CHEMICAL HYGIENE PLAN

1.0 PURPOSE

To provide the compliance with Michigan Occupational Safety and Health Administration's (MIOSHA) Part 431. Hazardous Work in Laboratories for all laboratories on Lake Superior State University's campus.

2.0 RESPONSIBILITIES

2.1 ENVIRONMENTAL, HEALTH AND SAFETY SPECIALISTHUMAN RESOURCES, SAFETY AND RISK OFFICE

2.1.1 Serve as Chemical Hygiene Officer

2.2 CHEMICAL HYGIENE OFFICER (CHO)

2.2.1 Develops, implement and revise Chemical Hygiene Plan (CHP) as required by plan

2.2.2 Coordinate safety and training programs

2.2.3 Coordinate safety inspections and give guidance on correcting deficiencies

2.2.4 Maintain training and inspection records

2.2.5 Serve as contact for hazardous materials emergencies

2.2.6 Serve as liaison with state, local and federal regulatory agencies

2.2.7 Coordinate list of hazardous chemical for campus and ensure completion of annual inventory

2.3 SUPERVISORS/MANAGERS/PRINCIPAL INVESTIGATORS

2.3.1 Develop written standard operating procedures (SOPs) for hazards beyond those identified in the CHP

2.3.2 Maintain an up to date list of hazardous chemicals in the lab and inventory annually

2.3.3 Perform routine periodic inspections of facilities as noted in this CHP

2.3.4 Train laboratory personnel to work safely with hazardous chemicals and operations

2.3.5 Know the current requirements for regulated substances used in that laboratory

2.3.6 Determine the required levels of personal protective equipment and facility engineering controls

2.3.7 Enforce the requirements of the CHP

2.4 LAB SAFETY COMMITTEE

2.4.1 Assist CHO with annual review of CHP

2.4.2 Meet regularly to review CHP compliance

2.4.3 Develop enforcement policies

2.5 EMPLOYEES

2.5.1 Follow established CHP, SOPs and safety rules

2.5.2 Use required Personal Protective Equipment (PPE)

2.5.3 Report safety hazards to supervisor

2.5.4 Report signs and symptoms of possible exposures, known exposures, accidents, and near misses to supervisor

2.5.5 Attend required safety training sessions

3.0 REFERENCE DOCUMENTS

- 3.1 Hazard Communication Program
- 3.2 Mercury Clean-Up Procedure
- 3.3 Lab Maintenance Procedure

4.0 PROCEDURE

4.1 GENERAL SAFETY RULES

- 4.1.1 DO NOT HAVE FOOD OR BEVERAGES IN A LABORATORY WHERE HAZARDOUS MATERIALS ARE PRESENT. Food and beverages are only allowed in the hallways, office areas, and conference rooms.
- 4.1.2 Wear appropriate clothing in the laboratory and animal rooms. Long pants, shirts with sleeves (long or short), socks and closed-toe shoes are required when working in any laboratory on campus. Tie back long hair and loose clothing and remove dangling jewelry prior to working in the laboratory.
- 4.1.3 Always wash hands thoroughly with soap and water before leaving the laboratory.
- 4.1.4 Avoid working alone. Working alone in a chemical storage area or in an area where hazardous materials are used is never a good idea and should be avoided, if possible. If the employee and supervisor of the laboratory determine that work must be done under these conditions, the hazards should be carefully assessed, contingencies thought out, and the work approved only if the chances of injury are minimal. An effort should be made to keep in contact with the employee who is working alone.
- 4.1.5 Wear the appropriate personal protective equipment
- 4.1.6 Use a tip-resistant shield for protection whenever there is the potential that an explosion or implosion might occur.
- 4.1.7 Know the location and proper use of all emergency equipment.
- 4.1.8 When working with chemicals, be aware of:
  - The hazards of the chemicals, as determined from the SDS or other appropriate documented references
  - Appropriate safeguards that need to be taken when using the chemical, including personal protective equipment
  - How and where to properly store the chemical when not in use, as well as how to properly dispose of the chemical once the task is complete
  - The proper methods of transporting chemicals within the facility
  - Appropriate procedures for emergencies, including evacuation routes, spill cleanup procedures and proper waste disposal methods avoid tasting or directly smelling chemical
- 4.1.9 Do not ride in the elevator with containers of cryogenic materials or poison inhalation hazards. DOT Class 4 flammable solids and pyrophoric/water-reactive chemicals should also be hand-carried using the stairs.

