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SOUTHEASTERN
UNIVERSITY**

ENVIRONMENTAL
HEALTH AND
SAFETY

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Section 1: SUMMARY

Nova Southeastern University (NSU) is committed to providing a healthy and safe working environment for the university community, free from recognized hazards. The Chemical Hygiene Plan (CHP) establishes a formal written program for protecting laboratory personnel against adverse health and safety hazards associated with exposure to potentially hazardous chemicals and must be made available to all employees working with hazardous chemicals. The CHP describes the proper use, handling practices and procedures to be followed by faculty, staff, students, and all other personnel working with potentially hazardous chemicals in laboratory settings. This plan is based on best practices identified in, among other sources, “Prudent Practices for Handling Hazardous Chemicals in Laboratories,” published by the National Research Council, and the American Chemical Society’s “Safety in Academic Chemistry Laboratories” (www.acs.org).

Section 2: SCOPE

- The CHP applies to all laboratories, workshops, classrooms, and storage areas that use, store, or handle potentially hazardous materials and all individuals (including students) who work in these facilities. The information presented in the CHP is revised annually and represents best practices and provides a broad overview of the information necessary for the safe operation of laboratories that utilize potentially hazardous materials. The CHP can be printed physically in labs or online: [Chemical Hygiene Plan](#)

The CHP is not intended to be all inclusive. Departments, divisions, or other work units engaged in work with potentially hazardous materials that have unusual characteristics or are otherwise not sufficiently covered in the written CHP, must customize this document by

adding additional sections addressing these specific hazards and how to mitigate their risks, as appropriate. For assistance, please contact EHS.

Section 3: REGULATORY REQUIREMENTS

Implementation of the necessary work practices, procedures, and policies outlined in this CHP is required by the following:

- U.S. Environmental Protection Agency Regulations (40 CFR) (enforced by the Florida Department of Environmental Protection (FDEP))
- U.S. Occupational Health and Safety Agency Regulations (29 CFR)
- U.S. Department of Labor including 29 CFR 1910.1450 "Occupational Exposure to Hazardous Chemicals in Laboratories" (the "Laboratory Standard").

These regulations require that the CHP be readily available wherever potentially hazardous chemicals are used, handled, or stored. EHS will review and evaluate the effectiveness of this Plan at least annually and update, as necessary.

Section 4: PERSONNEL AND FACILITIES

4.1 Rights and Responsibilities

Employees and other personnel who work in laboratories have the right to be informed about the potential health hazards of the chemicals in their work areas and to be properly trained to work safely with these substances. This includes custodial staff and other personnel who work to clean and maintain laboratories. All personnel working with potentially hazardous chemicals are encouraged to report any concerns about unsafe work conditions to EHS.

Responsibility for the health and safety of the campus community extends to the highest administrative levels of NSU. Deans and Department Heads are responsible for establishing and maintaining programs in their areas and for providing a safe and healthy work environment.

The day-to-day responsibility for the management of laboratory safety and adherence to safe laboratory practices rests with the Principal Investigators and Faculty Members (Supervisor in Charge) within individual laboratories and associated departments. All personnel have a duty to fulfill their obligations with respect to maintaining a safe work environment.

All employees and other personnel working with potentially hazardous chemicals have the responsibility to conscientiously participate in training classes on general laboratory safety and review and be familiar with the contents of the Chemical Hygiene Plan (CHP). Those working with chemicals are responsible for staying informed about the chemicals in their

work areas, safe work practices and proper personal protective equipment (PPE) required for the safe performance of their job.

4.1.1 General Principles for Work with Laboratory Chemicals

There are some general principles that should always be considered when individuals are working with chemical substances. Chemicals are an integral part of any laboratory. Safety must be incorporated into the laboratory environment. The following principles have been incorporated in the NSU Chemical Hygiene Plan.

Minimize all exposures to chemicals. There are few laboratory chemicals without hazards. In general, specific chemicals will not be addressed individually, but will be included in classes of chemicals. General precautions are provided for each class of laboratory chemicals. In general, all skin contact with laboratory chemicals should be avoided. Additionally, instructors should use the least hazardous chemicals possible when designing lab processes.

Never underestimate the risk of working with chemicals. Even if a substance has no significant hazard, exposure should still be minimized. One should always assume that any mixture will be more toxic than its most toxic component. If a substance's toxicity is unknown, consider it toxic.

4.2 Chemical Hygiene Responsibilities

4.2.1 Responsibilities of Supervisor in Charge

The Supervisor in Charge has responsibility for the health and safety of all individuals working in his or her laboratory. The Supervisor in Charge may delegate safety duties but remains responsible for ensuring that delegated safety duties are adequately performed. The Supervisor in Charge is responsible for:

- Knowing all applicable health and safety rules and regulations, training and reporting requirements and standard operating procedures associated with safety for their laboratory;
- Identifying hazardous conditions or operations in the laboratory or other facility containing hazardous chemicals and determining safe procedures and controls, and implementing and enforcing standard safety procedures;
- Establishing standard safety operating procedures (general and protocol specific) and performing literature searches relevant to health and safety for laboratory-specific work;
- Ensuring that all chemicals are inventoried in NSU's current chemical inventory system;
- Providing approval for the use of hazardous chemicals in the laboratory or other facility with hazardous chemicals;

- Consulting with EHS on the use of higher risk materials, such as use of more hazardous substances;
- Ensuring laboratory or other personnel under his/her supervision have access to and are familiar with the appropriate safety procedures and resources;
- Training all staff and students he/she supervises to work safely with hazardous materials and maintain written records of laboratory-specific or other specialized training in the appropriate procedures and resources. Training must include information of the location and availability of hazard information;
- Promptly notifying EHS and Physical Plant Operations should he/she become aware that workplace engineering controls (e.g., fume hoods) and safety equipment (e.g., emergency showers/eyewashes, fire extinguishers, etc.) become non-operational;
- Ensuring all students are wearing/using the proper Personal Protective Equipment (PPE) in the correct manner at the correct times;
- Promptly reporting accidents and injuries to Public Safety.
- Informing facilities personnel, other non-laboratory personnel and any outside contractors of potential laboratory-related hazards when they are required to work in the laboratory environment.

4.2.2 Responsibilities of All Personnel Who Handle Chemicals in the Laboratory

All personnel in laboratories that use, handle or store potentially hazardous chemicals are responsible for:

- Following all verbal and written laboratory safety rules, regulations, and standard operating procedures required for the tasks assigned;
- Developing good personal chemical hygiene habits, including but not limited to, keeping the work areas safe and uncluttered;
- Understanding the hazards of materials and processes in their laboratory work prior to commencing;
- Utilizing appropriate measures to control identified hazards, including consistent and proper use of engineering controls, personal protective equipment, and administrative controls;
- Understanding the capabilities and limitations of PPE used by them;
- Gaining prior approval from the Supervisor in Charge for the use of chemicals and other materials;
- Immediately reporting all accidents and unsafe conditions to the Supervisor in Charge;
- Completing all required laboratory specific and applicable EHS training modules;

4.2.3 Responsibilities of EHS

EHS will provide a Safety Officer to work with administrators and employees to develop and implement the necessary chemical hygiene practices and policies.

- Perform and maintain records of safety inspections.
- Maintain and disseminate information on current regulatory requirements and changes in the Standards that affect NSU.
- Provide appropriate educational programs and training for laboratory personnel.
- Review the CHP at least annually and make changes to it as required by Federal/State/Local regulations.
- Work with administrators and other employees to develop and implement effective and appropriate chemical hygiene practices and policies.

4.2.4 Responsibilities of the Academic Chair, Associate/Assistant Dean, or University Designee

The Academic Chair or, if none, Associate/Assistant Dean or the individual(s) designated by the College shall be responsible for their laboratories as covered under the chemical hygiene plan. He/she will have complete authority (subject to appeal and review by the EHS and the President (or his/her designee)), and be responsible for the university's compliance with this mandated program as required in 29 CFR 1910.1450. The individual(s) designated by the university will oversee and enforce the policies and procedures in the NSU Chemical Hygiene Plan.

- Act as the chemical hygiene officer for their assigned area.
- Be responsible for compliance of required actions as written in the CHP by their department(s).
- Advise the safety officer of any additional program needs or improvements to the CHP.
- Ensure that employees know and follow the CHP, that PPE (personal protective equipment) is available and in good condition.
- Schedule required training and make sure it has been provided to all affected employees.
- Review inspection records.
- Be responsible for preparing required Laboratory Safety Rules (LSRs) for each laboratory. Copies shall be forwarded to the safety officer.
- Shall develop and maintain specific chemical spill protocols for the most likely spill risks. For example, if mercury is a spill risk in your laboratory, a plan for spill cleanup of mercury and a spill kit for a mercury spill must be available.

4.3 The Laboratory Facility

4.3.1 Facility Design

All OSHA regulated laboratories will have appropriate general ventilation available and adequate chemical storage areas. Sinks will be conveniently located and accessible in each

lab and/or prep area. An operational fume hood will be available for labs working with flammable and/or toxic chemicals. Each laboratory working with corrosive chemicals will have an eyewash and safety shower available. Waste containers for any glass, chemical and biohazard waste will be provided.

4.3.2 General Laboratory Maintenance

All laboratory equipment will be continually evaluated, and periodic calibration of equipment will be performed. Equipment checks will be the responsibility of the affected laboratory/department. The assigned individual will keep a record of all maintenance, deficiencies, and corrective actions. Physical Plant will be responsible for maintenance, repair and general cleaning of the lab and prep rooms. ***Custodial personnel are not responsible for cleaning countertops and upper laboratory surfaces.*** All required repairs should be documented by a work order submitted to the appropriate entity under Physical Plant.

4.3.3 Machine Guarding

All mechanical equipment shall be adequately furnished with guards that prevent access to electrical connections or moving parts, i.e. belts and pulleys. All laboratory employees shall inspect equipment prior to using it to ensure that the guards are in place and functioning.

- Safety shielding should be used for any operation having the potential for explosion. Centrifuges that are not fitted with an interlocking lid shall not be used.
- Gas hose connectors can be used for laboratory equipment, such as Bunsen burners, provided the following items are met:
 1. A shut off valve is installed where the connector is attached.
 2. The connector shall not exceed 6 feet.
 3. The connector shall not be concealed nor shall it pass from room to room or through walls, ceilings or floors.
 4. Only listed gas hose connectors shall be used. According to the National Fuel Gas Code, latex tubing is not allowed to be used as a connector between a gas source and a Bunsen burner.

4.3.4 Ventilation and Fume Hoods

General room ventilation cannot be relied upon to provide sufficient protection from toxic substances. Laboratories will draw air from non-laboratory areas and exhaust to the outside. Fume hoods will provide the primary working area for chemicals. All fume hoods shall be maintained as per manufacturer's specification, including an annual certification. Certification inspection reports will be kept by EHS, and certification tags/decals, indicating the current certification results, will be clearly visible on all fume hoods.

Any repair or deficiency shall be reported by work order to Physical Plant. The fume hood shall have a sign placed on it informing laboratory personnel that the hood is not working properly and should not be used until repaired. Any hood not passing the annual certification inspection is designated out of service immediately and will not be used until the hood has passed inspection. Inspection records will be reviewed by the Safety Officer during the months of August and September of each year. Inspection tags/decals will be placed on each fume hood. Results shall be marked on the tag for each test performed.

Section 5: CHEMICAL HAZARD COMMUNICATION

5.1 Regulatory Requirements

NSU has an established Hazard Communication Program that complies with 29 CFR 1910.1200, the Federal Hazard Communication Standard from OSHA. The purpose of NSU's Hazard Communication Program is to ensure that all employees have the right to receive information regarding the hazardous substances to which they may have been exposed at work. NSU is responsible for providing information about the hazardous substances in our workplace, the associated hazards, and the control of these hazards, through a comprehensive hazard communication program that is summarized below (see NSU's *Hazard Communications Plan* for more details). The requirements of the Hazard Communication Program apply to laboratory environments at NSU due to the potential for large scale experiments and for activities that may occur outside of areas where engineering controls are available.

5.2 List of Hazardous Substances

All labs are required to keep their chemical inventory up to date in NSU's current chemical inventory system, which is always accessible to EHS. For each hazardous substance on their inventory, specific information (SDS/MSDS) on any associated health or safety hazards must be made readily available **in English** (other languages may be used in conjunction with English) to all laboratory personnel. Compressed gases, kits containing chemicals, medias, diluents, and preserved specimens need to be included on the inventory list. EHS will ensure that the SDS's of inventoried chemicals are maintained, review the chemical inventory on a periodic basis, and check the chemical inventory upon inspection.

5.3 Hazard Determination

The Supervisor in Charge of each laboratory is responsible for determining whether any of the items on their chemical inventory are subject to the requirements of the hazard communication regulation.

The term “hazardous substance” refers to any chemical for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed individuals. Hazardous substances include, but are not limited to, those chemicals that pose either a physical or health hazard:

Physical hazard means a chemical for which there is scientifically valid evidence that it is a combustible liquid, a compressed gas, explosive, flammable, an organic peroxide, an oxidizer, pyrophoric, unstable (reactive) or water reactive.

Health hazard means a chemical for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed employees. The term "health hazard" includes chemicals which are carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, neurotoxins, agents which act on the hematopoietic system, and agents which damage the lungs, skin, eyes, or mucous membranes.

Inventory items found to meet the above are subject to the requirements outlined below.

SAFETY DATA SHEETS (SDS)/MATERIAL SAFETY DATA SHEETS (MSDS)

An SDS/MSDS contains all the necessary information needed to safely use a chemical. An SDS must be available for each hazardous substance in a laboratory's chemical inventory. Supervisors in Charge are responsible for keeping their chemical inventory current, so that the SDSs will be available to all laboratory employees throughout the workday. SDSs in the current chemical inventory system will be readily available in the event of an emergency. Forward any new/updated SDSs to EHS.

LABELS AND OTHER FORMS OF WARNING

Labeling requirements for all hazardous substances are summarized as follows:

- All containers of hazardous materials must be labeled with the identity of the hazardous substance
- The label must contain all applicable hazard warning statements

- The name and address of the chemical manufacturer or other responsible party must be present
- Manufacturer's product labels must remain on all containers, and must not be defaced in any way.
- Labels must be legible, in English, and prominently displayed
- Secondary containers (such as spray bottles) must be labeled with the identity of the substance and appropriate hazard warnings
- Newly synthesized compounds must be labeled with the appropriate hazard warnings based on the knowledge of the chemical and physical properties of that substance.
- Additional information on container labeling is provided in Appendix B.

GLOBAL HARMONIZATION SYSTEM (HAZARD COMMUNICATION STANDARD
PICTOGRAMS)

| | | |
|--|--|---|
| <p align="center">Health Hazard</p>  <p align="center">Carcinogen Mutagenicity Reproductive Toxicity Respiratory Sensitizer Target Organ Toxicity Aspiration Toxicity</p> | <p align="center">Flame</p>  <p align="center">Flammables Pyrophorics Self-Heating Emits Flammable Gas Self-Reactives Organic Peroxides</p> | <p align="center">Exclamation Mark</p>  <p align="center">Irritant (skin and eye) Skin Sensitizer Acute Toxicity Narcotic Effects Respiratory Tract Irritant</p> |
| <p align="center">Gas Cylinder</p>  <p align="center">Gases Under Pressure</p> | <p align="center">Flame Over Circle</p>  <p align="center">Oxidizers</p> | <p align="center">Skull and Crossbones</p>  <p align="center">Acute Toxicity (fatal or toxic)</p> |
| <p align="center">Corrosion</p>  <p align="center">Skin Corrosion/Burns Eye Damage Corrosive to Metals</p> | <p align="center">Environment (Non-Mandatory)</p>  <p align="center">Aquatic Toxicity</p> | <p align="center">Exploding Bomb</p>  <p align="center">Explosives Self-Reactives Organic Peroxides</p> |

5.3 Employee/Student Information and Training

Employee/Student training on specific workplace hazards must be provided at the time of initial assignment. Additional employee/student training is required whenever a new hazard is introduced into the work environment and must be provided within 30 days of receiving the SDS or other safety information. All training must be in the appropriate language, educational level, and vocabulary for laboratory personnel. Employees/students must be given the opportunity to ask questions. Each Supervisor in Charge is responsible for training their own personnel (employees and students) on lab-specific chemical hazards and safety procedure. EHS provides general laboratory safety training. At a minimum, all employees who work in laboratories with chemicals must be trained in the following:

Personal Protective Equipment (PPE) - selection, location and care of same

Laboratory Safety- laboratory rules (see appendix A)

Hazard Communication – how to access SDSs

Section 6: CLASSES OF HAZARDOUS CHEMICALS

6.1 Identification and Classification of Hazardous Chemicals

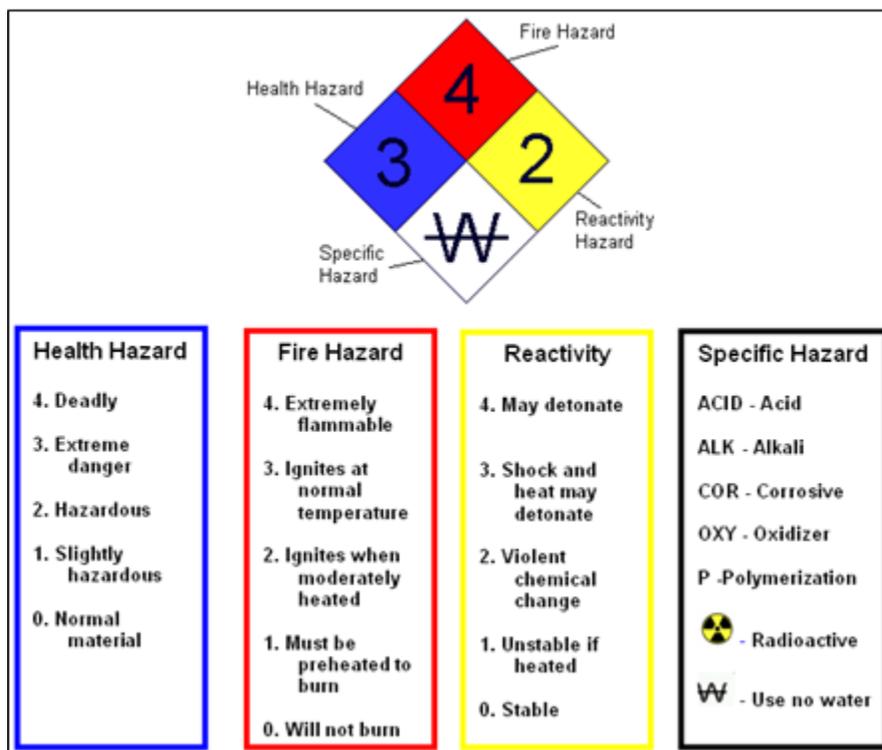
Chemicals can be divided into several different hazard classes. The hazard class will determine how these materials should be stored and handled and what special equipment and procedures are needed to use them safely. Each chemical container, whether supplied by a vendor or produced in the laboratory, must include labels that clearly identify the hazards associated with that chemical. In addition to specific chemical labels, hazard information for specific chemicals can be found by referencing the Safety Data Sheet (SDS) for that chemical. Note that products regulated under the Food and Drug Administration are not covered under the Hazard Communication Standard. This includes pharmaceuticals and drugs in solid form.

