintained of the amounts of these materials which are at the facility, the amounts in use within the laboratories, and the names of the employees using these compounds.
- At least two people must be present in the laboratory at all times when a chemical being used in that area is highly, acutely toxic or has an unknown toxicity.
- Breakable containers of these substances need to be stored in chemically resistant trays. It is a good practice to mount apparatus containing these compounds above such trays or to cover work and storage areas with removable, absorbent, plastic backed paper.
- Personnel responding to a spill must use appropriate personal protective equipment. Contaminated clothing or shoes must be disposed of as hazardous waste.
- Contaminated waste is to be stored in suitable, labeled, impervious containers.

The procedures noted above are also effective safety precautions for compounds of moderate, chronic toxicity.

Select Carcinogens: The procedures for safely carcinogens include:

* Gloves and laboratory coats will protect the hands and forearms from skin contact with these materials.
* Operations with volatile toxic substances or procedures which could generate toxic aerosols or vapors are best conducted in a hood or other suitable containment device.
* Designated areas are to be established for these chemicals. These compounds must be stored in areas of restricted access and special warning signs posted in that location.
* Laboratory employees should wash hands and arms after using these materials.

* Records must be maintained of the amounts of these materials which are at the facility, the amounts in use within the laboratories, and the names of the employees using these compounds.
* At least two people must be present in the laboratory at all times when a chemical being used in that area *is* a select carcinogen.
* Breakable containers of these substances need to be stored in chemically resistant trays. It *is* a good practice to mount apparatus containing these compounds above such trays or to cover work and storage areas with removable, absorbent, plastic backed paper.
* Personnel responding to a spill must use appropriate personal protective equipment. Contaminated clothing or shoes must be disposed of as hazardous waste.
* Contaminated waste *is* to be stored in suitable labeled, impervious containers.

Additionally, when substances are to be used in quantities in excess of a few milligrams to a few grams (depending on the hazard posed by the compound), extra precautionary measures should be taken.

- All transfers and work involving these materials will be conducted in designated areas. All people with access to these compounds must be aware of the nature of the materials and all necessary precautions must be used when handling the material. The controlled areas needs to be conspicuously marked with warning and restricted access signs.
- Containers should be labeled with the compound's identity and a hazard warning, such as: WARNING! CARCINOGENIC!
- Plans for use and disposal of these substances must be developed which have the approval of a laboratory manager. These plans need to specify that containers of waste contaminated with select carcinogens, including wash water from contaminated glassware, will be transferred from the controlled area in a secondary container under the supervision of authorized personnel.
- Vacuum pumps must be protected against contamination by scrubbers or HEPA filters. Pumps should be vented into a hood. Pumps and other contaminated equipment, including glassware, must be decontaminated before removing them from the controlled area.
- Employees leaving the controlled area must remove protective apparel, placing it in an appropriate, labeled container. Face, hands, forearm and other potentially exposed areas of the body should be washed.
- A wet mop or a vacuum cleaner equipped with HEPA filter, rather than dry sweeping, should be used for picking up a powdered, toxic material.
- Should a controlled area be designated to become a normal work zone, this area must be thoroughly decontaminated.
- A physician may be consulted if toxicologically significant amounts of these substances are used routinely (i.e. 3 times weekly) to determine if regular medical surveillance is desirable.
- Negative pressure glove boxes containing these materials must provide at least 2 volume changes per hour and negative pressure at least 0.5" of water. Positive pressure glove boxes must be checked for leaks before each use. Exhaust gases should be trapped or passed through a HEPA filter or other appropriate media and then released into a hood for both types of glove boxes.

Many of the safety procedures described in this section can be used for other compounds of high, chronic toxicity. The substances considered to be of high, chronic toxicity include dimethylmercury and nickel carbonyl.

Protection from Particularly Hazardous Substances: Laboratory chemicals can pose a severe potential threat to human health. Many chemicals pose potential health hazards, either through acute effects which act immediately or through chronic effects which are observed days, months, or even years after exposure. The hazards associated with a newly developed compound may not be fully understood by laboratory workers.

Some toxic compounds have unusual hazard properties. There are chemicals which can affect the health of unborn children or cause mutations. These substances include teratogens (which cause non-hereditary birth defects), mutagens (which cause hereditary changes in the chromosomes which may be passed on to future generations) and other reproductive toxins. Some compounds may cause allergic reactions.

It is exceedingly important that laboratory workers understand how toxins may enter the body, as well as what precautions are necessary to take when working with chemicals that have acute or chronic hazard properties.