4.1.10 Promptly notify the appropriate personnel in the event of an accident, injury, or chemical release.

4.1.11 Do not participate in behavior that may startle, distract or disorient another worker. Always inspect equipment for leaks, tears or other damages before use

4.1.12 Be alert to any unsafe condition. If an unsafe condition exists, either remediate the problem or notify the appropriate supervisor to ensure the unsafe condition is corrected.

4.1.13 Do not block access to emergency equipment, safety showers, eyewashes, fire extinguishers, or exits, even with temporary equipment or parked carts.

4.1.14 Label all containers of chemicals with the full chemical name, the hazard warnings, and the concentration.

4.1.15 Keep all work areas, workbenches, and hoods free of clutter.

4.1.16 Keep all aisles, hallways, and stairways clear of all obstructions.

4.1.17 Label and store recovered chemicals and waste containers properly.

4.1.18 Clean all working surfaces regularly. Keep floors free of all slip and trip hazards.

4.1.19 Do not store chemicals in hallways or stairwells, in aisles or on the floor, or on desktops or workbenches. Return materials requiring long-term storage to the appropriate storage area.

4.1.20 Make sure that all chemical containers are closed when not in use.

4.1.21 Make sure that fume hoods are working properly before working with chemicals inside of them.

4.1.22 Dispose of glass, sharps, in appropriate disposal containers. Secure compressed gas cylinders at all times. Keep cylinder caps in place when cylinders are not in use.

4.2 UNDERSTANDING AND RECOGNIZING CHEMICAL HAZARDS

To ensure that employees of Lake Superior State University (LSSU) are not overexposed to chemicals, each employee must be knowledgeable of the chemical hazards in their work environment. Each employee must be able to identify chemical hazards and understand what measures can be taken to eliminate chemical hazards. This section addresses how to understand and recognize chemical hazards.

4.2.1 Employee Training

LSSU will provide training to its employees who work in areas where hazardous materials are used or stored and to its employees who work in areas where hazardous materials are not used or stored yet have the potential for incidental exposure because they are located in the same building. New employees must receive training on the requirements of the CHP prior to working with chemicals in the laboratory. Annual refresher training is required. Refresher training will be provided when procedures are updated in the CHP. Employee training records will be maintained with the Human Resource, Safety and Risk Office.

• All training will include the following:

a) The content and requirements of the Laboratory Standard.
b) The content, location, and availability of the chemical hygiene plan.
c) The Permissible Exposure Limit (PEL), action levels, and other recommended exposure limits for hazardous chemicals used in LSSU's laboratories.
d) Signs and symptoms associated with exposures to the hazardous chemicals used in the laboratory.
e) The location and availability of SDS and other reference materials.
f) The methods and observations that may be used to detect the presence or release of a hazardous chemical.
g) The hazards associated with the chemicals used in LSSU's laboratories.
h) The measures employees can use to protect themselves from these hazards, including specific procedures such as appropriate work practices, personal protective equipment, and emergency procedures.
i) Questions about CHP training (to whom does it apply, training dates and times, etc.) should be directed to the principal investigator, the supervisor, or the Human Resource and Safety and Risk Office.

4.2.2 IDENTIFICATION OF HAZARDOUS CHEMICALS

Before starting any procedure that requires the use of a chemical, you must identify the hazards associated with the chemical. Reading and understanding the warning or hazard labels on the chemical containers and the Safety Data Sheet (SDS) for each of the chemicals used can help achieve this.