Rooms containing hazardous chemicals must be labeled with a National Fire Prevention Association (NFPA) door placard that gives an overview of the key chemical hazards contained within that room. The chemical inventory system may be used to generate the content of these signs.

These postings have the familiar four colors, 0-4 number rating that quickly supplies the hazard information broken down into four hazard classes, with 0 indicating a low level of hazard and 4 indicating a high hazard level. The four chemical hazard types correspond to the four-color areas: red indicates a flammability hazard, yellow indicates a reactive

hazard, blue indicates a health hazard and the white area is reserved for special hazards that are identified by hazard symbols or labels to indicate hazards such as radioactivity, biohazard, water reactive chemicals, etc. Each of these hazards has a different set of safety precautions associated with them. Figure 6.1 illustrates the NFPA rating system.

Fig 6.1



All laboratory workers must understand the types of hazards, recognize the routes of exposure, and be familiar with the major hazard classes of chemicals. In many cases, the specific hazards associated with new compounds and mixtures will not be known, so it is recommended that all chemical compounds be treated as if they were potentially harmful and to use appropriate eye, inhalation, and skin protection equipment.

6.1.1 Fire Hazards

Several highly flammable substances are in common use in campus laboratories. These materials must be stored in flammable storage cabinets if aggregate quantities of 10 gallons/room or more are stored in the lab. Flame-resistant laboratory coats must be worn when working with flammable materials and/or with procedures where a significant fire risk is present (e.g., when working with open flame, etc.). These materials can constitute a significant immediate threat and should be treated with particular



care, even though the use of these materials is common in the laboratory setting. Particular attention should be given to preventing static electricity and sparks when handling flammable liquids.

1. **Flammable substances** stored in the laboratory shall be in minimal quantities and segregated. A material is considered flammable if it can generate sufficient vapors to ignite at temperatures below 100 degrees Fahrenheit.

Precautions: Flammables may not be stored in any refrigerator except those certified as explosion proof. All domestic refrigerators in the lab will be labeled with “Do Not Store Flammables in This Refrigerator”. Signs can be requested from the College sign shop. Domestic refrigerators shall only be purchased if they will not be used for flammable storage and there is at least one explosion safe refrigerator within the immediate area. Large amounts of flammables shall be kept in an approved flammable storage cabinet. When transferring flammable liquids from bulk, the containers shall be bonded and grounded. All flammable storage cabinets are to be properly vented to allow proper vapor dissipation.

2. **Combustible Materials:** Materials that can generate sufficient vapors to ignite at temperatures at or above 100 degrees Fahrenheit. Follow the same handling precautions as flammable products.

6.1.2 Reactive Chemicals

Reactive and explosive substances are materials that decompose under conditions of mechanical shock, elevated temperature, or chemical action, and release of large volumes of gases and heat. Some materials, such as peroxide formers, may not be explosive, but may form explosive substances over time. These substances pose an immediate potential hazard and procedures which use them must be carefully reviewed. These materials must also be stored in a separate flame-resistant storage cabinet or, in many cases, in a laboratory grade refrigerator or freezer that are designed for flammable and reactive chemicals (*unless they are peroxide formers*). Pyrophoric chemicals are a special classification of reactive materials that spontaneously combust when in contact with air and require laboratory- specific training. Flame-resistant laboratory coats must always be worn when working with pyrophoric chemicals.

6.1.3 Health Hazards

OSHA uses the following definition for health hazards:

The term “health hazard” includes chemicals which are carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, neurotoxins, agents which act on the hematopoietic systems, and agents which damage the lungs, skin, eyes, or mucous membranes.



The major classes of “hazardous” and “particularly hazardous substances (aka acute hazardous substances)” and their related health and safety risks are detailed below.

6.1.4 Corrosives

As a health hazard, corrosive substances cause destruction of, or alterations in, living tissue by chemical action at the site of contact. Corrosive chemicals are those with a pH 4.0 or lower or a pH 9.0 or higher. A highly corrosive chemical has a pH of 2.0 or lower or a pH of 12.5 or higher. Solutions of all acids and bases at concentrations greater than 1 molar (1M) are corrosive.

Major classes of corrosive substances include:

- Strong acids – e.g., sulfuric, nitric, hydrochloric and hydrofluoric acids
- Strong bases – e.g., sodium hydroxide, potassium hydroxide and ammonium hydroxide
- Dehydrating agents – e.g., sulfuric acid, sodium hydroxide, phosphorus pentoxide and calcium oxide
- Oxidizing agents – e.g., hydrogen peroxide, chlorine and bromine.



They can be solid, liquid or gas and act on the body tissue through direct contact, inhalation, or ingestion. Corrosive liquids are responsible for most corrosive based injuries. Corrosive gases are the most serious because they can be readily absorbed into the body through inhalation.

Precautions: Eye protection and rubber gloves should always be worn when handling corrosives. Strong oxidizing agents should always be stored in glass or other inert material (preferably unbreakable). In most cases, these materials should be segregated from other chemicals and require secondary containment when in storage. Safety rubber bottle carriers or non-breakable bottles shall be used for the transport of strong acids and bases from one location to another. Containers and equipment used for storage shall be corrosion resistant. Acids and bases shall be stored separately. Organic acids shall be stored separate from oxidizers including oxidizing acids.

6.1.5 Irritants

Irritants are defined as non-corrosive chemicals that cause reversible inflammatory effects on living tissue by chemical action at the site of contact. A wide variety of organic and inorganic compounds, including many chemicals that are in a powder or crystalline form, are irritants. The most common example of an irritant may be ordinary smoke which can irritate the nasal passages and respiratory system. Consequently, eye and skin contact with all laboratory

chemicals should always be avoided. Symptoms of exposure can include reddening or discomfort of the skin and irritation to respiratory systems.

6.1.6 Sensitizers

A sensitizer (allergen) is a substance that causes exposed people to develop an allergic reaction in normal tissue after repeated exposure to the substance. Examples of sensitizers include diazomethane, chromium, nickel, formaldehyde, isocyanates, arylhydrazines, benzylic and allylic halides, and many phenol derivatives.

Sensitizer exposure can lead to all of the symptoms associated with allergic reactions or can increase an individual's existing allergies.



6.1.7 Hazardous Substances with Toxic Effects on Specific Organs

Substances included in this category include:

- Hepatotoxins – i.e., substances that produce liver damage, such as nitrosamines and carbon tetrachloride
- Nephrotoxins – i.e., agents causing damage to the kidneys, such as certain halogenated hydrocarbons
- Neurotoxins – i.e., substances which produce their primary toxic effects on the nervous system, such as mercury, acrylamide and carbon disulfide
- Agents which act on the hematopoietic system – e.g., carbon monoxide and cyanides which decrease hemoglobin function and deprive the body tissues of oxygen
- Agents which damages lung tissue – e.g., asbestos and silica.

Symptoms of exposure to these materials vary. Staff working with these materials should review the SDS for the specific material being used and should take special note of the associated symptoms of exposure.

6.1.7 Particularly Hazardous Substances

OSHA recognizes that some classes of chemical substances pose a greater health and safety risk than others. To differentiate this different risk characteristic, OSHA identifies two categories of hazardous chemicals:

1. Hazardous chemicals;
2. Particularly hazardous substances (aka acute hazardous substances or “p-listed” substances).

3. Substances that pose such significant threats to human health are classified as "particularly hazardous substances" (PHSs). The OSHA Laboratory Standard requires that special provisions be established to prevent the harmful exposure of employees to PHSs, including the establishment of designated areas and signage for their use.

Particularly hazardous substances are divided into three primary types:

1. Reproductive Toxins
2. Carcinogenics
3. Acute Toxins

Different between p-listed and PHS Reproductive Toxins

Reproductive toxins include any chemical that may affect the reproductive capabilities, including chromosomal damage (mutations) and effects on fetuses (teratogenesis).

Carcinogens

Carcinogens are chemical or physical agents that cause cancer. Generally, they are chronically toxic substances; that is, they cause damage after repeated or long-duration exposure, and their effects may only become evident after a long latency period. Chronic toxins are particularly insidious because they may have no immediately apparent harmful effects.

Acute Toxins

Substances that have a high degree of acute toxicity are interpreted by OSHA as being substances that "may be fatal or cause damage to target organs as the result of a single exposure or exposures of short duration." These chemicals associated chemical waste, and storage containers must be handled with care to prevent cross contamination of work areas and unexpected contact. These chemicals must be labeled as "Toxic." Empty containers of these substances must be packaged and disposed of as hazardous waste without rinsing trace amounts into the sanitary sewer system.



Currently, in NSU there are two p-listed chemicals: Sodium cyanide and Potassium cyanide. Both substances are p-listed.

1. **Sodium cyanide and Potassium cyanide (Acute Toxin):**

Both are white, granular or crystalline solid with a faint, almond-like odor. They are incompatible with strong oxidizers (such as acids, acid salts, chlorates & nitrates) . The targets are the eyes, skin, cardiovascular system, central nervous system, thyroid, and blood causing irritation, lassitude

(weakness, exhaustion), headache, confusion; nausea, vomiting; increased respiratory rate; slow gasping respiration; thyroid and blood changes; asphyxia.

Exposure limits

- OSHA PEL of $5\text{mg}/\text{m}^3$ as an 8-hour time-weighted average
- NIOSH REL of $5\text{mg}/\text{m}^3$ as a 10-minute ceiling limit

Personal Protection/Sanitation

Skin: Prevent skin contact wearing gloves, lab coats, aprons.

Eyes: Prevent eye contact wearing goggles or face shields

Wash skin: When contaminated and at the end of each work shift, and prior to eating, drinking, smoking, etc.

Remove cloth or instruments: When wet or contaminated

Change PPE: Daily before leaving the premises

The lab must have: Eyewash, Quick drench

If exposure occurs in:

Eye: Irrigate immediately and seek medical attention

Skin: Soap wash immediately and seek medical attention

Breathing: Use respiratory support and seek medical attention immediately

Swallow: Medical attention immediately

6.1.8 Compressed Gasses

Compressed gasses represent three different types of gas products: compressed gases, liquefied gases, and cryogenic gases. Compressed gases may be grouped into various hazard classifications based on their physical or health properties. A gas could be corrosive, flammable, toxic or an oxidizer. An additional physical hazard is because gases are stored under pressure. Cryogenics create unique hazards including embrittlement of materials and skin or eye burns upon contact with the liquid. Pressure is a hazard because of the large expansion ratio from liquid to gas, causing pressure to build up in containers.

Precautions: Gas cylinders shall always be transported using a hand truck and with the valve cap in place. All cylinders must be secured in a cart or chained in place against a wall. Exposure of compressed gas cylinders to excessive heat or direct sunlight shall be avoided. Never drop cylinders or permit them to strike each other. Never tamper with safety devices in valves or cylinders. No part of a cylinder shall be subjected to temperatures higher than 125 degrees Fahrenheit. A flame shall never be permitted to meet any part of a compressed gas cylinder. Do not store full and empty gas cylinders together. Bond and ground all cylinders, lines and equipment used with flammable gases. Use compressed gases only in a well-ventilated area. Toxic, flammable, and corrosive gases should be handled in a hood. Replace any



valve outlet and protective caps originally shipped with cylinder. Mark or label cylinder “empty” and store in a designated area.

6.1.9 Peroxide Formers

Materials which react with oxygen to form peroxides, which can explode on impact, heat or friction. Peroxide-forming compounds can be divided into three categories:

- 1.) Class A Severe Peroxide Hazard: Compounds forming peroxides that can spontaneously decompose during storage. Maximum storage time is three (3) months. Examples are isopropyl ether, potassium metal, vinylidene chloride, sodium amide.
- 2.) Class B Concentration Hazard: Compounds forming peroxides that require the addition of a certain amount of energy (distillation, shock) to explosively decompose. Maximum storage time is twelve (12) months. Examples are cyclohexene, diacetylene, ether, dioxane, methyl acetylene, methyl isobutylketone, tetrahydrofuran.
- 3.) Class C Shock and Heat Sensitive: Compounds that have the potential to form peroxide polymers, a highly dangerous form of peroxide, which precipitate from solution easily and are extremely heat and shock sensitive. Maximum storage time is twelve (12) months. Examples are acrylic acid, acrylonitrile, butadiene, styrene, methyl methacrylate, vinyl acetate, vinyl chloride, vinyl pyridine, and chloroprene.



Precautions: All peroxide formers shall be labeled, dated upon receipt, dated upon opening, and used by or disposed of before the maximum storage time. A test kit must be available to monitor for the presence of peroxides. **Do not open any container that has crystal formation around the lid.** Consult the chemical’s SDS for specific storage requirements.

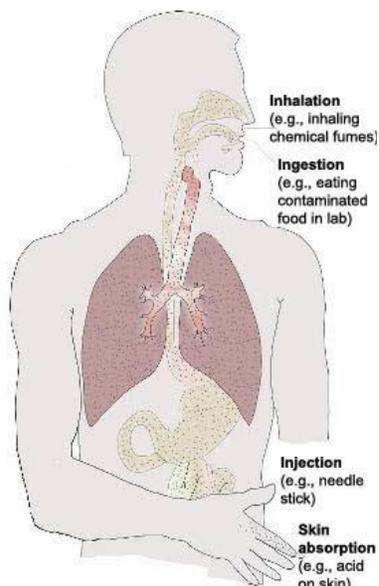
Section 7: HOW TO REDUCE EXPOSURE TO HAZARDOUS CHEMICALS

Hazardous chemicals require a carefully considered, multi-tiered approach to ensure safety. There are four primary routes of exposure for chemicals which have associated health hazards (illustrated in Figure 7.1):

1. Inhalation;
2. Absorption (through the skin or eyes);
3. Ingestion; and
4. Injection (skin being punctured by a contaminated sharp object or uptake through an existing open wound).

Of these, the most likely route of exposure in the laboratory is by inhalation. Many hazardous chemicals may affect people through more than one of these exposure modes, so it is critical that protective measures are in place for each of these uptake mechanisms.

Figure 7.1 – Routes of Exposure



Safety Controls

Safety controls are divided into four main classifications:

1. Engineering Controls;
2. Administrative Controls;
3. Protective Apparel (PPE);
4. Protective Equipment.

Elements of these three classes are used in a layered approach to create a safe working environment. The principles of each of these elements are detailed below.

7.1 Engineering Controls

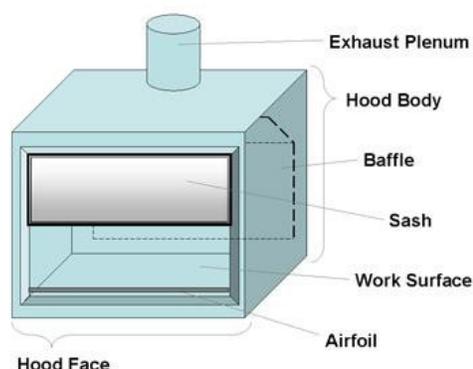
Engineering controls include all “built in” safety systems. These controls offer the first line of protection and are highly effective in that they generally require minimal special procedures or actions on the part of the user except in emergency situations. Additionally, engineering controls often involve the replacement or elimination of hazards for a work environment. A fundamental and very common example is the laboratory fume hood which is very effective at containing chemical hazards and protecting users from inhalation hazards. Other examples of

engineering controls include general room ventilation, flammable material storage units, and secondary containment.