Animal Work with Compounds of High Chronic Toxicity: Work with experimental animals can present special exposure situations, because of the possibility of the formation of aerosols or dusts that contain toxins. These dusts and aerosols may become dispersed throughout the laboratory or animal quarters through animal food, urine, or feces. The following precautions are recommended for animal work involving compounds of high, chronic toxicity.

* If large-scale studies are done, restricted access facilities should be made available.

* These substance are best administered by injection or gavage instead of in the diet. If administration is in the diet, a caging system can be used if it is under negative pressure or under laminar air flow directed toward HEPA filters.

* Procedures can be developed which minimize the formation and dispersal of contaminated aerosols, including those from food, urine, and feces. Such procedures may include using HEPA filtered vacuum equipment for cleaning and moistening contaminated bedding before removing from cage. Any mixing of food and chemicals needs to be done in a hood.

* Workers in the animal room should wear plastic or rubber gloves, fully buttoned laboratory coat or jumpsuit, and any other safety apparel appropriate.

* Disposal of contaminated animal tissue, feces, and urine should be by incineration, if the incinerator can convert the contaminant to nontoxic products. Otherwise, package the waste appropriately for burial in an EPA-approved site.

Organic Peroxides: Organic peroxides are low powered explosives that are very sensitive to electrical, mechanical, and chemical ignition. Numerous accidents have been reported about chemicals that are themselves safe but over time form a peroxide which then detonates. Because of these properties, peroxides (and the compounds that are likely to produce peroxides) are subject to special consideration.
Compounds that will form peroxides, and must be tested on a regular basis are:

* Aldehydes
* Cyclic ethers
* Ethers with a primary or secondary alcohol group
* Ethyl Ether
* Isopropyl Ether
* compounds containing benzylic hydrogen atoms
* compounds containing allylic structures
* ketones
* vinyl and vinylidene compounds

Special care should be taken whenever a peroxide is either present, or is suscpected of being present. In sucha a situation it is important to:
* Minimize the amount of peroxide being used
* Clean up all spills immediately
* If possible work with the peroxide diluted in an inert solvent. Toluene is know to induce the decomposition of some peroxides
* If diluted, be careful not to allow the solvent to vaporize, thus increasing the peroxide concentration
* Perform all work behind a blast shield, while wearing a safety shield and goggles
* Never use metal instruments (including the spatula) or store the peroxide in contact with any metal
* Do not store the peroxide in a glass container. Peroxides should be stored in bottles which (including the cap) is made from polyethelyene
* Do not grind, use friction, or subject to any kind of impact
* store at the lowest possible temperature with out freezing. Never allow the peroxide to freeze or precipitate out. These types of peroxides are particularly sensitive
* Properly dispose of all peroxides or solutions containing peroxides

6.2 Off-hours work, sole occupancy of lab and unattended operations: If off-hours work, sole occupancy of lab or unattended operations must occur, complete the Laboratory Safety Permit in Appendix B to ensure that proper precautions have been taken. Then post the permit on the door during the duration of the operation(s). Submit a copy of the permit to the EHS department.

The toxicity of the chemicals used, the hazards of the procedures to be done, and the knowledge and experience of the laboratory workers must be considered in deciding what control measures must be implemented before the work can be safely conducted.

1. **Off-Hours Work Procedures:** Laboratory personnel are not permitted to work after hours in the lab, except when the conditions of the Laboratory Safety Permit referenced above are met.
2. **Working Alone:** Work with particularly hazardous chemicals (as described in Section 6.1) shall not be performed in the laboratory when the only person in the lab is the person performing the work. Under unusual conditions, cross-checks, periodic security guard checks, or other measures may be taken as established by a permit.
3. **Unattended Operations:** When laboratory operations are performed that will be unattended by laboratory personnel (continuous operations, overnight reactions, etc.), the following procedures will be employed:

7 Incident Response

All spills, releases and accidents should be reported to the EHS department on an "Occurrence Report Form". See the Hauser Emergency Plan for further details.