4.2.3 SIGNS

At a minimum, the following signs should be posted in each laboratory:

- A listing of telephone numbers for LSSU Public Safety (635-2100), Human Resources, Safety and Risk Office, and supervisory personnel on the outside of the lab door.
- Location signs for safety equipment, such as safety showers, eyewash stations, fire extinguishers, emergency cut-off switches, and first aid equipment.
- Signs designating the location of SDS information.
- Signs designating the areas where food and beverages are NOT permitted.
- Warning signs where dangerous equipment is in use or where potentially dangerous operations are taking place.

4.2.4 CHEMICAL LABELING

At a minimum, each new chemical container must be labeled complaint with GHS guidelines.

- At a minimum, you must label each secondary chemical container with the following:
  a) Name of chemical (no abbreviations).
  b) Hazard warnings (may use NFPA system)
  c) Chemical concentration
  d) Date
- You must also properly label containers of non-hazardous materials. (Example: distilled water).

4.2.5 SAFETY DATA SHEET (SDS)

SDS's must be readily accessible during each work shift to employees in their work area. SDS must be maintained for thirty years because they serve as exposure records. When a new SDS arrives, date it. When the chemical is no longer in use or an updated SDS is on file, forward the old SDS copy to the Human Resource, Safety and Risk Office.

4.2.6 CHEMICAL INVENTORY

Each department shall maintain a hazardous chemical inventory. Update the inventory at least annually and forward a copy to the Human Resource, Safety and Risk Office for regulatory reporting. Chemical inventory will be kept electronically using Quartzy. Store all chemicals safely and properly. Store by chemical classification and hazard, and separate incompatible materials. Do not store chemicals alphabetically.

4.2.7 INSPECTIONS

Principal Investigators/Supervisors are responsible for conducting periodic inspections of laboratories. Include personal protective equipment (PPE), safety equipment, electrical cords, laboratory equipment, and general laboratory conditions during the inspection. If you discover any defective equipment during the safety inspection, tag it, take it out of service, and have it repaired. If the equipment is not going to be repaired, then it is recommended that the item is either disposed of or removed to a storage location. Maintain a file of inspection checklists and logs.

The Human Resource, Safety and Risk Office will be responsible for coordinating the inspecting/flushing of safety showers and eyewash stations. Any safety shower or eyewash not passing the inspection will be immediately tagged and taken out of service until it is repaired.

Physical Plant will be responsible for inspecting the performance of chemical and biological hoods annually. If any hood does not pass the inspection, it will be immediately tagged and taken out of service until it is repaired.

Public Safety will be responsible for inspecting fire extinguishers monthly.

4.2.8 HAZARD NOTIFICATION FORMS FOR REPAIR WORK

Follow the Lab Maintenance Safety Procedures. When making a work request of Facilities Management to do work in an area where hazardous materials are used. In summary, the procedure is as follows:

- Make your work request online.
- Inform the person that you will be faxing a hazard notification form to accompany the work request.
- Fill out the hazard notification form as the listed tasks are completed. Tasks include such items as clearing an area within 4 feet of the work site and cleaning surfaces. Sign the form and fax it to 906-635-2764. The FM employee completing the work will also sign off on this form to acknowledge acceptance.

4.3 REDUCING EXPOSURE TO CHEMICALS

4.3.1 VENTILATION

General room ventilation is not usually sufficient to prevent the accumulation of chemical vapors; therefore, chemicals must be used in an operating fume hood, glove box, vacuum line, or similar device, which is equipped with appropriate traps and/or scrubbers. If this equipment is not available, then no work shall be performed using that chemical. There are many different types and sizes of hoods as well as other forms of local exhaust ventilation such as snorkels and vented chemical storage cabinets on campus. Become familiar with the local exhaust ventilation units in your work area. **NOTE: Most biological safety cabinets are not designed for chemical ventilation. Check the cabinet rating before using chemicals.**

When laboratory handling of a chemical will be likely to exceed exposure limits, see section 4.3.4, Environmental Monitoring, for further guidance.