7.1.1 Fume Hoods

Fume hoods are the most used local exhaust system on campus. Other methods include vented enclosures for large pieces of equipment or chemical storage, and portable exhaust systems for capturing contaminants near the point of release. Some systems are equipped with air cleaning devices (HEPA filters or carbon absorbers). Figure 7.2 displays the key components of a fume hood.

Figure 7.2 – Fume Hood



It is advisable to use a laboratory hood when working with all hazardous substances. In addition, a laboratory hood or other suitable containment device must be used for all work with "particularly hazardous substances." A properly operating and correctly used laboratory hood can reduce or eliminate volatile liquids, dusts, and mists. Fume hoods are evaluated for operation and certified by EHS on an annual basis. These annual evaluations check the fume hood air flow velocity to ensure that the unit will contain hazardous vapors. Data on annual fume hood monitoring is maintained by EHS. A complete report of fume hood monitoring data must be kept for one year; summary data must be maintained for 5 years.

Each fume hood should have a current calibration sticker and a marker indicating the highest sash height to be used when working with hazardous materials. Contact Plant Operations for a hood evaluation if these labels are missing. Testing will follow Federal and State requirements for procedure and results.

When hazardous materials are in a fume hood, but it is not under active use (e.g., during an unattended reaction or experiment), the sash should be closed. Fume hoods are not designed for storage of hazardous materials.

Routine maintenance and repairs of fume hoods are coordinated by EHS. Hood users may route requests for hood repair directly to EHS by submitting a work order.

General Rules for Fume Hood Use

The following general rules should be followed when using laboratory hoods:

1. Fume hoods should not be used for work involving hazardous substances unless they have a certification label that confirms certification has occurred within the past year
2. Always keep hazardous chemicals >6 inches behind the plane of the sash
3. **Never** put your head inside an operating laboratory hood. The plane of the sash is the barrier between contaminated and uncontaminated air
4. Work with the hood sash in the **lowest practical position**. The sash acts as a physical barrier in the event of an accident. Keep the sash closed when not conducting work in the hood
5. Do not clutter your hood with unnecessary bottles or equipment. Keep it clean and clear. Only materials actively in use should be in the hood
6. Do not make any modifications to hoods, duct work, or the exhaust system without first contacting EHS.
7. Do not use large equipment in laboratory hoods unless the hood is dedicated for this purpose, as large obstructions can change the airflow patterns and render the hood unsafe
8. Shut your sash! For energy efficiency, make sure to shut your sash when the hood is not in use

Laboratory fume hoods are one of the most important pieces of equipment used to protect laboratory and other workers from exposure to hazardous chemicals. Chemical fume hoods should be inspected upon installation, renovation, when a deficiency is reported, or a change has been made to the operating characteristics of the hood.

7.1.2 Other Engineering Controls

In addition to the elements listed above, consideration must be given to providing sufficient engineering controls for the storage and handling of hazardous materials. No more than 10 gallons of flammable chemicals may be stored outside of an approved flammable storage cabinet. For refrigerated or frozen storage, flammable and explosive materials must be kept in refrigeration units specifically designed for storing these materials. Generally, these units do not have internal lights or electronic systems that could spark and trigger an ignition;

additionally, the cooling elements are external to the unit. These units should be labeled with a rating from Underwriters Laboratory or other certifying organization.

Secondary containment must be provided for corrosive and reactive chemicals and is recommended for all other hazardous chemicals. Secondary containment should be made of chemically resistant materials and should be sufficient to hold the volume of at least the largest single bottle stored in the container.

Laboratories that use hazardous materials must contain a sink, kept clear for hand washing (stocked with soap and towels) to remove any final residual contamination. Hand washing is required whenever a staff member who has been working with hazardous materials plans to exit the laboratory or work on a project that does not involve hazardous materials.

7.2 Administrative Controls

The next layer of safety controls is Administrative Controls. These controls consist of policies and procedures; they are not generally as reliable as engineering controls in that the user must carefully follow the appropriate procedures and must be fully trained and aware to do so.

EHS requires that each laboratory have safety procedures, which include safety practices, for any work that involves hazardous materials. These safety procedures should be laboratory specific and communicated via lab specific trainings, Lab Safety Rules, or Job Safety Analyses and properly documented.

7.2.1 Laboratory Safety Rules

Laboratory Safety Rules (LSR) (*Appendix A*) relevant to safety and health considerations must be developed and followed when laboratory work involves the use of hazardous chemicals. LSRs are written instructions that detail the steps that will be performed during a given experimental procedure and include information about potential hazards and how these hazards will be mitigated. LSRs should be written by laboratory personnel who are most knowledgeable and involved with the experimental process. The development and implementation of LSRs is a core component of promoting a strong safety culture in the laboratory and helps ensure a safe work environment.

While general guidance regarding laboratory work with chemicals is contained in this plan, the Supervisor in Charge is required to develop and implement laboratory-specific LSRs for certain hazardous chemicals and PHS that are used in their laboratories. All personnel/students responsible for performing the procedures detailed in the LSR shall sign the LSR acknowledging the contents, requirements and responsibilities outlined in the LSR. The LSRs shall be reviewed by qualified personnel and shall be amended and subject to additional review and approval by the Instructors where changes or variations

in conditions, methodologies, equipment, or use of the chemical occurs. For certain hazardous chemicals, PHS, or specialized practices, consideration must be given to whether additional consultation with safety professionals is warranted or required.

When drafting an LSR, consider the type and quantity of the chemical being used, along with the frequency of use. The Safety Data Sheet (SDS) for each hazardous chemical or PHS that will be addressed in the LSR should be referenced during LSR development. The SDS lists important information that will need to be considered, such as exposure limits, type of toxicity, warning properties, and symptoms of exposure. If a new chemical will be produced during the experiment, an SDS will not necessarily be available. In these cases, the toxicity is unknown, and it must be assumed that the substance is particularly hazardous, as a mixture of chemicals will generally be more toxic than its most toxic component.

7.2.2 Chemical Monitoring

Regular monitoring of airborne concentrations is not usually justified, but shall be instituted in select cases when deemed necessary by responsible faculty and implemented by the safety officer:

- 1) There is any reason to believe that exposure levels routinely exceed the TLV, PEL or STEL values.
- 2) There is a redesign of ventilation or hoods.
- 3) A highly toxic substance is used regularly in the lab.
- 4) Personal exposure has occurred.
- 5) Formaldehyde is used (initial monitoring is required).
- 6) Anesthetic gases are used (initial monitoring is required).
- 7) Monitoring reveals an exposure level above what is allowed.

EHS will notify the affected employees of the results.

7.3 Personal Protective Equipment (PPE)

Personal protective equipment (PPE) serves as a person's last line of defense against chemical exposures and is required by everyone entering a laboratory containing hazardous chemicals.

The PPE policy outlines the basic PPE requirements, which include but are not limited to:

- Full length pants and close-toed shoes, or equivalent
- Protective gloves, laboratory coats, & eye protection when working with, or adjacent to, hazardous chemicals
- Flame resistant laboratory coats for high hazard materials, pyrophorics, and flammables.

The primary goal of basic PPE is to mitigate, at a minimum, the hazard associated with exposure to hazardous substances. In some cases, additional, or more protective, equipment

must be used. If a project involves a chemical splash hazard, chemical goggles are required; face shields may also be required when working with chemicals that may cause immediate skin damage. Safety goggles differ from safety glasses in that they form a seal with the face, which completely isolates the eyes from the hazard. If a significant splash hazard exists, heavy gloves, protective aprons and sleeves may also be needed. Gloves should only be used under the specific condition for which they are designed, as no glove is impervious to all chemicals. It is also important to note that gloves degrade over time, so they should be replaced as necessary to ensure adequate protection.

7.3.1 How to Use and Maintain PPE

Personal protective equipment should be kept clean and stored in an area where it will not become contaminated. Personal protective equipment should be inspected prior to use to ensure it is in good condition. It should fit properly and be worn properly. If it becomes contaminated or damaged, it should be cleaned or repaired when possible, or discarded and replaced.

7.3.2 Contaminated Clothing/PPE

In cases where spills or splashes of hazardous chemicals on clothing or PPE occur, the clothing/PPE should immediately be removed and placed in a closed container that prevents release of the chemical. Heavily contaminated clothing/PPE resulting from an accidental spill should be disposed of as hazardous waste. Non-heavily contaminated laboratory coats should be cleaned and properly laundered, as appropriate. Laboratory personnel should **never** take contaminated items home for cleaning or laundering. Persons or companies hired to clean contaminated items must be informed of potentially harmful effects of exposure to hazardous chemicals and must be provided with information to protect themselves.

7.3.3 Respiratory Protection

Typically, respiratory protection is not needed in a laboratory. Under most circumstances, safe work practices, small scale usage, and engineering controls (fume hoods, biosafety cabinets, and general ventilation) adequately protect laboratory workers from chemical and biological hazards. If a university employee suspects a respirator may be necessary for work, they are required to contact EHS **before** the work in question is performed. (See NSU Respiratory Protection Plan Policy/Procedure No. 14)

7.4 Protective Equipment

New personnel must be instructed in the location of fire extinguishers, safety showers, and other safety equipment *before* they begin work in the laboratory. This training is considered part of the laboratory specific training that all staff members must receive.

7.4.1 Fire Extinguishers

All laboratories working with combustible or flammable chemicals must be outfitted with appropriate fire extinguishers. All extinguishers should be mounted on a wall in an area free of clutter or stored in a fire extinguisher cabinet. Personnel should be familiar with the location, use and classification of the extinguishers in their laboratory.

Laboratory personnel are not required to extinguish fires that occur in their work areas and should not attempt to do so unless:

- It is a small fire (i.e., small trash can sized fire)
- Appropriate training has been received
- It is safe to do so

Any time a fire extinguisher is used, no matter for how brief a period, the Supervisor in Charge, or most senior laboratory personnel present at the time of the incident, must immediately report the incident to Public Safety.

7.4.2 Safety Showers

All laboratory operations with the risk of being splashed with corrosive chemicals must have immediate access to a safety shower.

In the event of an emergency, individuals using the safety shower should be assisted by an uninjured person to aid in decontamination and should be encouraged to stay in the safety shower for 15 minutes to remove all hazardous material.

All safety shower stations require signage and are tested by Physical Plant on an annual basis and flushed monthly. If a safety shower needs repair, call submit a work order and give the specific location of the defective equipment.



7.4.2 Eye Washes

All laboratory operations with the risk of being splashed with corrosive chemicals must have immediate access to an eye wash.

In the event of an emergency, individuals using the eye wash should be assisted by an uninjured person to aid in decontamination and should be encouraged to irrigate their eye thoroughly for 15 minutes to remove all hazardous material.

All eye washes must be tested/flushed weekly by laboratory staff and documented on

https://www.nova.edu/portal/ehs/forms/ehs_eyewash_inspection.pdf.

7.4.3 Laboratory Doors

Because many areas of university buildings may contain critical fire doors as part of the building design. To help maintain this element of the fire containment, all laboratory doors should remain closed unless they are on a magnetic self-closing or other automated self-closing system.

7.5 Safe Laboratory Habits

As detailed above, a safety program must include layers of policies and protective equipment to allow for a safe working environment, but to achieve effectiveness, a number of fundamental elements must become basic working habits for the research community. Some of these elements are detailed below:

Personal Protective Equipment:

- Wear closed-toe shoes and full length pants, or equivalent, at all times when in the laboratory
- Utilize appropriate PPE while in the laboratory and while performing procedures that involve the use of hazardous chemicals or materials
- Confine long hair and loose clothing
- Remove laboratory coats or gloves immediately on significant contamination, as well as before leaving the laboratory
- Avoid use of contact lenses in the laboratory unless necessary. If they are used, inform supervisor so special precautions can be taken
- Use any other protective and emergency apparel and equipment as appropriate. Be aware of the locations of first aid kits and emergency eyewash and shower station

Chemical Handling:

- Properly label and store all chemicals. Use secondary containment at all times
- Deposit chemical waste in appropriately labeled receptacles and follow all other waste disposal procedures of the Chemical Hygiene Plan
- Do not smell or taste chemicals
- Never use mouth suction for pipetting or starting a siphon
- Do not dispose of any hazardous chemicals through the sewer system
- Be prepared for an accident or spill and refer to the emergency response procedures

for the specific material. Procedures should be readily available to all personnel. Information on minor chemical spill mitigation may also be referenced in *Appendix D*. For general guidance, the following situations should be addressed:

- ✓ Eye Contact: Promptly flush eyes with water for a prolonged period (15 minutes) and seek medical attention
- ✓ Skin Contact: Promptly flush the affected area with water and remove any contaminated clothing. If symptoms persist after washing, seek medical attention

Equipment Storage and Handling:

- Store laboratory glassware with care to avoid damage. Use extra care with Dewar flasks and other evacuated glass apparatus; shield or wrap them to contain chemicals and fragments should implosion occur
- Use certified fume hoods, glove boxes, or other ventilation devices for operations which might result in release of toxic chemical vapors or dust. Preventing the escape of these types of materials into the working atmosphere is one of the best ways to prevent exposure
- Keep hood closed when you are not working in the hood
- Do not use damaged glassware or other equipment
- Do not use uncertified fume hoods or glove boxes for hazardous chemical handling
- Avoid storing materials in hoods
- Do not allow the vents or air flow to be blocked

Laboratory Operations:

- Keep the work area clean and uncluttered
- Seek information and advice about hazards, plan appropriate protective procedures, and plan positioning of equipment before beginning any new operation
- If unattended operations are unavoidable, and have been approved by the Instructor, place an appropriate sign on the door, leave lights on, and provide for containment of toxic substances in the event of failure of a utility service (such as cooling water)
- Be alert to unsafe conditions and ensure that they are corrected when detected
- Research staff and students should never work alone on procedures involving hazardous chemicals, biological agents, or other physical hazards
- Do not engage in distracting behavior such as practical jokes in the laboratory. This type of conduct may confuse, startle, or distract another worker

Food/Drink:

- No food or drink may be present or consumed in a laboratory or any other space in which hazardous materials are stored or handled.
- Do not smoke, chew gum, or apply cosmetics in areas where laboratory chemicals are present; wash hands before conducting these activities
- Do not store, handle, or consume food or beverages in storage areas, refrigerators, glassware or utensils which are also used for laboratory operations
- Wash areas of exposed skin well before leaving the laboratory

Section 8: INVENTORYING, LABELING, STORAGE AND TRANSPORT

8.1 Chemical Inventories

Procurement: Chemicals may only be acquired through the university purchasing system. Chemicals may not be brought in from home, nor may a department accept a gift of chemicals without the permission of EHS. For substances described in 42 CFR 73.4 or 73.5 (“Select Agents and Toxins”) <http://www.gpo.gov/fdsys/granule/CFR-2010-title42-vol1/CFR-2010-title42-vol1-sec73-4> approval by EHS is required.

When a hazardous substance is received, the substance will be immediately entered into the current chemical inventory system, and the Safety Data Sheet (SDS) will be reviewed prior to use. Information on the proper handling, storage and disposal will be disseminated to those individual employees that will be handling the material. No container shall be accepted from a vendor without a proper identification label and an SDS, unless one is already on file. Toxic substances shall be segregated in a well-identified area with local exhaust ventilation. Any chemicals that are highly toxic shall be placed in unbreakable secondary containers. Open containers shall be stored on spill trays.

Each laboratory is required to maintain a current chemical inventory that lists the chemicals and compressed gases used and stored in the lab and the quantity of these chemicals. Chemical inventories are used to ensure compliance with storage limits and fire regulations and can be used in an emergency to identify potential hazards for emergency response operations.

The chemical inventory report/list should be reviewed prior to ordering new chemicals and only the minimum quantities of chemicals necessary should be purchased. As new chemicals are

added to the inventory, each laboratory must confirm that they have access to the Safety Data Sheets (SDS) for those chemicals. Where practical, each chemical should be dated so that expired chemicals can be easily identified for disposal. Inventory the materials in your laboratory frequently (at least annually) to avoid overcrowding with materials that are no longer useful and note the items that should be replaced, have deteriorated, or show container deterioration. Unneeded items should and compromised items should be discarded as chemical waste.

Indications for disposal include:

- Cloudiness in liquids
- Color change
- Evidence of liquids in solids, or solids in liquids
- "Puddling" of material around outside of containers
- Pressure build-up within containers
- Obvious deterioration of containers

Access to hazardous chemicals, including toxic and corrosive substances, should be always restricted. These materials must be stored in laboratories or storerooms that are kept locked when laboratory personnel are not present. Locked storage cabinets or other precautions are always recommended, and in some cases may be required in the case of unusually toxic or hazardous chemicals. Unusually toxic chemicals may include those that are associated with very low immediately dangerous to life or health (IDLH) conditions. For guidance on locked storage requirements, please contact the EHS. On termination or transfer of laboratory personnel, all related hazardous materials should be properly disposed of, or transferred to the Supervisor in Charge.