EMERGENCY RESPONSE PROCEDURES

Accidents in the laboratory will occur, and employees must be aware of emergency procedures that are to be taken whenever an incident happens. Protecting human health and safety is the primary consideration for all people responding to the emergency --their own as well as their co-workers. Important steps the response to an emergency include:

4. Assisting any personnel involved and remove them from exposure to further possible injury
5. Warning employees in surrounding areas of potential hazards
6. Providing appropriate first aid. This may be in the form of assisting with a safety shower washdown or giving artificial respiration.
7. Extinguishing small fires with a portable fire extinguisher
8. Initiating the evacuation of the building

All personnel working in the analytical laboratory must be familiar with the response and reporting procedures, as well as the alarm system covering the lab. At all times, there must be at least one telephone readily available to the users of the laboratory, which will be tagged with the appropriate numbers to call in case of an emergency.

7.1 LAYOUT OF ANALYTICAL LABORATORY AND SURROUNDING AREAS: The Center for Environmental Sciences is housed in rooms 3208a, 3208B, 3208B1, 3009, 3009A, and 3009B. The Analytical Laboratory is in rooms 3208A, and 3009. Figure 2 depicts the layout of the CES, and Figure 3 shows the area surrounding the CES. Shown on Figure 3, are the various exits from the analytical laboratory, the alarm pull boxes, and the back-up emergency showers.

7.1 Emergency Response: Telephone numbers of emergency personnel, Lab Supervisors and other workers, as deemed appropriate, are posted on the entrance to each laboratory. These signs will be checked monthly by the Lab Supervisor for accuracy.

7.2 In Case of Fire: HAUSER policy is that the first reaction to a fire is to evacuate the occupants of the building. All employees must report to their assembly areas and remain there until further instructions have been given. If you can do so safely, shut down your equipment before you leave the work area. Fire extinguishers are available in labs and are inspected monthly. They may be used by trained personnel to extinguish small fires. Fire extinguisher training is conducted periodically by the EHS department.

Fires: In the event of a fire, regardless of it's size, the building must be evacuated and the Department of Public Safety (DPS) must be notified. After the evacuation of the building is initiated, and the Department of Public Safety is notified, it is up to the discretion of the ranking person in the laboratory whether or not to try to extinguish the fire before the fire department arrives. It cannot be stressed enough that, at no time should an attempt be made to fight the fire, before the building is evacuated or the authorities are notified. The Fire Department would rather arrive to an extinguished fire than chance being called to a fire that has become major as a result of an avoidable delay.

The person in charge of the laboratory at the time will (in order of occurence):

9. Announce to the rest of the users of the laboratory that the lab is being evacuated
10. If a class is in session, the instructor or teaching assistant will designate the exit and meeting location to use

11. Designate a person to call the DPS
12. Designate a person to initiate the evacuation of the building
13. Ensure their own route of escape
14. Make a decision as to whether they will attempt to fight the fire

The person designated to call the Department of Public Safety should be prepared to tell the DPS the nature of the fire, the chemicals that may be involved, the size of the fire, the building name and the room number. The desigated person should call from a phone away from the vicinity of the fire. (in the lobby or outdoors, if possible) The person should remain on the phone with the DPS untill the dispatcher terminates the call. When the call is finished, the person will proceed on to the designated meeting place.

The person designated to initiate the evacuation of the building will activate a pull box along the designated exit route. The person will then proceed on to the designated meeting place. After initiating the evactuation of the building, and notifying the proper authoritites, the person in charge must decide whether or not to attempt to fight the fire. If the decision is made not to try to fight the fire, the door will be closed and the person will continue on to the designated meeting location.

If the person decides to try to fight the fire, the first, and hgighest priority throughout the incident is to ensure a safe exit route from the location of the fire. If at any time the route of exit starts to become dangerous, the person must quit fighting the fire and leave the building. After ensuring a route of escape, the person may use one of the fire extinguishers placed at each of the exits around the laboratory to attempt to extinguish the fire.

Remove the extinguisher from the wall, and pull the storage pin from the handle. Pulling the handles together will release the contents of the extinguisher. Aim the discharge of the extinguisher at the base of the flames, and play the discharge back and forth across the base of the flames. It may be necessary to use more than one extinguisher to completely extinguish the blaze. If the fire is sucsefully extinguished, the person or people fighting the fire should not turn their back on the location of the fire or leave the room. Flare ups are very common with fires.

Everyone who is fighting the fire should be aware that the combustion of chemicals is very likely to produce toxic gases and smoke. Care should be taken to not breathe any of the combustion products. If the atmosphere becomes hazardous, the room should be evacuated, and the firefighters should be allowed to use their SCBA gear.

The instructor or teaching assistant should be prepared to tell the firefighters what chemicals may be involved in the fire, as well as the identities of any hazardous chemicals that may be in the area of the fire.