• Ventilation Failure

Fume hoods and other ventilation controls should provide enough ventilation to adequately remove the chemical hazard from the work area. Be alert to detect any malfunction in the ventilation equipment. In the event that a ventilation system fails, shut down all operations within that system promptly and safely. Close or seal any open containers or equipment containing hazardous materials to prevent a release of vapors into the room. If the ventilation equipment is a hood, post a sign on the item stating the hood is not working properly and cannot be used and submit a work order to Physical Plant. Do not use chemicals in the hood until further notice is given that the system has been repaired. If the ventilation shut down creates an emergency situation (i.e. hazardous chemical vapors are not controlled), then evacuate personnel from the area and contact LSSU Public Safety.

• Ventilation Testing

The chemical fume hoods will be tested annually by a certified contractor scheduled by the Facilities Management. The biological safety cabinets will be tested annually by a certified contractor scheduled by the Facilities Management. If any hood is not working properly, then it will be tagged out of service until the repairs are made. While the hood is out of service, it cannot be used.

• Use of Chemical Fume Hoods

Chemical fume hoods are engineering controls put into place to minimize exposure and must be used correctly to offer protection from chemical exposure. To ensure that the ventilation is properly working at all times, the following procedures must be followed:

a) Keep all laboratory doors to the hallway closed. This will aid in keeping the hallways at a positive pressure and the laboratories at a negative pressure so chemical odors will not migrate out of the lab.

b) Keep hood sashes in a lowered position with a maximum opening of 16 inches at all times. The hoods have been engineered with a stop to not allow to open more than the 16 inch max. When the sashes are wide open, the hood does not trap as much of the chemical vapor. When the hood is not in use, close the sash completely.

c) Keep storage of chemicals and equipment in the hood to a minimum (i.e. only those materials in use). If the hoods become cluttered, then airflow is blocked.

d) Place items at least six inches away from the front edge for better capture of vapors.

4.3.2 PERSONAL PROTECTIVE EQUIPMENT (PPE)

- Responsible Parties

  Supervisors and Principal Investigators are responsible for the Personal Protective Equipment (PPE) program in their laboratories. This includes enforcement of the program and maintenance of the equipment. Appropriate disciplinary action must be taken for repeated violation of this program. Each Department must provide the necessary PPE for their employees at no cost. To assist with PPE determinations, LSSU will complete hazard assessments. NOTE: If there are any questions on how to select PPE, contact the Human Resource, Safety and Risk Office.

- Hazard Assessments

  Perform a PPE Hazard Assessment and Certification in each laboratory to determine if hazards requiring the use of PPE are present. If potential hazards are present in the laboratory, do the following:

  a) Identify each hazard and the source
  b) Determine which body parts are affected
  c) Select appropriate PPE against the hazard
  d) Train each employee on the hazards present and when PPE should be worn
  e) Train employees on the proper use, maintenance and limitations of each PPE device used
  f) Maintain training records within the Human Resource, Safety and Risk Office
  g) Complete and maintain a workplace assessment form for each task or process performed in the laboratory that requires PPE

- Eye Protection

  Contact lenses do not provide eye protection. Wearing contact lenses is discouraged when working with materials or procedures that give off gases, vapors, welding fumes, smoke or dust. If you choose to wear contacts, be aware of the hazards of wearing contacts in a lab.

  a) Safety Glasses

  All safety eyewear and face protection must meet the ANSI Z87.1 standard for minimum allowable protection. Side shields are required, on all safety glasses. It is recommended that each individual be issued his or her own eye protection. Visitor eye protection shall be available for use. If eye protection is shared, MIOSHA regulations state that it must be cleaned and disinfected between uses by different wearers.