OSHA Title 8 Section 5194 (e) (1) requires that employers develop and maintain a list of the hazardous chemicals known to be present in the workplace. This is a long-standing regulatory requirement and is an important component of our lab safety inspections. For NSU to remain in compliance of this regulation, each laboratory must maintain a current chemical inventory and verify their inventory by performing annual updates.

8.2 Chemical Labeling

Every chemical found in the laboratory must be properly labeled. Most chemicals come with a manufacturer's label that contains the necessary information, so care should be taken to not damage or remove these labels. Chemical containers that do not have compliant manufacturer's labels (old chemicals) should be discarded as hazardous waste. It is recommended that each bottle also be dated when received and when opened to assist in determining which chemicals are expired and require disposal.

If chemicals are removed from their original container and placed in a different container, this container is referred to as secondary container. The secondary container may hold the original chemical, a mixture of chemicals, or a dilution of a chemical in water or solvent. Secondary containers must be labeled with:

- Full name(s) of the chemical(s). Do not use abbreviations as these can be ambiguous;
- Hazard identification (GHS Symbol/Wording) such as flammable, toxic, corrosive;
- Date of transfer or preparation;
- Name of person who transferred or prepared the solution;
- If the container holds a solution or mixture, concentrations and solvents used (e.g., 1M hydrochloric acid; 40% acetonitrile / 60% water; 1 mg/ml naphthalene in hexane).

Note: The current chemical inventory system has a secondary labeling feature. Contact EHS for other acceptable secondary container labeling system options.

It is important that labels on products be read and reviewed by the individuals who will be working with the product. Directions for safe handling should be followed.

Secondary containers don't require a label if the product transferred into the container will be used immediately by the employee who is transferring the product. For example, a bucket with floor cleaner, a beaker used in a lab experiment.

Peroxide forming chemicals (e.g., ethers) must be labeled "DANGER PEROXIDE FORMING CHEMICAL This material may form explosive peroxides during storage". The length of storage after opening, the date received, the date opened, the use-by date, dispose-by date and the date to discard, if unopened, are also required. These chemicals are only allowed a one-year shelf life and should be disposed of as hazardous waste in one year. These chemicals can degrade to form shock sensitive, highly reactive compounds and should be stored, monitored, and labeled very carefully (See Section 8.4).

Particularly Hazardous Substances (see *Section 6.1.7*) require additional labeling. These chemicals should be segregated from less hazardous chemicals to help with proper access control and hazard identification.

8.3 Signs

Current door signs with the NFPA fire diamond, caution symbols, required PPE, GHS classifications, and emergency contacts with phone numbers are required at all laboratory entrances, including storage and utility rooms. Signs must be generated and maintained using the current chemical inventory system. Other postings that are required are:

- Post location signs for all emergency equipment: safety showers, eyewash stations, first aid supplies, spill kits, exits.
- Post signs for restricted areas.

8.4 Chemical Storage and Segregation

Establish and follow safe chemical storage & segregation procedures for your laboratory.

Storage guidelines are included for materials that are flammable, oxidizers, corrosive, water reactive, explosive, and highly toxic. The specific Safety Data Sheet (SDS) should always be consulted when doubts arise concerning chemical properties and associated hazards. All procedures employed must comply with OSHA, Fire Code and building code regulations. Always wear appropriate personal protective equipment (e.g., laboratory coat, safety glasses, gloves, safety goggles, apron) when handling hazardous chemicals. Be aware of the locations of the safety showers and emergency eyewash stations. Each laboratory is required to provide appropriate laboratory-specific training on how to use this equipment **prior** to working with hazardous chemicals.

8.4.1 Chemical Safety Storage Priorities

Keep in mind that most chemicals have multiple hazards, and a decision must be made as to which storage area would be most appropriate for each specific chemical. First you must determine your priorities:

1. **Flammability.** When establishing a storage scheme, the number one consideration should be the flammability characteristics of the material. If the material is flammable, it should be stored in a flammable cabinet.
2. **Isolate.** If the material will contribute significantly to a fire (e.g., oxidizers), it should be isolated from the flammables. If there were a fire in the laboratory and response to the fire with water would exaggerate the situation, isolate the water reactive material away from contact with water.
3. **Corrosivity.** Next look at the corrosivity of the material, and store accordingly.
4. **Toxicity.** Finally, consider the toxicity of the material, with particular attention paid to regulated materials. In some cases, this may mean that certain chemicals will be isolated within a storage area. For example, a material that is an extreme poison but is also flammable, should be locked away in the flammable storage cabinet to protect it against accidental release.

There will always be some chemicals that will not fit neatly in one category or another, but with careful consideration of the hazards involved, most of these cases can be handled in a reasonable fashion.

General recommendations for safe storage of chemicals

Each chemical in the laboratory must be stored in a specific location and returned there after each use. Acceptable chemical storage locations may include corrosive cabinets, flammable cabinets, laboratory shelves, or appropriate refrigerators or freezers. Fume hoods should not be used as general storage areas for chemicals, as this may seriously impair the ventilating capacity of the hood. Figure 8.1 depicts improper fume hood storage. Chemicals should not be routinely stored on bench tops or stored on the floor. Additionally, bulk quantities of chemicals (i.e., larger than one gallon) should be stored in a separate storage area, such as a stockroom or supply room.

Figure 8.1 – Improper Fume Hood Storage



Laboratory shelves should have a raised lip along the outer edge to prevent containers from falling. Hazardous liquids or corrosive chemicals should not be stored on shelves above eye-level and chemicals which are highly toxic, or corrosive should be in unbreakable secondary containers.

Chemicals must be stored at an appropriate temperature and humidity level and should **never** be stored in direct sunlight or near heat sources, such as laboratory ovens. Incompatible materials should be stored in separate cabinets, whenever possible. If these chemicals must be stored in one cabinet, due to space limitations, adequate segregation and secondary containment must be ensured to prevent adverse reactions. All stored containers and research samples must be appropriately labeled and tightly capped to prevent vapor interactions and to alleviate nuisance odors. Flasks with cork, rubber or glass stoppers should be avoided because of the potential for leaking.

Laboratory refrigerators and freezers must be labeled appropriately with “No Food/Drink” and must **never** be used for the storage of consumables. If food/drink is used for laboratory purpose a sign or label reading “Not for Human Consumption” is required. Freezers should be defrosted periodically

so that chemicals do not become trapped in ice formations. *Never store peroxide formers (e.g., ether) in a refrigerator!*

8.4.2 Flammables and Combustible Liquids

Large quantities of flammable or combustible materials should not be stored in the laboratory. The maximum total quantity of flammable and combustible liquids must not exceed **60 gallons** within a flammable storage cabinet. The maximum quantity allowed to be kept outside a flammable storage cabinet, safety can, or approved refrigerator/freezer is **10 gallons**. Only the amounts needed for the current procedure should be kept on bench tops and the remainder should be kept in flammable storage cabinets, explosion proof refrigerators/freezers that are approved for the storage of flammable substances, or approved safety cans or drums that are grounded. Always segregate flammable or combustible liquids from oxidizing acids and oxidizers. Flammable materials must **never** be stored in domestic-type refrigerators/freezers and should not be stored in a refrigerator/freezer if the chemical has a flash point below the temperature of the equipment. Flammable or combustible liquids must not be stored on the floor or in any exit access.

All non-explosion proof Refrigerators/Freezers must be labeled “Do Not Store Flammable Chemicals”.

Handle flammable and combustible substances only in areas free of ignition sources and use the chemical in a fume hood whenever practical. Only the amount of material required for the experiment or procedure should be stored in the work area. Always transfer flammable and combustible chemicals from glass containers to glassware or from glass container/glassware to plastic. Transferring these types of chemicals between plastic containers may lead to a fire hazard due to static electricity. The transfer of flammable liquid from 5 gallon or larger metal containers should **not** be done in the laboratory.

8.4.3 Pyrophoric and Water-Reactive Substances

Because pyrophoric substances can spontaneously ignite on contact with air and/or water, they must be handled under an inert atmosphere and in such a way that rigorously excludes air and moisture. Some pyrophoric materials are also toxic, and many are dissolved or immersed in a flammable solvent. Other common hazards include corrosivity, teratogenicity, or peroxide formation.

Only minimal amounts of reactive chemicals should be used in experiments or stored in the laboratory. These chemicals must be stored as recommended in the SDS. Reactive materials containers must be clearly labeled with the correct chemical name, in English, along with a hazard warning.

Suitable storage locations may include inert gas-filled desiccators or glove boxes; however, some pyrophoric materials must be stored in a flammable substance approved freezer. If pyrophoric or water reactive reagents are received in a specially designed shipping, storage, or dispensing container, ensure that the integrity of that container is maintained. Ensure that sufficient protective solvent, oil, kerosene, or inert gas remains in the container while pyrophoric materials are stored. Never store reactive chemicals with flammable materials or in a flammable liquid's storage cabinet.

Never return excess reactive chemical to the original container. Small amounts of impurities introduced into the container may cause a fire or explosion. For storage of excess chemical, prepare a storage vessel in the following manner:

1. Dry any new empty containers thoroughly;
2. Insert the septum into the neck in a way that prevents atmosphere from entering the clean dry (or reagent filled) flask;
3. Insert a needle to vent the flask and quickly inject inert gas through a second needle to maintain a blanket of dry inert gas above the reagent;
4. Once the vessel is fully purged with inert gas, remove the vent needle then the gas line. To introduce the excess chemical, use the procedure described in the handling section, below;
5. For long-term storage, the septum should be secured with a copper wire;
6. For extra protection a second same-sized septa (sans holes) can be placed over the first; and
7. Use parafilm around the outer septa and remove the parafilm and outer septum before accessing the reagent through the primary septum.

8.4.4 Oxidizers

Oxidizers (e.g., hydrogen peroxide, ferric chloride, potassium dichromate, sodium nitrate) should be stored in a cool, dry place and kept away from flammable and combustible materials, such as wood, paper, Styrofoam, plastics, flammable organic chemicals, and away from reducing agents, such as zinc, alkaline metals, and formic acid.

8.4.5 Peroxide Forming Chemicals

Peroxide forming chemicals (e.g., ethyl ether, diethyl ether, cyclohexene) should be stored in airtight containers in a dark, cool, and dry place and must be segregated from other classes of chemicals that could create a serious hazard to life or property should an accident occur (e.g., acids, bases, oxidizers). Peroxide forming chemicals (e.g., ethers) must be labeled "DANGER MAY FORM EXPLOSIVE PEROXIDES" (see label in Figure B-1). The following information must be placed on the label by the laboratory staff:

- The receipt and opening dates
- The date and result any time a test is conducted to detect the presence of peroxides

These chemicals are only allowed a one-year shelf life and should be disposed of as hazardous waste in one year. This information, along with the chemical identity should face forward to minimize container handling during inspection. These chemicals must also be tested and documented for the presence of peroxides periodically. Minimize the quantity of peroxide forming chemicals stored in the laboratory and dispose of peroxide forming chemicals before peroxide formation.

Carefully review all cautionary material supplied by the manufacturer prior to use. Avoid evaporation or distillation, as distillation defeats the stabilizer added to the solvents. Ensure that containers are tightly sealed to avoid evaporation and that they are free of exterior contamination or crystallization. **Never** return unused quantities back to the original container and clean all spills immediately.

If old containers of peroxide forming chemicals are discovered in the laboratory, (greater than two years past the expiration date or if the date of the container is unknown), **do not handle the container**. If crystallization is present in or on the exterior of a container, **do not handle the container**. Secure it and contact EHS for pick-up and disposal.

Proper Storage and Handling

Purchase peroxide forming chemicals (PFCs) with inhibitors added by the manufacturer, when possible.

Maintain the minimal practical inventory of PFCs.

Do not retain or store redistilled or otherwise unstabilized PFCs.

Store PFCs at the lowest possible temperature consistent with their solubility or freezing point to minimize the rate of decomposition. Do not store them at, or lower than, the temperature at which the chemical freezes or precipitates. Peroxides in these forms are extremely sensitive to shock and heat.

Store all peroxidizable chemicals in tightly closed, air-impermeable, light-resistant containers, away from light, heat, direct sunlight, sources of ignition, oxidizers and oxidizing agents.

Storage under nitrogen may be advisable in some cases.

Avoid friction, grinding and all forms of impact near peroxides, especially solid peroxides. Do not use glass containers with screw caps or glass stoppers. Use polyethylene containers, screw caps or stoppers.

Do not use metal spatulas to handle PFCs because metal contamination can lead to explosive decomposition. Magnetic stirring bars can unintentionally introduce iron, which can initiate an explosive reaction of peroxides. Teflon, ceramic or wooden spatulas and stirring blades may be used if it is known that the material is not shock sensitive.

Test PFCs immediately prior to distillation or evaporation. It can be extremely dangerous to distill or significantly concentrate any uninhibited solvent in Classes A or B unless known to be free of peroxidation products.

Determine how the PFC will be stabilized after the procedure is completed if the procedure removed the inhibitor.

Do not reuse PFC containers. Triple rinse them with water and follow standard procedures for container disposal.

Discard containers of PFCs within the appropriate time frame (Class A: 3 months, Classes B&C: 12 months) or by the manufacturer's expiration date, if listed on the container. Testing can extend the 12-month period for Class B & C PFCs, but they should not be stored past the

manufacturer's expiration dates. Class A PFCs must be disposed of after three months, even if unopened.

If any of the following are observed with a peroxide forming chemical container, do not move or open the container and immediately contact EHS for assistance:

- Clear liquid containing suspended wisp-like structures
- Precipitated crystal formation appearing as chips, ice-like structures, or a solid mass
- Appearance of cloudiness
- Gross contamination

Any lab that either purchase or possess diethyl ether in the quantity of 2.5 gallons (9.5 liters) or more to use for research, teaching, or testing must obtain a letter of exemption from licensing from the Florida Department of Business and Professional Regulation (DBPR).

8.4.6 Corrosives

Store corrosive chemicals (i.e., acids, bases) below eye level and in secondary containers that are large enough to contain at least 10% of the total volume of liquid stored or the volume of the largest container, whichever is greater. Acids must always be segregated from bases and from active metals (e.g., sodium, potassium, magnesium) always and must also be segregated from chemicals which could generate toxic gases upon contact (e.g., sodium cyanide, iron sulfide).

Specific types of acids require additional segregation. Mineral acids must be kept away from organic acids and oxidizing acids must be segregated from flammable and combustible substances. Perchloric acid should be stored by itself, away from other chemicals. Picric Acid is reactive with metals or metal salts and explosive when dry and must contain at least 10% water to inhibit explosion.

8.4.7 Compressed Gas Cylinders

Compressed gas cylinders must be stored with the safety cap in place when not in use. Cylinders must be stored either chained to the wall or chained within in a cylinder storage rack. The cylinders must be restrained by two chains; one chain must be placed at one third from the

top of the cylinder, and the other placed at one third from the bottom of the cylinder (see Figure 8.2). For wall storage, no more than three cylinders may be chained together in the laboratory. Bolted “clam shells” may be used in instances where gas cylinders must be stored or used away from the wall. Store liquefied fuel-gas cylinders securely in the upright position.

Cylinders containing certain gases are prohibited from being stored in a horizontal position, including those which contain a water volume of more than 5 liters. Do not expose cylinders to excessive dampness, corrosive chemicals, or fumes.

Certain gas cylinders require additional precautions. Flammable gas cylinders must use only flame-resistant gas lines and hoses which carry flammable or toxic gases from cylinders and must have all connections wired. Compressed oxygen gas cylinders must be stored at least 20 feet away from combustible materials and flammable gases.

Figure 8.2 – Cylinders Stored & Chained Correctly



Gas cylinder connections must be inspected frequently for deterioration and must never be used without a regulator. Never use a leaking, corroded or damaged cylinder and never refill compressed gas cylinders. When stopping a leak between cylinder and regulator, always close the valve before tightening the union nut. The regulator should be replaced with a safety cap when the cylinder is not in use. Move gas cylinders with the safety cap in place using carts designed for this purpose.

8.4.8 Liquid Nitrogen

Because liquid nitrogen containers are at low pressure and have protective rings mounted around the regulator, they are not required to be affixed to a permanent fixture such as a wall. However, additional protection considerations should be addressed when storing liquid nitrogen in a laboratory. The primary risk to laboratory personnel from liquid nitrogen is skin

or eye thermal damage caused by contact with the material. In addition, nitrogen expands 696:1 when changing from a cryogenic liquid to a room temperature gas. The gases usually are not toxic, but if too much oxygen is displaced, asphyxiation is a possibility. Always use appropriate thermally insulated gloves when handling liquid nitrogen. Face shields may be needed in cases where splashing can occur.

8.5 Laboratory Security

Recently regulatory agencies have been implementing rules to ensure chemical security. While many of these rules are for large manufacturing facilities, it is critical that chemicals be secured to prevent theft from campus laboratories. Numerous federal agencies are involved in the maintenance of laboratory security, including the Drug Enforcement Agency (www.deadiversion.usdoj.gov/schedules), Federal Bureau of Investigations (www.fbi.gov/about-us/investigate/terrorism/wmd), and Department of Homeland Security (www.dhs.gov/xlibrary/assets/chemsec_appendixa-chemicalofinterestlist.pdf). It is each Department's responsibility to prevent and report any theft of chemicals from their laboratory.