After the building is safe to enter, and any injuries are properly taken care of, the principals involved in the incident must fill out an accident report. No one is to enter the room without theLaboratory Manager or a member of the Fire Department present. No work will be allowed in the lab until the accident is completely investigated.

7.3 In Case of Spills: In the event of a chemical spill, release or other accident, lab workers will respond as outlined in the Hauser Emergency Plan. A copy of this plan is kept in the Hauser EHS manual at each Hauser location. The size of the spill and its hazards will guide the appropriate response. If there is any doubt about the lab employee's ability to safely clean up the spill, call the EHS department or ERT pager number immediately. These numbers are posted on the entrances to all Hauser facilities and are available in the Emergency Plan. Note that proper emergency response depends upon a knowledge of the hazards present in the lab. For this reason, a company wide inventory of the hazardous chemicals in labs will be conducted at least annually.

Chemical Spills: In terms of accidental chemical releases, the easiest spills to handle are the ones which don't occur. The best method to reduce spills is for the users of the laboratory to limit the quantity of materials being handled, and to prudently use secondary containment. The policy of the analytical laboratory towards prevention of and response to chemical spills incorporates four important elements:

Prevention: The storage, operating, monitoring and training policies in this document are designed to aid in preventing spills from occurring. All of the cabinets used for the storage of chemicals either have lips on the shelves, or doors on the cabinets, to prevent bottles from falling off of the shelves. All chemicals on the workbench should be kept well back from the edge of the bench.

Containment: Users of the analytical laboratory should familiarize themselves with safety controls in storage facilities and on equipment designed for storage. The chemical storage cabinets have a two inch

sealed fllor for the containment of any spills that might occur in the cabinets. secondary containment will confine spills and possibly prevent employee injuries.

Cleanup: Laboratory workers must know how to handle spilled materials and when they are capable of responding to a spill. The cleanup procedures needed depend on the size of the spill and the type of material involved. All spilled materials and response mmaterials must be disposed of properly. These procedures are described in section () of this chemical hygiene plan. The major types of spills are:

Solids -Sweep up the solid and dispose of it properly. If the material is acutely toxic the area involved should be rinsed with an appropriate solvent, which should then disposed of by the approved manor.

Non-hazardous -In the case of a small spill of a liquid compound that is not acutely hazardous, the material may simply be wiped up with a towel which is then disposed of properly. If a larger quantity of chemicals is involved, it may be necessary to use the absorbent pillows located in the chemical spill response station. If the compound is a solid, the material may be picked up in a dust pan and disposed of according to the procedures outlined on page XXX of the Chemical Hygiene Plan.

Acids and Bases -The absorbent pillows in the spill response kit are effective for picking up all acids and bases, including hydrofluoric acid solutions. Special care should be taken to avoid any contact with the acid or base. The spill response station is equipped with two rubber suits, gloves, goggles, and shoe covers. The appropriate use of this safety equipment is enough to ensure that contact with the spill will be avoided. A concern in the response to an acid or base spill is the possibility of hazardous fumes. If fumes are present, the room should be evacuated, and the Fire Department should be called according to the procedures outlined in the fire response section of the Chemical Hygiene Plan (page XXX).

Volatile Organic Compounds -Because of the serious danger of fire, a spill involving a volatile organic compound receives special attention. As with the other types of spills, a small spill is simply be wiped up, and the towel or absorbent pad is disposed of properly. Larger spills, though, must be promptly and carefully attended to. If the spill can be cleaned up with the absorbent pads from the chemical spill station, the used pads are put into the fume hood until they may be disposed of properly.

At all times, sources of ignition and sparks must be avoided. The lights, and fume hood should never be turned on or off. The movement of any metal to metal contact should be avoided. The phone in the lab should not be used. As with the acid or base spill, one concern in the response, to the spill of a volatile organic compound, is the possibility of hazardous fumes. If fumes are present, the room should be evacuated, and the Fire Department should be called according to the procedures outlined in the fire response section of the Chemical Hygiene Plan (page XXX).

Mercury -A mercury spill also requires specialized attention. Because mercury forms very small beads that easily roll around on the bench and floor, rolls into nooks and crannies, and vaporizes to form hazardous mercury vapors, a mercury spill is very difficult to clean up completely. The mercury spill response kit contains a hand operated suction pump which should be used to pick up the larger mercury drops. Once used, the trap of the hand pump should be cleaned and the waste mercury properly disposed of.