  b) Safety Goggle and Face Shields

  Safety glasses do not give adequate protection from chemical splashes. If the potential for liquids to be splashed or sprayed is present, wear safety goggles. When liquids are under extreme, high pressure, wear a face shield. Never wear a face shield without wearing eye protection underneath.

  c) Eye Protection is Required:

  - When working with or in the vicinity of solvents or corrosive chemicals, or with any chemical that could produce an eye injury
  - When working near equipment or apparatus under high pressure or vacuum, or when around equipment that could produce projectiles

- When near laboratory benches where chemical reactions are being run or when around a radiation hazard
- When transporting flammable, corrosive or toxic chemicals
- During routine or maintenance activities involving chemicals, hand/power or machine tools, welding, cutting, grinding, or abrasive blasting
- When working behind hood doors or blast shields

• Gloves

Gloves provide protection against chemical, radiological and biological agents. Selection of proper gloves for the work task is critical in maintaining protection against hazardous agents. See reference Ansell Chemical Resistant Glove Guide. The Human Resource, Safety and Risk Office can assist employees in the selection of proper gloves.

a) Note the Following for Safe Glove Usage:

• When working with corrosive liquids, solvents, or other potentially hazardous materials, wear proper gloves. Proper glove selection is critical as all gloves do not provide the same protection. Consult with the glove manufacturer(s) as the primary source for glove selection and compatibility with intended procedures/chemicals.

• Remove gloves prior to answering phones, using computers, opening doors, or any other situation that might cause the spread of hazardous materials.

• Remove gloves prior to leaving the laboratory area.

• Wash hands anytime gloves are removed.

• Be careful not to touch other parts of your body or apparel while wearing gloves (i.e. pushing up your glasses, etc.).

• Respiratory Protection

Respirators are designed to keep the wearer from inhaling toxic chemicals or other contaminants in the air during accidents, emergencies or when engineering controls are not sufficient to maintain exposures below the Permissible Exposure Limit (PEL). If you plan to use a respirator, see the Human Resource, Safety and Risk Office prior to use. Respirators have inherent hazards, should be considered the last line of defense, and should not be used during routine laboratory operation.

a) Departments shall make every effort to use engineering and workplace controls to minimize exposures. Respirators shall only be used when engineering controls and workplace practices fail to reduce the exposures below the PEL. Departments are responsible for ensuring compliance with the Respiratory Protection Program. Responsibilities include:

• Inform the Human Resource, Safety and Risk Office of potential health hazards that may require the use of respirators.

• Ensure employees receive a respirator fit test prior to respirator usage.

• Ensure employees have received proper medical and training clearance before they start using respirators.

• Ensure employees use and store the respirator in compliance with the Respiratory Protection Program.

• Ensure respirators are stored in a closed container, shelf, or cabinet.

• Ensure respirators are kept clean and dust-free, and washed when necessary.
• Ensure respirator cartridges are changed on a regular basis according to specifications or use limitations.
• Require training for all employees using respirators. Make sure training is recorded and on file with the Human Resource, Safety and Risk Office.
• Monitor the respirator program for compliance and report deficiencies to the Human Resource, Safety and Risk Office.
• Laboratory Coats

Laboratory coats are issued to prevent the spread of hazardous materials outside the laboratory. Protective clothing is also provided to prevent damage to employees' personal clothing. Protective clothing is only to be worn on site or for external activities relating to laboratory requirements where protective clothing is needed. Remove contaminated clothing before leaving the laboratory area.

• Hearing Protection

If a procedure produces high noise output, contact the Human Resource, Safety and Risk Office to complete a noise monitoring survey. Generally speaking, if you have to raise your voice to have a conversation with the person standing next to you, then the noise may be at a level that requires a noise survey and assessment.