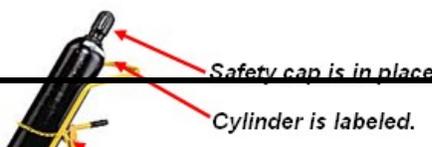
Labs can increase their security by simply keeping lab doors closed and locked when unoccupied, maintaining a current and accurate chemical inventory, training personnel on security procedures, and controlling access to keys. Labs should report any suspicious activity to Public Safety.

8.6 On Campus Distribution of Hazardous Chemicals

Precautions must be taken when transporting hazardous substances between laboratories. Chemicals must be transported between stockrooms and laboratories in break-resistant, secondary containers such as commercially available bottle carriers made of rubber, metal, or plastic, that include carrying handle(s) and which are large enough to hold the contents of the chemical container in the event of breakage.

When transporting cylinders of compressed gases, always secure the cylinder with straps or chains onto a suitable hand truck and protect the valve with a cover cap. Avoid dragging, sliding, or rolling cylinders and use a freight elevator when possible. Figure 6.4 illustrates correct cylinder transport. Never store cylinders of compressed gas in hallways, vestibules, outside elevators, or inside elevators.

Figure 6.4 – Correct Cylinder Transport



8.7 Off Campus Distribution of Hazardous Chemicals

The transportation of hazardous chemicals and compressed gases over public roads, or by air, is strictly governed by international, federal, and state regulatory agencies, including the U.S. Department of Transportation (DOT) and the International Air Transport Association (IATA). Any person who prepares and/or ships these types of materials must ensure compliance with pertinent regulations regarding training, quantity, packaging, and labeling. Without proper training, it is illegal to ship hazardous materials. Those who violate the hazardous materials shipment regulations are subject to criminal investigation and penalties. Individuals who wish to ship or transport hazardous chemicals or compressed gases off-campus, even when using NSU or personal vehicles, must contact EHS for assistance.

Section 9: TRAINING

Effective training is critical to facilitate a safe and healthy work environment and prevent laboratory accidents. Each lab's Academic Chair, Associate/Assistant Dean, or University Designee must ensure that all their employees/students have appropriate safety training before working in a laboratory. EHS provides online training to help meet this requirement.

9.1 Types of Training

All laboratory personnel must complete general safety training before:

1. Beginning work in the laboratory;
2. Prior to new exposure situations; and
3. As work conditions change.

Refresher training is also required for all laboratory personnel. EHS offers online training, plus resource materials and classroom training sessions to assist laboratories in implementing laboratory-specific training.

9.2 General (EHS) Laboratory Safety Training

Anyone working in a laboratory is required to complete EHS Laboratory Safety training, which includes:

- Review of general laboratory rules and regulations
- Recognition of laboratory hazards
- Use of engineering controls, administrative controls and personal protective equipment to mitigate hazards
- Review of reference materials (e.g., SDS) on hazards, handling, storage and disposal of hazardous chemicals
- Procedures for disposing of hazardous chemical waste
- Fire safety and emergency procedures
- Hazard communication and GHS

EHS provides on-line courses that are designed for specific types of laboratories (Research, Teaching, etc.).

9.3 Documentation of Training

Accurate recordkeeping is a critical component of health and safety training. Per OSHA regulations, university laboratories are responsible for documenting health and safety training, including safety meetings, one-on-one training, and classroom and online training.

Documentation, including staff/student certificates should be maintained in a binder kept in a prominent location in each laboratory.

Section 10: INSPECTIONS, HOUSEKEEPING AND MAINTENANCE

10.1 Laboratory Safety Inspections

Annual laboratory safety inspections will be conducted by EHS. A written report will be generated and sent to the Supervisor in Charge. Any deficiencies will require an immediate corrective action.

EHS can assist laboratories that use, handle or store hazardous chemicals to maintain a safe work environment. This program helps to ensure compliance with regulations and to fulfill NSU's commitment to protecting the health and safety of the campus community.

As part of this chemical safety program, EHS conducts annual inspections of laboratories and other areas with hazardous chemicals to ensure the laboratory is operating in a safe manner and to ensure compliance with all federal, state and university safety requirements.

The primary goal of inspection is to identify both existing and potential accident- causing hazards, actions, faulty operations, and procedures that can be corrected **before** an accident occurs.

The laboratory safety inspection is comprehensive in nature and investigates all key aspects of working with hazardous chemicals. While inspections are a snapshot in time and cannot identify every accident-causing mistake, they do provide important information on the overall operation of a particular laboratory.

They can also help to identify weaknesses that may require more systematic action across a broader spectrum of laboratories, and strengths that should be fostered in other laboratories. Specific inspection compliance categories include:

- Documentation and Training;
- Hazard Communication (including review of SOPs);
- Emergency and Safety Information;
- Fire Safety;
- General Safety;
- Use of personal protective equipment (PPE);
- Housekeeping;
- Chemical Storage;
- Fume Hoods;
- Chemical Waste Disposal and Transport;
- Mechanical and Electrical Safety.

Once the inspection is completed, EHS issues a Laboratory Inspection Report via email. The report identifies deficiencies in the laboratory. These deficiencies must be immediately corrected. The Supervisor in Charge must notify EHS when each deficiency is corrected.

Accurate recordkeeping demonstrates a commitment to the safety and health of the NSU community, as well as the protection of the environment. EHS is responsible for maintaining records of inspections, accident investigations, and training conducted by EHS. Per OSHA regulations, departments or laboratories must document health and safety training, including safety meetings, one-on-one training, and classroom and online training. Additionally, the following records must be retained in accordance with the requirements of state and federal regulations:

1. Accident records;
2. Measurements taken to monitor employee exposures;
3. Inventory and usage records for high-risk substances should be kept;
4. Medical records must be retained in accordance with the requirements of state and federal regulations.

10.2 Housekeeping

Floors shall be cleaned regularly by janitorial staff. Counters and lab benches will be cleaned after each use by laboratory staff. **Janitorial personnel are not responsible for cleaning countertops and upper laboratory surfaces.** Stairwells, aisles and hallways shall remain free from obstruction and debris. Janitorial personnel are not permitted to clean up any type of spill. If laboratory staff is not available, contact Public Safety.

Safety showers shall be tested annually and flushed monthly by Physical Plant. All tests and routine flushing should be documented, and dates provided on attached tags. Fire extinguishers shall be inspected annually by the fire equipment service company that is on contract. Submit a work order if tags on these items are not up to date. Each laboratory is responsible for documenting weekly flushing on a log to be located adjacent to the eyewash.

Section 11: CHEMICAL DISPOSAL

In Florida, hazardous waste is regulated by the Florida Department of Environmental Protection (FDEP). Federal EPA regulations also govern certain aspects of hazardous waste management since our waste may be treated and disposed out of state. These hazardous waste regulations are part of the Resource Conservation and Recovery Act, or RCRA.

EHS manages the shipment and disposal of all spent chemicals and hazardous waste generated by NSU operations. Each employee must comply with the campus Hazardous Waste Management Program requirements and all applicable regulations. Laboratory personnel are responsible for identifying waste, labeling it, storing it properly in the laboratory, and transporting waste to their designated pick-up location. The Supervisor in Charge is responsible for coordinating the disposal of all chemicals from his/her laboratories prior to closing laboratory operations.



Upon the termination or leave of an employee/student, for whatever reason, all chemicals for which that person had responsibility for shall be accounted for and inventoried. These chemicals will be returned to the stockroom, transferred to another individual or designated for disposal. This process shall be activated by the Academic Chair, Associate/Assistant Dean, or University Designee immediately upon knowledge of the leave or termination.

Broken glass must be placed in the designated glass waste container located in each laboratory.

11.1 Definition of Hazardous Waste

The Environmental Protection Agency (EPA) defines solid waste as any garbage or refuse, sludge from a wastewater treatment plant, water supply treatment plant, or air pollution control facility and other discarded material, including solid, liquid, semi-solid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations, and from community activities. Hazardous wastes fall into two categories, *Listed* and *Characteristic Waste*.

Listed Wastes

Listed wastes are wastes the EPA has determined are hazardous. The lists include:

- **F-list (wastes from common manufacturing and industrial processes – non-specific source wastes).** Examples include such as solvents that have been used in cleaning or degreasing operations.
- **K-list (wastes from specific industries),** such as petroleum refining or pesticide manufacturing wastes.
- **P- and U-lists (wastes from commercial chemical products)** such as specific commercial chemical products in an unused form, some pesticides and some pharmaceutical products when discarded.

Characteristic Wastes

Waste that has not been specifically listed may still be considered a hazardous waste if exhibits one of the four characteristics defined in 40 CFR Part 261 Subpart C:

- **Ignitability (D001).** Ignitable wastes can create fires under certain conditions, are spontaneously combustible, or have a flash point less than 60 °C (140 °F). Examples include waste oils and used solvents.
- **Corrosivity (D002).** Corrosive wastes are acids or bases (pH less than or equal to 2, or greater than or equal to 12.5) that are capable of corroding metal containers, such as storage tanks, drums, and barrels. Battery acid is an example.
- **Reactivity (D003).** Reactive wastes are unstable under "normal" conditions. They can cause explosions, toxic fumes, gases, or vapors when heated, compressed, or mixed with water. Examples include lithium-sulfur batteries and explosives.
- **Toxicity (D004 - D043).** Toxic wastes are harmful or fatal when ingested or absorbed (e.g., containing mercury, lead, etc.). When toxic wastes are land disposed,

contaminated liquid may leach from the waste and pollute ground water posing a hazard to the environment.

The EPA's definition of hazardous waste also extends to the following items:

- Abandoned chemicals
- Unused or unwanted chemicals
- Chemicals in deteriorating containers
- Empty containers that have visible residues
- Containers with conflicting labels
- Unlabeled or unknown chemicals

Chemicals not in frequent use must be carefully managed to prevent them from being considered a hazardous waste. This is especially true for certain compounds that degrade and destabilize over time and require careful management so that they do not become a safety hazard (see the section below titled "Wastes that Require Special Handling").

Acutely Hazardous Waste

Certain compounds meet an additional definition known as "acutely hazardous waste" (P-listed waste). This list of compounds includes carcinogens, pesticides, and reactive compounds, among others (e.g., cyanides, sodium azide, and hydrofluoric acid).

11.2 Proper Hazardous Waste Management

Training

All personnel who are responsible for handling, managing, or disposing of hazardous waste must attend training **prior** to working with these materials.

Waste Identification

All the chemical constituents in each hazardous waste stream must be accurately identified by knowledgeable laboratory personnel. This is a critical safety issue for both laboratory employees and the waste technicians that handle the waste. Mixing of incompatible waste streams has the potential to create violent reactions and is a common cause of laboratory accidents. If there is uncertainty about the composition of a waste stream resulting from an experimental process, laboratory workers must consult the Supervisor in Charge and/or EHS. In most cases, careful documentation and review of all chemical products used in the experimental protocol will result in accurate waste stream characterization. The manufacturer's SDS provides detailed information on each hazardous ingredient in laboratory reagents and other chemical products, and also the chemical, physical, and toxicological properties of that ingredient.

11.3 Labeling

Unused Chemicals in Original Manufacturer's Labeled Containers – Chemicals that are expired, or no longer needed, require no additional labeling for disposal as hazardous waste. These chemicals must be removed from the lab's chemical inventory.

Processed Chemical Waste – Waste from laboratory experiments (often mixtures) must be collected and stored in labeled waste containers. These labels must detail the components and percentages of each chemical in the mixture. When bulk disposing of processed chemical waste, one basic principle applies: Keep each different class of chemical in a separate clearly labeled disposal container. Labels may be obtained from EHS and the must include the following:

***** HAZARDOUS WASTE LABEL *****

State and Federal Laws Prohibit Improper Disposal

Department Start Date
Lab Group/Course Room
Responsible Person Phone

Check all that apply.

- | | | | |
|--|--|------------------------------------|-------------------------------------|
| <input type="checkbox"/> Organic Halogenated | <input type="checkbox"/> Organic Non-Halogenated | | |
| <input type="checkbox"/> Inorganic | <input type="checkbox"/> Acid | <input type="checkbox"/> Base | <input type="checkbox"/> Carcinogen |
| <input type="checkbox"/> Flammable | <input type="checkbox"/> Aqueous | <input type="checkbox"/> Corrosive | |

Contents (full name only, no formulas) / Approximate Amounts (%)

Date placed in 90-day storage (for EHS use only)

A container may not be used to collect waste processed chemicals or be placed in the satellite accumulation area in the lab unless a completed label is attached to the container.

11.4 Hazardous Waste Storage

As a Small Quantities Generator, the NSU may not store more than 2.2 pounds (1 kilo) of P-listed waste (see above) and no more than 13200 pounds (6000 kilos) of total waste on any campus (excluding hazardous waste pharmaceuticals and universal waste). Waste may not be kept for more than 180 days in any case. Each responsible person will check the container integrity and the label.

1. Hazardous waste containers must be clearly labeled at all times
2. Waste must be collected and stored at or near the point of generation (Satellite Accumulation Area (SAA) (see below)
3. The maximum amount of flammable solvents allowed to be stored in a laboratory is 60 gallons; this figure also includes waste solvents
4. All hazardous waste containers in the laboratory must be kept closed when not in used.
5. Hazardous waste streams must have compatible constituents, and must be compatible with the containers that they are stored in
6. Hazardous waste containers must be always stored in secondary containment.
7. Containers must be in good condition with leak proof lids
8. Containers must be less than 90% full
9. Dry wastes must be double-bagged and sealed in clear, 3-mil plastic bags (these do not require secondary containment).

180-day Container Storage

- Containers of hazardous waste must be marked with the date accumulation began and the words **HAZARDOUS WASTE**. NOTE: The start date is when the first waste is poured/placed into the waste container at the 180-day accumulation point OR, the date the container is filled at a satellite accumulation point.
- Weekly inspections must be conducted and logged.
- There must be sufficient aisle space to allow unobstructed movement of personnel, fire protection equipment, spill control equipment, and decontamination equipment to any area of the operation.
- Required equipment is easily accessible and in working condition and is tested to ensure it is in working condition.
- There is internal communications or alarm system capable of providing immediate emergency instruction to personnel.
- There is a telephone or hand-held two-way radio capable of contacting local and emergency responders.

- There are portable fire extinguishers and fire control equipment, including special extinguishing equipment (foam, inert gas, or dry chemicals).
- There is spill control equipment.
- There is decontamination equipment available (eye-wash, emergency showers, etc.).
- There are fire hydrants or other source of water (reservoir, storage tank, etc.) with adequate volume and pressure, foam producing equipment, automatic sprinklers, or water spray systems.
- When waste leaves the 180-day storage area, it either is going for disposal, treatment, or recycle.

Satellite Accumulation Areas

- SQGs may keep waste at a satellite accumulation area (SAA) and meet less stringent storage and labeling requirements. A SAA is defined as at or near the point of generation where wastes initially accumulate and is under the control of the operator of the waste generating process.
- Containers must be in good condition and compatible with the waste stored in them.
- Containers must be kept closed except when waste is being added or removed.
- Containers must be marked **HAZARDOUS WASTE** or other words that identify contents.
- There should be no more than 55 gal of hazardous waste (this is the total of all the hazardous waste stored at the SAA) or 1 qt of acutely hazardous waste in containers.
- When waste is accumulated in excess of quantity limitations, the excess container must be marked with the date the excess amount began accumulating and the excess waste is transferred to a 180-day or permitted storage area within 3 days.
- When a facility has equipment that discharges hazardous wastes to attached containers (i.e. photo processing), the containers that collect such wastes have to be in compliance with the SAA regulations even if the discharging unit is not regulated under RCRA, the attached containers that collect hazardous wastes from the equipment must be in compliance with the SAA regulations, if those containers collect wastes that are listed or characteristic hazardous wastes.

11.5 Training

All personnel must be thoroughly familiar with waste handling and emergency procedures relevant to their responsibilities during normal facility operation and emergencies. As the ones generating hazardous waste, however, personnel working in SAAs need to be familiar

enough with the chemicals with which they are working to know when they have generated a hazardous waste so that it will be managed in accordance with the RCRA regulations. EHS provides training modules on these topics as part of the safety training course offered to laboratory staff.

NOTE: In addition to EHS provided training, personnel that have access to or work in central accumulation areas, including those that move hazardous waste from a SAP to the 180-day storage area, must successfully complete DOT HM-181, HM 126F, HM232 Hazmat Employee #1058 - 49 CFR Part 172.704 (Subpart H) & RCRA Hazardous Waste Generator Training #1391 - 40 CFR 262.34 and 40 CFR 265.16.

11.6 Segregation

All hazardous materials must be managed in a manner that prevents spills and uncontrolled reactions. Stored chemicals and waste should be segregated by hazard class. Examples of proper segregation are:

- Segregate acids from bases
- Segregate oxidizers from organics
- Segregate cyanides from acids

Segregation of waste streams should be conducted in a similar manner to segregation of chemical products. Refer to Appendix C for chemical segregation guidelines.