The mercury spill kit contains a metal powder which amalgamates with the smaller bits of mercury that the hand pump could not pick up. The powder should be spread over the area of the spill, and then sifted back and forth over the area. After the area of the spill is thoroughly cleaned with the powder, the powder/mercury amalgam is swept up and disposed of properly. The spill kit also contains some mercury vapor sensing paper. After the spill is cleaned up, the sensing paper is set out in the laboratory for several days to ensure that none of the mercury was missed, resulting in

hazardous vapors in the laboratory.

Reporting: A spill involving an acutely hazardous material, or where the chemical spill response kits are used should be reported to the Chemcial Hygiene Officer. Reporting the spill will help to determine if the facilities or policies of the CES need to be modified in order to minimize the chance of a reoccurence of such an accident, and will also allow for the chemical spill station to be restocked if necessary.

The Laboratory Manager will report the spill to the Director of the CES and the Chemical Hygiene Committee, along with any corrective action taken. If necessary, the Chemical Hygiene Oficer will report the spill to the proper local, state, of fedeal agencies.

Corrective Actions: All accidents and spills should be carefully reviewed to eliminate the hazards which led to the incident. The goal of such investigations is to make recommendations to improve safety, not to assign blame. The response should also be reviewed to determine what was done correctly and what elements of the emergency response procedures should be changed.

7.4 In Case of Personnel Injuries or Exposures: In case of medical emergency dial 0. For a serious (life-threatening) medical emergency, push the "outgoing" button and dial 911. After reporting the emergency, contact the receptionist and explain the situation so the Emergency Medical Services can be directed to the right location. The Hauser designated medical facility for non-life-threatening injuries is the Western Center. A detailed map to the Western Center is available at the reception desk at each Hauser facility. Refer to the Emergency Plan for more information on actions to take during emergency situations.

All personal injuries must be reported on the company "Occurrence Report Form". Then the injury will be classified as Workers Compensation or First Aid only.

Note: Medical consultation after chemical exposures is provided as detailed in Section 8.

Injuries: In the case of an accident, the response procedures are much more subjective, with the severity of the injury and the training of the person responding to the accident both varying the type of response. If the injury is serious, one person should be sent to call the Department of Public safety, while another person gives aid to the injured person. The person calling the DPS should know the type of injury, the approximate severity of the injury, and the location of the victim. The person should stay on the line until the DPS terminates the call. If an ambulance is involved, the DPS will meet the ambulance crew and guide them to the location of the accident. Fill out accident report.

PROCEDURES FOR THE DISPOSITION OF CHEMICALS AND BYPRODUCTS

Good chemical hygiene means keeping both workers AND the environment free from contaminants. A good chemical disposition program's chief goal is to assure that the storage and use of laboratory chemicals, and the disposal of waste laboratory chemicals causes no harm to people, animals or the environment.

A common laboratory practice is to pour waste chemicals down the drain. Although this is acceptable for some waste chemicals, for the vast majority of wastes, this is unacceptable. Also unacceptable is the practice of disposing volatile chemicals using a hood's ventilation system. Wastes should be collected in specified containers set up in the laboratory. These containers will be removed at regular intervals, at least once a week, to a central waste disposal area,

If large quantities of a solvent are used, recycling might be a viable alternative to disposal. If it is safe and practical, very hazardous substances should be rendered less hazardous in the laboratory instead of being put "as is", into containers for disposal. For example, highly toxic substances could be oxidized in solution.

Unlabeled containers in laboratories must be immediately discarded. The Safety Department should be contacted for assistance. At the termination of a laboratory worker's employment, chemicals for which that person was responsible should be discarded or returned to storage.

All employees should be familiar with the proper collection, segregation, storage and transportation procedures at [Your Institution].

Waste Minimization: The officers and administrators of the Center for Environmental Sciences is strongly committed to the spirit of the Resource Conservation and Recovery Act. A major goal of this act is to minimize the impact of the operation of the analytical laboratory on the Environment. One method of doing this is to minimize the waste generated by the laboratory.

Experimental Design: Substitution:

Minimizing Volume:

Rendering Nonhazardous: From a che@lical point of view it is @asible to reduce or destroy the hazard characteristic of many hazardous chemicals by chemical reaction in the laboratory. Although in-house chemical destruction of chemicals is not Iikely to be an economically practical general solution to the disposal of laboratory wastes, many laboratories may find the route useful for certain wastes. Academic laboratories may find that laboratory destruction of some chemicals can be made an efective part of their instructional programs, while at the same time reducing the quantities of wastes that have to be disposed of.