11.7 Incompatible Waste Streams

Mixing incompatible waste streams or selecting a container that is not compatible with its contents, is a common cause of accidents in laboratories and waste storage areas. Reactive mixtures can rupture containers and explode, resulting in serious injury and property damage. All chemical constituents and their waste byproducts must be compatible for each waste container generated. Waste tags must be immediately updated when a new constituent is added to a mixed waste container, so that others in the laboratory will be aware and manage it accordingly.

- Oxidizers added to any fuel can create an exothermic reaction and explode. The most frequent is acids oxidizing flammable liquids. For this reason, all flammable liquids are pH tested before they are consolidated.

11.8 Wastes That Require Special Handling

Unknowns

Unlabeled chemical containers and unknown/unlabeled wastes are considered unknowns, and additional fees must be paid to have these materials analyzed and identified. These containers must be labeled with the word “unknown”.

Peroxide Forming Chemicals

Peroxide forming chemicals, or PFCs, include several substances that can react with air, moisture or product impurities, and undergo a change in their chemical composition during normal storage. The peroxides that form are highly reactive and can explode upon shock or spark. Peroxides are not particularly volatile and thus tend to precipitate out of liquid solutions. It is particularly dangerous to allow a container of these materials to evaporate to dryness, leaving the crystals of peroxide on the surfaces of the container.

Each container of peroxide forming chemicals should be labeled with the required "DANGER PEROXIDE FORMING CHEMICAL" label dated with the maximum months of storage after opening, the date received, the date first opened, use by or dispose of after date, and the maximum number of month the PFC may be stored unopened. There are three classes of peroxide forming chemicals, with each class having different management guidelines. Review the safety information provided by the manufacturer for any chemicals you purchase.

Ensure containers of PFCs are kept tightly sealed to avoid unnecessary evaporation, as this inhibits the stabilizers that are sometimes added. Visually inspect containers periodically to ensure that they are free of exterior contamination or crystallization. PFC containers must be disposed of prior to expiration date. If old containers of peroxide forming chemicals are discovered in the laboratory, (greater than two years past the expiration date or if the date of the container is unknown), **do not handle the container**. If crystallization is present in or on the exterior of a container, **do not handle the container**. Secure it and contact the EHS for pick-up and disposal.

Dry Picric Acid

Picric acid (also known as trinitrophenol) must be kept always hydrated, as it becomes increasingly unstable as it loses water content. When dehydrated, it is not only explosive but also sensitive to shock, heat, and friction. Picric acid is highly reactive with a wide variety of compounds (including many metals) and is extremely susceptible to the formation of picrate salts. Be sure to label all containers that contain picric acid with the date received, and then monitor the water content every 6 months. Add distilled water as needed to maintain a consistent liquid volume.

If old or previously unaccounted for bottles of picric acid are discovered, **do not touch the container**. Depending on how long the bottle has been abandoned and the state of the product inside, even a minor disturbance could be dangerous. Visually inspect the contents of the bottle without moving it to evaluate its water content and look for signs of crystallization inside the

bottle and around the lid. If there is even the slightest indication of crystallization, signs of evaporation, or the formation of solids in the bottle, **do not handle the container** and contact **EHS immediately**. Secure the area and restrict access to the container until it can be evaluated by EHS.

Explosives and Compounds with Shipping Restrictions

NO EXPLOSIVES MAY BE USED ON NSU PROPERTY WITHOUT THE WRITTEN APPROVAL OF PUBLIC SAFETY AND EHS.

If approval for use of these substances is given, a special procedure for disposal will be worked out in writing. A variety of other compounds that are classified as water or air reactive are used in laboratories. These compounds often have shipping restrictions and special packaging requirements. When disposing of these compounds, employees must ensure that they are stored appropriately for transport. Flammable metals must be completely submerged in oil before they are brought to a waste pick-up. Many pyrophoric and reactive compounds can be stabilized using a quenching procedure prior to disposal. Chemicals classified by the Department of Transportation (DOT) as explosives (e.g., many nitro- and azo- compounds) will require special packaging and shipping and may require stabilization prior to disposal. Consult with the EHS for disposal considerations of these compounds.



11.9 Managing Empty Containers

Empty containers that held Extremely Hazardous (P-Listed) waste must be managed as hazardous waste and brought to the waste pick-up. Do not rinse or reuse these containers.

All other hazardous waste containers, if they are less than 5 gallons in size, should either be reused for hazardous waste collection, or should be cleaned and discarded in the regular trash. Proper cleaning involves triple rinsing the container, with the first rinse collected as hazardous waste. Remove the lids and dispose or recycle rinsed plastic or glass containers as regular trash. Do not place in the recycle bin or dumpster.

11.10 Transportation

When transporting waste to the pick-up location, inspect all containers to make sure that they are safe to transport. Verify that each container has an accurate waste label, and the containers are clean and free of residue and do not show any signs of bulging, fuming, or bubbling. Use only a stable, heavy duty cart for transporting waste. Containers should be segregated on carts, and carts should be equipped with secondary containment. Do not

overload a cart or stack containers more than one level high. Never leave the waste unattended once departing the laboratory. Employees must wear long pants and closed toe shoes (and carry gloves with them) when transporting chemicals. An appropriate lab coat, gloves and eye protection must be carried as a spill response measure but should not be worn while transporting chemicals.

11.11 Disposal

Frequent disposal will ensure that waste accumulation areas in labs are managed properly, and that maximum storage volumes are not exceeded. NSU policy states that hazardous chemical waste can be stored for up to 180 days. Once a waste container is 90% full or it is near the 180 day time limit, it should be requested for pick-up. Once an experiment or process is completed, all partially filled containers should be collected for the next scheduled pick-up for that campus. Laboratory chemical waste shall be removed from the laboratory to the central storage area at least quarterly, unless the quantities stored in the lab warrant more frequent transfer to the central waste storage area. *Disposal of chemicals down the drain is prohibited.* Fume Hoods shall not be used as a means for disposal of volatile organics.

Chemical pickups shall be scheduled quarterly, or as needed. A TSD (Treatment, Storage or Disposal Company) with an contract/agreement with NSU shall be used. Once a pickup of waste chemicals has occurred, all manifests must be forwarded to EHS. EHS will maintain a copies of these manifests.

11.12 Hazardous Waste Minimization

NSU is a small quantity generator of hazardous waste. To help maintain this status, EHS has developed a Hazardous Waste Minimization Program, to minimize the costs, health hazards, and environmental impacts associated with the disposal of hazardous waste.

11.13 Administrative Controls

To reduce the amount of chemicals that become waste, administrative and operational waste minimization controls can be implemented. Usage of chemicals in the laboratory areas should be reviewed to identify practices which can be modified to reduce the amount of hazardous waste generated.

Purchasing Control: when ordering chemicals, be aware of any properties that may preclude long term storage, and order only exact volumes to be used.

Inventory Control: Rotate chemical stock to keep chemicals from becoming outdated. Locate surplus/unused chemicals and attempt to redistribute these to other users or investigate returning unused chemicals to the vendor.

Operational Controls: Review your experimental protocol to ensure that chemical usage is minimized. Reduce total volumes used in experiments; employ small scale procedures when possible. Instead of wet chemical techniques, use instrumental methods, as these generally require smaller quantities of chemicals. Avoid mixing hazardous and non-hazardous waste streams. Use less hazardous or non-hazardous substitutes when feasible. Some examples include:

- Specialty detergents can be substituted for sulfuric acid/chromic acid cleaning solutions
- Gel Green and Gel Red are recommended in place of ethidium bromide

11.14 Drain Disposal Prohibited

NSU does not permit drain disposal of chemical wastes unless a specific dilution and/or neutralization method for a consistent waste stream has been reviewed and approved by EHS. This applies to all chemical waste, regardless of whether it falls under the EPA criteria for hazardous waste. Contact EHS for specific questions about drain disposal variances.

Section 12: ACCIDENTS AND CHEMICAL SPILLS

Laboratory emergencies may result from a variety of factors, including serious injuries, fires and explosions, spills and exposures, and natural disasters. All laboratory employees should be familiar with and aware of the location of their laboratory's emergency response plans and safety manuals. *Before beginning any laboratory task*, know what to do in the event of an emergency. Identify the location of safety equipment, including first aid kits, eye washes, safety showers, fire extinguishers, fire alarm pull stations, and spill kits. Plan and know the location of the closest fire alarms, exits, and telephones in your laboratory.

Emergency equipment (fire extinguishers, eyewash stations, shower stations, and core shutoff doors) should never be blocked.

12.1 Special Needs

The Supervisor in Charge should discuss evacuation procedures with all mobility-impaired persons in the laboratory to determine their needs for assistance upon beginning work in the lab and/or the beginning of each semester.

12.2 Response

The priority in an emergency response is the protection of life and health. **The following basic steps apply to ALL emergency situations:**

1. Make sure everyone in the immediate vicinity is aware of the problem and stays a safe

distance away from the incident.

2. Contain the emergency if it can be done safely without causing harm to you.
3. Pull the fire alarm to evacuate the building if the emergency cannot be contained or if there is any doubt as to the severity of the situation.
4. **For all incidents requiring emergency response, call NSU Public Safety at (954) 262-8999.**
5. After the event, EHS and the Academic Chair, Associate/Assistant Dean, or University Designee will investigate the incident and complete a report.

12.3 Accidents

Supervisors and Instructors are responsible for ensuring that their staff and students receive appropriate medical attention in the event of an occupational injury or illness. All accidents and near misses must be reported to the Public Safety. EHS will conduct an accident investigation and develop recommendations and corrective actions to prevent future accidents. At a minimum, each laboratory must have the following preparations in place:

1. Fully stocked first aid kit
2. Posting of emergency telephone numbers and locations of emergency equipment
3. SDS accessible electronically (a complete chemical inventoryh) for all chemicals in use or storage on hand

| Accident Prevention Methods | |
|---|--|
| Do | Don't |
| Always wear appropriate eye protection | Never enter the laboratory wearing inappropriate clothing (e.g., open-toe shoes and shorts) |
| Always wear appropriate laboratory coat | Never work alone on procedures involving hazardous chemicals, biological agents, or other physical hazards |
| Always wear appropriate gloves | |
| Always wear closed-toe shoes and long pants | |
| Always confine long hair and loose clothing | Never eat, drink, chew gum or tobacco, smoke, |

If an employee/student has a severe or life-threatening injury, call for emergency response. Employees/students with minor injuries should be treated with first aid kits as appropriate and sent to Student Health, Workers Compensation or the Nurse's Office for further evaluation and treatment. After normal business hours, treatment may be obtained at designated medical centers and emergency rooms.

Exposure Incident:

- Eye Contact: Promptly flush with water for at least 15 minutes. Contact Public Safety.
- Skin Contact: Promptly flush with water. If body is exposed to a chemical product, use the safety shower to adequately flush. Remove contaminated clothing. Contact Public Safety.
- Ingestion: Consult the Safety Data Sheet (SDS). Contact Contact Public Safety.

Serious occupational injuries, illnesses, and exposures to hazardous substances must be reported to the EHS within 8 hours. EHS will investigate the accident, and complete exposure monitoring if necessary. Serious injuries include those that result in permanent impairment or disfigurement or require hospitalization. Examples include amputations, lacerations with severe bleeding, burns, concussions, fractures, and crush injuries. As soon as an Academic Chair, Associate/Assistant Dean, or University Designee becomes aware of a potentially serious incident, they must contact EHS.

12.4 Fire-related Emergencies

If you encounter a fire, or a fire-related emergency (e.g., abnormal heating, smoke, burning odor), immediately follow these instructions:

1. Pull the fire alarm pull station and call 911;
2. Evacuate and isolate the area
 - Use portable fire extinguishers to facilitate evacuation and/or control a small fire (i.e., size of a small trash can), if safe to do so
 - If possible, shut off equipment before leaving
 - Close doors;
3. Remain safely outside the affected area to provide details to emergency responders; and
4. Evacuate the building when the alarm sounds. *It is against state law to remain in the building when the alarm is sounding.* If the alarm sounds due to a false alarm or drill, you will be allowed to re-enter the building as soon as the Fire Department determines that it is safe to do so. *Do not go back in the building until the alarm stops and you are cleared to reenter.*

If your clothing catches on fire, go to the nearest emergency shower immediately. If a shower is not immediately available, then stop, drop, and roll. A fire extinguisher may be used to extinguish a fire on someone's person. Report any burn injuries to the supervisor immediately and seek medical treatment. You are required to inform Public Safety (within 8 hours) every time a fire extinguisher is discharged.

Fire Extinguishers

Faculty members, with the assistance of the Director of Environmental Health and Safety, should review the hazards in their laboratory on an ongoing basis to determine if the fire extinguisher(s) present are appropriate. If additional or different class extinguishers are needed, the faculty member should notify the Director of Environmental Health and Safety. Classes and types of extinguishers are described in following table:

| TYPES and CLASSES OF FIRE EXTINGUISHERS | |
|--|---|
| Class (Type)* | Use |
| A (Water) | For ordinary combustibles (e.g., paper, wood) |
| B (CO2) | For flammable liquids or electrical equipment (e.g., computers, ovens, instruments) |
| ABC (Dry Chemical) | For all types of fire, including flammable liquids other than paper, metal and grease fires |
| K (Chemical) | Grease fires |
| * = Classes: Class A - wood, cloth, paper, rubber, and plastic. Class B - flammable liquids, oils, greases, tars, oil-based paints, and flammable gases. Class C - energized electrical equipment. Class D - combustible metals such as magnesium, titanium, zirconium, sodium, lithium, and potassium. Class K- kitchen grease fires | |

12.5 Chemical Spills

Chemical spills can result in chemical exposures and contaminations. Chemical spills become emergencies when:

- The spill results in a release to the environment
- The material or its hazards are unknown
- Laboratory staff cannot safely manage the hazard because the material is too hazardous or the quantity is too large

Effective emergency response to these situations is imperative to mitigate or minimize adverse reactions when chemical incidents occur.

In the event of a significant chemical exposure or contamination, immediately try to remove or isolate the chemical if safe to do so.

Factors to Consider Before Spill Clean-Up

- Size of spill area
- Quantity of chemical
- Toxicity
- Volatility
- Clean up materials available

When skin or eye exposures occur, remove contaminated clothing, and flush the affected area using an eye wash or shower for at least 15 minutes. If a chemical is ingested, drink plenty of water. Obtain medical assistance as indicated. Remember to wear appropriate PPE before helping others. The Academic Chair, Associate/Assistant Dean, or University Designee must review all exposure situations, make sure affected students/employees receive appropriate medical treatment and/or assessment, and arrange for containment and clean-up of the chemical as appropriate.

Small chemical spills can be cleaned up by laboratory personnel who have been trained in spill clean-up and with the appropriate materials. A small spill is generally defined as < 1 liter of chemical that is not highly toxic, contained (has not sprayed or spread), does not present a significant fire, environmental or inhalation hazard, and is not in a public area such as a common hallway. **Large chemical spills** include spills of larger quantities, spills of any quantity of highly toxic chemicals, or chemicals in public areas or adjacent to drains. Large spills require emergency response. Call **(954) 262-8999** from an off-campus

or cell phone for assistance.

WHAT TO DO WITH A SMALL CHEMICAL SPILL (<1 LITER)

- Evacuate all non-essential persons from the spill area
- If needed, call for medical assistance by dialing **(954) 262-8999** from a campus phone or **from** an off-campus or cell phone
- Help anyone who may have been contaminated. Use emergency eyewashes/showers by flushing the skin or eyes for *at least 15 minutes*
- Post someone just outside the spill area to keep people from entering. Avoid walking through contaminated areas
- You must have the proper protective equipment and clean-up materials to clean-up spills. Check the chemical's Safety Data Sheet (SDS) in your laboratory for spill clean-up procedures, or call EHS for advise
- Turn off sources of flames, electrical heaters, and other electrical apparatus, and close valves on gas cylinders if the chemical is flammable
- Confine the spill to a small area. Do not let it spread
- Avoid breathing vapors from the spill. If the spill is in a non-ventilated area, do not attempt to clean it up. Call for emergency personnel to respond and clean up the spill
- Wear personal protective equipment, including safety goggles, gloves, and a laboratory coat or other protective garment to clean-up the spill
- Work with another person to clean-up the spill. Do not clean-up a spill alone
- DO NOT ADD WATER TO THE SPILL
- Use an appropriate kit to neutralize and absorb inorganic acids and bases. For other chemicals, use the appropriate kit or absorb the spill with sorbent pads, paper towels, vermiculite, dry sand, or diatomaceous earth. For specific procedures for all other spills see *Appendix D*.
- Collect the residue and place it in a thick plastic bag or bucket (with a top). Double bag the waste and label the bag with the contents.



WHAT TO DO WITH A LARGE CHEMICAL SPILL (>1 LITER)

Large chemical spills require emergency response. Call (954) 262-8999 from a campus, off-campus or cell phone. If the spill presents a situation that is immediately dangerous to life or health (IDLH) or presents a significant fire risk, activate a fire alarm, evacuate the area and wait for emergency response to arrive.

- Remove the injured and/or contaminated person(s) and provide first aid
- Call for emergency medical response
- As you evacuate the laboratory, close the door behind you, and:
- Post someone safely outside and away from the spill area to keep people from entering
- Confine the spill area if possible and safe to do so
- Leave on or establish exhaust ventilation
- If possible, turn off all sources of flames, electrical heaters, and other electrical equipment if the spilled material is flammable
- Avoid walking through contaminated areas or breathing vapors of the spilled material
- Any student/employee with known contact with a particularly hazardous chemical must shower, including washing of the hair as soon as possible unless contraindicated by physical injuries

Highly Toxic Chemical Spills

Do not try to clean up spills of any size. All Highly Toxic chemical spills require emergency response.

Appendix A: General Rules for Laboratory Work with Chemicals

PRUDENT LABORATORY PRACTICES

It is prudent to minimize all chemical exposures. Few laboratory chemicals are without hazards, and general precautions for handling all laboratory chemicals should be adopted, in addition to specific guidelines for some chemicals. Exposure should be minimized even for substances of no known significant hazard, and special precautions should be taken for work with substances that present special hazards. One should assume that any mixture will be more toxic than its most toxic component and that all substances of unknown toxicity are toxic.

Avoid inadvertent exposures to hazardous chemicals by developing and encouraging safe habits and thereby promoting a strong safety culture.

SAFE LABORATORY HABITS

Personal Protective Equipment:

- Wear closed-toe shoes and full-length pants, or equivalent, at all times when in the laboratory
- Utilize appropriate PPE while in the laboratory and while performing procedures that involve the use of hazardous chemicals or materials. These items may include laboratory coats, gloves, and safety glasses or goggles.
- Confine long hair and loose clothing

- Wear appropriate gloves when the potential for contact with toxic materials exists; inspect the gloves before each use, and replace them often
- Remove laboratory coats or gloves immediately on significant contamination, as well as before leaving the laboratory
- Avoid use of contact lenses in the laboratory unless necessary; if they are used, inform supervisor so special precautions can be taken
- Ensure that appropriate PPE is worn by all persons, including visitors, where chemicals are stored or handled
- Use any other protective and emergency apparel and equipment as appropriate. Be aware of the locations of first aid kits and emergency eyewash and shower stations

Chemical Handling:

- Use only those chemicals for which the quality of the available ventilation system is appropriate
- Do not smell or taste chemicals.
- Never use mouth suction for pipetting or starting a siphon
- Vent apparatus which may discharge toxic chemicals (vacuum pumps, distillation columns, etc.) into local exhaust devices
- Properly label and store all chemicals. Use secondary containment at all times
- Deposit chemical waste in appropriately labeled receptacles and follow all other waste disposal procedures of the Chemical Hygiene Plan
- In the case of an accident or spill, refer to the emergency response procedures for the specific material. These procedures should be readily available to all personnel. Information on minor chemical spill mitigation may also be referenced in *Appendix D*. For general guidance, the following situations should be addressed:
 - Eye Contact: Promptly flush eyes with water for a prolonged period (15 minutes) and seek medical attention
 - Skin Contact: Promptly flush the affected area with water and remove any contaminated clothing. If symptoms persist after washing, seek medical attention
 - Clean-up: Promptly clean up spills, using appropriate protective apparel and equipment, and proper disposal

Equipment Storage and Handling:

- Use equipment only for its designed purpose
- Do not use damaged glassware or other equipment, under any circumstances.
- Store laboratory glassware with care to avoid damage. Use extra care with Dewar flasks and other evacuated glass apparatus; shield or wrap them to contain

chemicals and fragments should implosion occur

- Use certified fume hoods, glove boxes, or other ventilation devices for operations which might result in release of toxic chemical vapors or dust. Preventing the escape of these types of materials into the working atmosphere is one of the best ways to prevent exposure
- Keep hood closed at all times, except when adjustments within the hood are being made
- Leave the fume hood "on" even when it is not in active use if toxic substances are in the fume hood or if it is uncertain whether adequate general laboratory ventilation will be maintained when it is "off"
- Do not use uncertified fume hoods for hazardous chemical handling

Laboratory Operations:

- Keep the work area clean and uncluttered
- Seek information and advice about hazards, plan appropriate protective procedures, and plan positioning of equipment before beginning any new operation
- Avoid unattended operations, if possible.
- If there is the need for a laboratory project to be left unattended, the individual responsible for the project must notify the Academic Chair, Associate/Assistant Dean, or University Designee. The individual responsible for the setup will need to provide for containment of the chemicals involved in the event of an unforeseen accident.
- Be alert to unsafe conditions and ensure that they are corrected when detected
- Never work alone on procedures involving hazardous chemicals, biological agents, or other physical hazards
- Do not engage in distracting behavior such as practical joke playing in the laboratory. This type of conduct may confuse, startle, or distract another person
- Do not eat, drink, smoke, chew gum, or apply cosmetics in the laboratory chemicals; wash hands before leaving the lab to conduct these activities
- Do not store, handle, or consume food or beverages in storage areas, refrigerators, glassware or utensils which are also used for laboratory operations
- Wash areas of exposed skin well before leaving the laboratory

Appendix B: Container Labeling

Chemical container labels are a good resource for information on chemical hazards. All containers of hazardous chemicals must have labels attached.

The warning may be a single word (e.g. Danger, Caution, Warning) or may identify the primary hazards, including both physical (e.g. water reactive, flammable, or explosive) and health (e.g. carcinogen, corrosive or irritant), such as what is found on an NFPA diamond and hazard warnings from the label or SDS.

Most labels provide additional safety information to help workers protect themselves from the substance. This information may include protective measures and/or protective clothing to be used, first aid instructions, storage information and emergency procedures.

Chemical Labeling – What are Laboratory Personnel Responsible for?

- Inspecting incoming containers to be sure that labels are attached and are in good condition and contain the information outlined above
- Reading the container label each time a newly purchased chemical is used. It is possible that the manufacturer may have added new hazard information or reformulated the product since the last purchase
- Ensuring that chemical container labels are not removed or defaced, except when containers are empty
- Labeling any secondary containers used in the laboratory, to prevent unknown chemicals or inadvertent reaction
- Verifying that chemical waste containers have complete and accurate chemical

waste labels

Labeling is important for the safe management of chemicals, preventing accidental misuse, inadvertent mixing of incompatible chemicals, and facilitating proper chemical storage. Proper labeling helps ensure quick response in the event of an accident, such as a chemical spill or chemical exposure incident. Finally, proper labeling prevents the high costs associated with disposal of “unknown” chemicals.

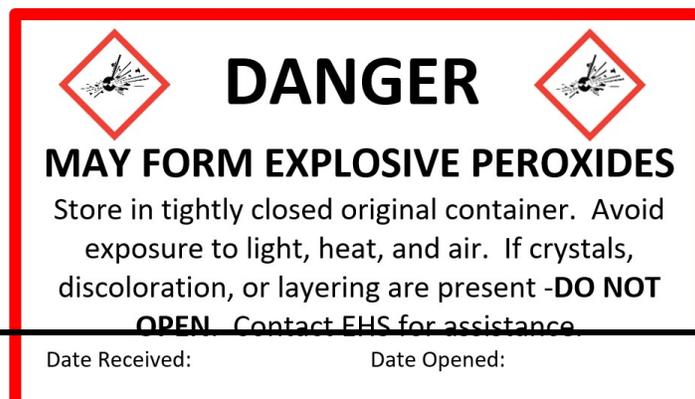
With the exception of transient containers that will contain chemicals for immediate use, all containers of chemicals being used or generated at NSU must be labeled sufficiently to indicate the contents of the container. On original containers, the label must not be removed or defaced in any way until the container is emptied of its original contents. Incoming containers must be inspected to make sure the label is in good condition. It is also advisable to put a date on new chemicals when they are received in the laboratory, and to put a date on containers of chemicals generated in the laboratory, as well as the initials of the responsible person.

Original Commercial Containers

The OSHA Hazard Communication Standard 1910.1200 as it applies to laboratories requires that labels on incoming containers of hazardous chemicals must not be removed or defaced until the container is empty and rinsed. No chemical shall be accepted without an adequate identifying label. Original containers should be labeled with the date received and the date opened. This is particularly important for peroxide-forming compounds and other chemicals that become unstable over time, and it is good laboratory practice for ALL chemicals.

Peroxide forming chemicals (e.g., ethers) must be labeled “DANGER PEROXIDE FORMING CHEMICAL This material may form explosive peroxides during storage”. The length of storage after opening, the date received, the date opened, the use-by date, dispose-by date and the date to discard, if unopened, are also required. Labels and label templates are available from EHS (Figure B.1).

Figure B.1



Secondary Containers

If chemicals are removed from their original container and placed in a different container, this container is referred to as secondary container. The secondary container may hold the original chemical, a mixture of chemicals, or a dilution of a chemical in water or solvent. Secondary containers must be labeled with:

- Full name(s) of the chemical(s). Do not use abbreviations as these can be ambiguous;
- Hazard identification (GHS Symbol) such as flammable, toxic, corrosive;
- Date of transfer or preparation;
- Name of person who transferred or prepared the solution;
- If the container holds a solution or mixture, concentrations and solvents used (e.g., 1M hydrochloric acid; 40% acetonitrile / 60% water; 1 mg/ml naphthalene in hexane).

The current NSU chemical inventory system provides a tool for creating and printing these labels (See example in Figure B.2). Make sure the label remains legible. Use a permanent marker that does not dissolve in water or the solvent used or attach an adhesive label with the required information. For long term storage, check the label periodically (every six months) and replace it if it has become illegible. Containers stored in refrigerators are particularly likely to lose their labels. Check them more frequently or put them into a second container with an additional label inside.

Figure B.2



In addition, small containers, such as vials and test tubes, may be labeled as a group by labeling the outer container (e.g., rack or box). Alternatively, a placard can be used to label the storage location for small containers (e.g., shelf, refrigerator, etc.). This information must be provided to janitorial and maintenance staff as part of their hazard communication training.

Containers of practically non-toxic and relatively harmless chemicals must also be labeled with content information, including containers such as squirt bottles containing water.

Synthesized Compounds

All newly synthesized compounds should be labeled with the notebook number and page where a description of the synthesis can be found. If no name exists, draw the structure onto the label instead of a name. If the identity is not fully known, list the reactants, the expected structure, or the expected chemical class of the product (e.g., ester, aliphatic alcohol, aromatic amine). List your name, tared container weight, and synthesis date. If the product is expected to be hazardous, list potential hazards (e.g., may be explosive, toxic).

According to the OSHA Laboratory Standard (1910.1450), the Hazard Communication Standard (OSHA 1910.1200) applies for a newly synthesized compound produced for a user outside the laboratory. This means that a safety data sheet must be prepared, and the chemical has to be labeled with its name, appropriate hazard identification, and manufacturer's name, address, and phone number.

Appendix C: Segregation of Incompatible Chemicals

Table C.1 contains a list of incompatible chemicals. The following chemicals, listed in the left column, should not be used with chemicals listed in the right column, except under specially controlled conditions. Chemicals in the left column should not be stored in the immediate area with chemicals in the right column. Incompatible chemicals should always be handled, stored or packed so that they cannot accidentally come into contact with one another. This list is representative of chemical incompatibilities and is not complete, nor are all incompatibilities shown.

Table C.1 – Incompatible Chemicals

| Chemical | Keep Out of Contact with: |
|--|--|
| Alkaline metals, such as powdered aluminum, magnesium, sodium, Acetic Acid | Carbon tetrachloride or other chlorinated hydrocarbons, carbon dioxide and water Chromic acid, nitric acid, hydroxyl compounds, ethylene glycol, perchloric acid, peroxides and permanganates |
| Acetylene Ammonia | Chlorine, bromine, copper, fluorine, silver and mercury Mercury, chlorine, calcium hypochlorite, iodine, bromine and hydrofluoric acid |

| | |
|--|--|
| Ammonium nitrate | Acids, metal powders, flammable liquids, chlorates, nitrites, sulfur, finely divided organic or combustible materials |
| Carbon, activated | Calcium hypochlorite |
| Copper | Acetylene and hydrogen peroxide |
| Chromic acid | Acetic acid, naphthalene, camphor, glycerin, turpentine, alcohol and flammable liquids |
| Chlorine | Ammonia, acetylene, butadiene, butane, methane, propane, hydrogen, sodium carbide, turpentine, benzene and finely divided |
| Cyanides | Acids - organic or inorganic |
| Hydrogen peroxide | Copper, chromium, iron, most metals, alcohols, acetone, organic materials, aniline, nitromethane, flammable liquids and combustible |
| Hydrogen sulfide | Fuming nitric acid and oxidizing gases |
| Hydrocarbons (butane, propane, benzene, gasoline, turpentine etc.) | Fluorine, chlorine, bromine, chromic acid and sodium peroxide |
| Iodine | Acetylene, ammonia and hydrogen |
| Nitric acid | Acetic acid, aniline, chromic acid, hydrocyanic acid, hydrogen sulfide, flammable liquids, flammable gases, copper, brass and any heavy metals |
| Perchloric acid | Acetic anhydride, bismuth and its alloys, alcohol, paper, wood, ether, oils and grease |
| Phosphorous | Oxidizing agents, oxygen, strong bases |
| Potassium chlorate | Sulfuric and other acids |
| Potassium permanganate | Glycerin, ethylene glycol, benzaldehyde and sulfuric acid |
| Sodium | Carbon tetrachloride, carbon dioxide and water |
| Sodium nitrite | Ammonium nitrate and other ammonium salts |
| Sodium peroxide | Ethyl or methyl alcohol, glacial acetic acid, acetic anhydride, benzaldehyde, carbon disulfide, glycerin, ethylene glycol, ethyl |
| Sulfides, inorganic | Acids Sulfuric acid Potassium chlorate, potassium perchlorate and potassium permanganate |

Special Segregation of Incompatible Chemicals

In addition to the segregation noted in Table M.1, dangerously incompatible substances, even in small quantities, should not be stored next to each other on shelves or in such a position that accidental rupture of containers may allow mixing. Table M.2 contains

examples of dangerously incompatible substances. Table M.3 contains examples of incompatible oxidizing agents and reducing agents.

Table C.2 – Dangerously Incompatible Substances

| Chemical | Keep out of contact with: |
|--------------------------------|----------------------------------|
| Chlorine | Acetylene |
| Chromic acid | Ethyl alcohol |
| Oxygen (compressed, liquefied) | Propane |
| Sodium | Chloroform and aqueous solutions |
| Nitrocellulose (wet, dry) | Phosphorous |
| Potassium permanganate | Sulfuric acid |
| Perchloric acid | Acetic acid |
| Sodium chlorate | Sulfur in bulk |

Table C.3 – Incompatible Oxidizing Agents and Reducing Agents

| Oxidizing Agents | Reducing Agents |
|-------------------------|------------------------|
| Chlorates | Ammonia |
| Chromates | Carbon |
| Dichromates | Metals |
| Chromium trioxide | Metal hydrides |
| Halogens | Nitrates |
| Halogenating agents | Organic Compounds |
| Hydrogen peroxide | Phosphorus |
| Nitric acid | Silicon |
| Nitrates | Sulfur |
| Perchlorates | |
| Peroxides | |
| Permanganates | |
| Persulfates | |

Appendix D: Minor Spill Cleanup

Laboratory personnel can clean up small spills if trained and competent to do so. Small spills include chemical spills that are up to 1 liter in size and of limited toxicity, flammability and volatility. If respiratory protection is needed for spill clean-up, the spill is too large to be handled by laboratory personnel – Call Public Safety at (954) 262-8999 from an off-campus, or cell phone. Commercial chemical and mercury spill kits are available, which include protective equipment such as goggles and gloves, neutralizing and absorbing materials, bags, and scoops. You can also make your own spill kits to include the materials described below:

- 1 pair neoprene or nitrile gloves
- 1 pair safety goggles
- 1 scoop
- Spill pillows, sorbent pads
 - Disposable shoe covers (plastic bags may work)
 - Thick sealable plastic bag or bucket
- High Visibility Label or Sign (SPILL KIT)

General Chemical Spill Clean Up

1. Wear gloves, goggles, laboratory coat and shoe covers
2. Absorb the spill with a non-reactive material such as:
 - Vermiculite
 - Dry sand
 - Paper towels
 - Sponges
3. Scoop or place the absorbent materials and disposable personal protective equipment into a thick plastic bag or bucket. Double bag (or seal the bucket) and tag the bag/bucket. Apply a completed hazardous waste label.
4. Do not rinse or dispose of any chemicals down the sink or into any drain
5. Submit a Chemical Waste Pick Up Request from EHS

Note: When using commercial spill kits designed for neutralizing or collecting specific spill types (Mercury, for example), consult the instructions found in the kit.

Appendix E. Glossary of Terms

ACGIH - The American Conference of Governmental Industrial Hygienists is a voluntary membership organization of professional industrial hygiene personnel in governmental or educational institutions. The ACGIH develops and publishes recommended occupational exposure limits each year called Threshold Limit Values (TLVs) for hundreds of chemicals, physical agents, and biological exposure indices.

ACTION LEVEL - A concentration designated in CFR 1910.1450 (Subpart Z) Title 8, for a specific substance, calculated as an eight (8)-hour time weighted average, which initiates certain required activities such as exposure monitoring and medical surveillance.

AEROSOL - Liquid droplets or solid particles dispersed in air that are of fine enough size (less than 100 micrometers) to remain dispersed for a period of time.

ASPHYXIANT - A chemical (gas or vapor) that can cause death or unconsciousness by suffocation. Simple asphyxiants, such as nitrogen, either use up or displace oxygen in the air. They become especially dangerous in confined or enclosed spaces. Chemical asphyxiants, such as carbon monoxide and hydrogen sulfide, interfere with the body's ability to absorb or transport oxygen to the tissues.

ACUTE HAZARDOUS WASTE (aka "P-Waste")- chemicals listed in 40 CFR §261.33

"C" OR CEILING - A description usually seen in connection with a published exposure limit. It refers to the concentration that should not be exceeded, even for an instant. It may be written as TLV-C or Threshold Limit Value - Ceiling. (See also Threshold Limit Value).

CARCINOGEN - A cancer-producing substance or physical agent in animals or humans. A chemical is considered a carcinogen or potential carcinogen if it is so identified in any of the following:

- National Toxicology Program, "Annual Report of Carcinogens" (latest edition)
- International Agency for Research on Cancer, "Monographs" (latest edition)
- OSHA, 29 CFR 1910, Subpart Z, Toxic and Hazardous Substances

CFR - Code of Federal Regulations

CHEMICAL HYGIENE OFFICER - An employee who is designated by the employer and who is qualified by training or experience to provide technical guidance in the development and implementation of the provisions of the Chemical Hygiene Plan.

CHEMICAL HYGIENE PLAN - A written program developed and implemented by the employer which sets forth procedures, equipment, personal protective equipment, and work practices that (1)

can protect employees from the health hazards presented by hazardous chemicals used in that particular workplace and (2) meets the requirements of OSHA regulation 29 CFR 1910.1450.

CHEMICAL NAME - The scientific designation of a chemical in accordance with the nomenclature system developed by the International Union of Pure and Applied Chemistry (IUPAC) or the Chemical Abstracts Service (CAS) rules of nomenclature, or a name which will clearly identify the chemical for the purpose of conducting a hazard evaluation.

COMBUSTIBLE LIQUID - Any liquid having a flashpoint at or above 100°F (37.8°C) but below 200°F (93.3°C) except any mixture having components with flashpoints of 200°F or higher, the total volume of which make up 99% or more of the total volume of the mixture.

COMPRESSED GAS - A gas or mixture of gases having, in a container, an absolute pressure exceeding 40 psi at 70°F (21.1°C), or; a gas or mixture of gases having, in a container, an absolute pressure exceeding 104 psi at 130°F (54.4°C) regardless of the pressure at 70°F (21.1°C), or; a liquid having a vapor pressure exceeding 40 psi at 100°F (37.8°C) as determined by ASTM D-323-72.

COMMON NAME - Any designation or identification such as code name, code number, trade name, brand name, or generic name used to identify a chemical other than by its chemical name.

CONTAINER - Any bag, barrel, bottle, box, can, cylinder, drum, reaction vessel, storage tank, or the like that contains a hazardous chemical. For purposes of this section, pipes or piping systems, and engines fuel tanks or other operating systems in a vehicle are not considered to be containers.

CORROSIVE - A substance that, according to the DOT, causes visible destruction or permanent changes in human skin tissue at the site of contact or is highly corrosive to steel.

DESIGNATED AREA - An area which has been established and posted with signage for work involving hazards (e.g., "select carcinogens," reproductive toxins, or substances which have a high degree of acute toxicity). A designated area may be the entire laboratory, an area of a laboratory, or a device such as a laboratory hood.

EMERGENCY - Any potential occurrence, such as, but not limited to, equipment failure, rupture of containers, or failure of control equipment which could result in an uncontrolled release of a hazardous chemical into the workplace.

EPCRA - Emergency Planning and Community Right-To-Know Act (Title III or SARA)

EXPLOSIVE - A chemical that causes a sudden, almost instantaneous release of pressure, gas, and heat when subjected to a sudden shock, pressure, or high temperature.

FLAMMABLE - A chemical that falls into one of the following categories:

1. Flammable aerosol - an aerosol that, when tested by the method described in 16 CFR 1500.45, yields a flame projection exceeding 18 inches at full valve opening, or a flashback (a flame extending back to the valve) at any degree of valve opening;
2. Flammable gas - a gas that, at ambient temperature and pressure, forms a flammable mixture with air at a concentration of 13% by volume or less; or a gas that, at ambient

temperature and pressure, forms a range of flammable mixtures with air wider than 12% by volume, regardless of the lower limit;

3. Flammable liquid - any liquid having a flashpoint below 100°F (37.8°C), except any mixture having components with flashpoints of 100°F (37.8°C) or higher, the total of which make up 99% or more of the total volume of the mixture; or
4. Flammable solid - a solid, other than a blasting agent or explosive as defined in 1910.109(a), that is liable to cause fire through friction, absorption of moisture, spontaneous chemical change, or retained heat from manufacturing or processing, or which can be ignited readily and, when ignited, burns so vigorously and persistently as to create a serious hazard. A chemical shall be considered to be a flammable solid if, when tested by the method described in 16 CFR 1500.44, it ignites and burns with a self-sustained flame at a greater than one-tenth of an inch per second along its major axis.

FLASHPOINT - The minimum temperature at which a liquid gives off a vapor in sufficient concentration to ignite in the presence of an ignition source or when tested as follows:

1. Tagliabue Closed Tester (See American National Standard Method of Test for Flashpoint by Tag Closed Tester, Z11.24-1979 (ASTM D-56-79) for liquids with a viscosity of less than 45 Saybolt Universal Seconds (SUS) at 100°F (37.8°C) or that contain suspended solids and do not have a tendency to form a surface film under test;
2. Pensky-Martens Closed Tester (See American National Standard Method of Test for Flashpoint by Pensky-Martens Closed Tester, Z11.7-1979 (ASTM D-73-79) for liquids with a viscosity equal to or greater than 45 SUS at 100°F (37.8°C), or that contain suspended solids, or that have a tendency to form a surface film under test; or,
3. Setaflash Closed Tester (See American National Standard Method of Test for Flashpoint of Setaflash Closed Tester (ASTM D-3278-78)). Organic peroxides, which undergo auto-accelerating thermal decomposition, are excluded from any flashpoint determination methods specified above.

GENERAL VENTILATION - Also known as general exhaust ventilation, this is a system of ventilation consisting of either natural or mechanically induced fresh air movements to mix with and dilute contaminants in the workroom air. This is not the recommended type of ventilation to control contaminants that are highly toxic, when there may be corrosion problems from the contaminant, when the worker is close to where the contaminant is being generated, and where fire or explosion hazards are generated close to sources of ignition. (See Local Exhaust Ventilation)

GLOBALLY HARMONIZED SYSTEM (GHS) - The GHS is a system for standardizing and harmonizing the classification and labeling of chemicals. It is a logical and comprehensive approach to: defining health, physical and environmental hazards of chemicals; creating classification processes that use available data on chemicals for comparison with the defined hazard criteria; and communicating hazard information, as well as protective measures, on labels and Safety Data Sheets (SDS).

HAZARD ASSESSMENT - A formal procedure undertaken by the supervisor in which occupational hazards for all employees are described per procedure or task, and by affected body

part(s) or organ(s), and which is documented and posted in the workplace with all personal protective equipment requirements.

HAZARD WARNING - Any words, pictures, symbols or combination thereof appearing on a label or other appropriate form of warning which convey the hazards of the chemical(s) in the container(s).

HAZARDOUS MATERIAL (DOT) - A substance or material capable of posing an unreasonable risk to health, safety, and property when transported including, but not limited to, compressed gas, combustible liquid, corrosive material, cryogenic liquid, flammable solid, irritating material, material poisonous by inhalation, magnetic material, organic peroxide, oxidizer, poisonous material, pyrophoric liquid, radioactive material, spontaneously combustible material, an water-reactive material.

HAZARDOUS CHEMICAL - A chemical for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed employees. The term "health hazard" includes chemicals which are carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, neurotoxins, agents which act on the hematopoietic system, and agents which damage the lungs, skin, eyes or mucous membranes. A chemical is also considered hazardous if it is listed in any of the following:

1. OSHA, 29 CFR 1910, Subpart Z, Toxic and Hazardous Substances;
2. "Threshold Limit Values for Chemical Substances and Physical Agents in the Work Environment," ACGIH (latest edition);
3. "The Registry of Toxic Effects of Chemical Substances," NIOSH (latest edition);

HIGHLY TOXIC - A substance falling within any of the following categories:

1. A substance that has a median lethal dose (LD50) of 50 milligrams or less per kilogram of body weight when administered orally to albino rats weighing between 200 and 300 grams each;
2. A substance that has a median lethal dose (LD50) of 200 milligrams or less per kilogram of body weight when administered by continuous contact for 24 hours (or less if death occurs within 24 hours) with the bare skin of albino rabbits weighing between two and three kilograms each; or
3. A substance that has a median lethal concentration (LC50) in air of 200 parts per million by volume or less of gas or vapor, or 2 milligrams per liter or less of mist, fume, or dust, when

administered by continuous inhalation for one hour (or less if death occurs within one hour) to albino rats weighing between 200 and 300 grams each.

IARC - International Agency for Research on Cancer.

IGNITABLE - A solid, liquid or compressed gas waste that has a flashpoint of less than 140°F. Ignitable material may be regulated by the EPA as a hazardous waste as well.

INCOMPATIBLE - The term applies to two substances to indicate that one material cannot be mixed with the other without the possibility of a dangerous reaction.

IRRITANT - A substance which, by contact in sufficient concentration for a sufficient period of time, will cause an inflammatory response or reaction of the eye, skin, nose or respiratory system. The contact may be a single exposure or multiple exposures. Some primary irritants: chromic acid, nitric acid, sodium hydroxide, calcium chloride, amines, metallic salts, chlorinated hydrocarbons, ketones and alcohols.

LABEL - Any written, printed or graphic material displayed on or affixed to containers of chemicals, both hazardous and non-hazardous.

LABORATORY- A facility where the "laboratory use of hazardous chemicals" occur. It is a workplace where relatively small quantities of hazardous chemicals are used on a non-production basis.

LABORATORY TYPE HOOD - A device located in a laboratory, enclosed on five sides with a movable sash or fixed partial enclosure on the remaining side; constructed and maintained to draw air from the laboratory and to prevent or minimize the escape of air contaminants into the laboratory; and allows chemical manipulations to be conducted in the enclosure without insertion of any portion of the employee's body other than hands and arms.

LABORATORY USE OF HAZARDOUS CHEMICALS - Handling or use of such chemicals in which all of the following conditions are met:

1. Chemical manipulations are carried out on a "laboratory scale";
2. Multiple chemical procedures or chemicals are used;
3. The procedures involved are not part of a production process nor in any way simulate a production process; and
4. "Protective laboratory practices and equipment" are available and in common use to minimize the potential for employee exposure to hazardous chemicals.

LD50 - Lethal dose needed to kill 50% of the test population.

LOCAL EXHAUST VENTILATION (Also known as exhaust ventilation) – A ventilation system that captures and removes the contaminants at the point they are being produced before they escape into the workroom air. The system consists of hoods, ductwork, a fan, and possibly an air-cleaning device. Advantages of local exhaust ventilation over general ventilation include it removes the contaminant rather than dilutes it, requires less airflow and, thus, is more economical over the long term; and the system can be used to conserve or reclaim valuable materials; however, the

system must be properly designed with the correctly shaped and placed hoods, and correctly sized fans and ductwork.

LSRs – Lab Safety Rules

MEDICAL CONSULTATION - A consultation which takes place between an employee and a licensed physician for the purpose of determining what medical examinations or procedures, if any, are appropriate in cases where a significant exposure to a hazardous chemical may have taken place.

MIXTURE - Any combination of two or more chemicals if the combination is not, in whole or in part, the result of a chemical reaction.

MUTAGEN - Anything that can cause a change (or mutation) in the genetic material of a living cell.

NFPA - The National Fire Protection Association; a voluntary membership organization whose aims are to promote and improve fire protection and prevention. NFPA has published 16 volumes of codes known as the National Fire Codes. Within these codes is Standard No. 705, "Identification of the Fire Hazards of Materials". This is a system that rates the hazard of a material during a fire. These hazards are divided into health, flammability, and reactivity hazards and appear in a well-

known diamond system using from zero through four to indicate severity of the hazard. Zero indicates no special hazard and four indicates severe hazard.

NIOSH - The National Institute for Occupational Safety and Health; a federal agency that among its various responsibility's trains occupational health and safety professionals, conducts research on health and safety concerns, and tests and certifies respirators for workplace use.

NTP - National Toxicology Program

ODOR THRESHOLD - The minimum concentration of a substance at which a majority of test subjects can detect and identify the substance's characteristic odor.

OXIDIZER - Is a substance that gives up oxygen easily to stimulate combustion of organic material.

PERMISSIBLE EXPOSURE LIMIT (PEL) - An exposure, inhalation or dermal permissible exposure limit specified in the Z-Tables of 29 CFR 1910.1000. PELs may be a time-weighted average (TWA) exposure limit (8- hour), a 15-minute short-term limit (STEL), or a ceiling (C).

PERSONAL PROTECTIVE EQUIPMENT (PPE)- Any devices or clothing worn by the worker to protect against hazards in the environment. Examples are respirators, gloves, and chemical splash goggles.

PHYSICAL HAZARD - A chemical for which there is scientifically valid evidence that it is a combustible liquid, a compressed gas, explosive, flammable, an organic peroxide, an oxidizer, pyrophoric, unstable (reactive), or water-reactive.

PYROPHORIC - A chemical that will spontaneously ignite in the air at a temperature of 130oF (54.4oC) or below.

RCRA - Resource Conservation and Recovery Act

REACTIVITY - A substance's susceptibility to undergoing a chemical reaction or change that may result in dangerous side effects, such as explosion, burning, and corrosive or toxic emissions. The

conditions that cause the reaction, such as heat, other chemicals, and dropping, will usually be specified as "Conditions to Avoid" when a chemical's reactivity is discussed on an SDS.

REPRODUCTIVE TOXINS - Chemicals which affect the reproductive capabilities including chromosomal damage (mutations) and effects on fetuses (teratogenesis).

RESPIRATOR - A device which is designed to protect the wearer from inhaling harmful contaminants.

RESPIRATORY HAZARD - A particular concentration of an airborne contaminant that, when it enters the body by way of the respiratory system or by being breathed into the lungs, results in some body function impairment.

Responsible party is defined as any individual employed by the University.

SAFETY DATA SHEET (SDS) - Written or printed material concerning a hazardous chemical which is prepared in accordance with paragraph (g) of 29 CFR 1910.1200. Formerly known as Material Safety Data Sheet (MSDS)

SARA- Superfund Amendments and Reauthorization Act of 1986

SELECT CARCINOGENS - Any substance which meets one of the following:

1. It is regulated by OSHA as a carcinogen; or
2. It is listed under the category, "known to be carcinogens," in the Annual Report on Carcinogens published by the National Toxicology Program (NTP) (latest edition);or
3. It is listed under Group 1 ("carcinogen to humans") by the International Agency for Research on Cancer Monographs (IARC)(latest editions); or
4. It is listed in either Group 2A or 2B by IARC or under the category, "reasonably anticipated to be carcinogens" by NTP.

SENSITIZER - A substance that may cause no reaction in a person during initial exposures, but afterwards, further exposures will cause an allergic response to the substance.

SHORT-TERM EXPOSURE LIMIT - Represented as STEL or TLV-STEL, this is the maximum concentration to which workers can be exposed for a short period of time (15 minutes) for only four

times throughout the day with at least one hour between exposures. Also, the daily TLV-TWA must not be exceeded.

SIC - Standard Industrial Code.

SIGNIFICANT HAZARD is any hazard, which left untreated, will result in injury or harm to life or property.

SIGNIFICANT SPILL is any hazard, which left untreated, will result in injury or harm to life or property.

SOLVENT - A substance, commonly water, but in industry often an organic compound, which dissolves another substance.

THRESHOLD LIMIT VALUE (TLV) - Airborne concentration of substances devised by the ACGIH that represents conditions under which it is believed that nearly all workers may be exposed day after day with no adverse effect. TLVs are advisory exposure guidelines, not legal standards, that are based on evidence from industrial experience, animal studies, or human studies when they exist. There are three different types of TLVs: Time-Weighted Average (TLV-TWA), Short-Term Exposure Limit (TLV-STEL), and Ceiling (TLV-C). (See also PEL).

TOXICITY - A relative property of a material to exert a poisonous effect on humans or animals and a description of the effect and the conditions or concentration under which the effect takes place.

VAPOR - The gaseous form of substances which are normally in the liquid or solid state (at normal room temperature and pressure). Vapors evaporate into the air from liquids such as solvents. Solvents with lower boiling points will evaporate faster.

UNIVERSAL WASTE- Florida universal wastes include most rechargeable batteries; aerosol cans; pesticides that are recalled or collected under a pesticide waste collection program; mercury-containing devices such as manometers and switches; mercury-containing lamps such as fluorescent lamps that are recycled.