From this survey, the following items can be addressed:

a) Sources of noise output
b) Whether the action levels are exceeded
c) Types of hearing protection devices needed and when they should be worn
d) Who is affected by the problem and whether the affected employee needs to participate in the Hearing Conservation Program

4.3.3 Laboratory Practices

Proper lab practice can greatly reduce exposure to chemicals. If a chemical is highly hazardous, then substituting a less hazardous chemical that will accomplish the same procedure is strongly recommended. Observe the following practices at all times:

• Plan work ahead of time. Be prepared for spills and emergencies.
• Be familiar with the chemicals being used and the associated signs and symptoms of exposures.
• Do not eat or drink in a laboratory area.
• Wash hands prior to leaving the laboratory.
• Label unattended operations with name, contact phone number, and a brief description of the apparatus, reaction, and chemicals. See Appendix XX.

4.3.4 Environmental Monitoring

The recommended exposure limits or OSHA-mandated limits for toxic chemicals can be found in the SDS for most of the chemicals used in the laboratory. These limits may be expressed as threshold limit values (TLV), permissible exposure limits (PEL), and short-term exposure limits (STEL), ceilings (C), and action levels. These limits help to serve as guidelines for determining the appropriate safety precautions to be taken when handling specific chemicals. In laboratories,

instrumental monitoring for airborne contaminants is usually not practical or required. However, the Human Resource, Safety and Risk Office will conduct monitoring for any substance regulated by a standard that requires monitoring or if it is suspected that exposure levels routinely exceed the action level or PEL/STEL.

- Employees may request a determination of their exposure to a chemical by contacting the Human Resource, Safety and Risk Office.
- Employees must be notified within 15 business days after receipt of monitoring results.
- The Human Resource, Safety and Risk Office will maintain records pertaining to work-related exposure to chemicals or harmful physical agents for at least 30 years after an employee's termination of employment.

4.3.5 Medical Surveillance Criteria

All employees working with chemicals have the option to receive medical consultation and examination under any of the following conditions:

- The employee develops signs or symptoms associated with a hazardous chemical to which the employee may have been exposed in the laboratory.
- If exposure monitoring suggests that there could have been an exposure above the action level (or PEL if there is no action level) for a chemical for which a substance-specific standard has been established.
- An event occurs (spill, leak, explosion) resulting in a hazardous chemical exposure.
- The examining health care physician will provide a written opinion for examinations or consultations performed. The opinion shall include:

a) Any recommendations for further medical follow-up.

b) The results of the medical examination and any associated tests.

c) Conclusions concerning any other medical condition noted that could put the employee at increased risk.

d) A statement that the employee has been informed of the previous items.

Note: These statements shall not reveal findings that do not relate to the chemical exposure. The written opinion shall remain confidential.

4.3.6 Medical Records

All employees have the right to examine and obtain a copy of their own medical and chemical exposure records. No one shall have access to this information, except the employee and his or her physician.

- All memos, notes, and reports related to a complaint of actual or possible exposure must be maintained as part of the medical record.
- Records will be maintained in employee file for at least 30 years after termination of employment.
- These records shall include the results of biological monitoring and any blood tests performed for work-related monitoring programs.

4.4 SPECIFIC CHEMICAL HAZARDS

Each hazardous chemical container label includes the product identifier used on the SDS. Additionally, the label contains a signal word, hazard statement(s), pictograms(s) and precautionary statements(s) for each hazard class. Pictograms have been standardized with the Global Harmonization Standard.

4.4.1 Prior Approval

The Lab Manager must give prior approval before any new or non-routine task is started that involves the use of hazardous materials. The following items require prior approval:

- The same procedure but with new or different materials
- Any significant change in the procedure, particularly changes in temperature or pressure
- The use of new equipment or equipment that has been in storage
- A significantly new procedure

4.4.2 Particularly Hazardous Substances

The use of select carcinogens, reproductive toxins, and substances that have a high degree of acute or chronic toxicity requires a written standard operating procedure (SOP) be completed by party using the hazardous substance and on file with Human Resource, Safety and Risk Office. This SOP shall be available in lab where substance is being used. The SOP must include the establishment of a designated area with appropriate signs warning of the hazards associated with the substance, personal protective equipment required, the use of a fume hood or equivalent containment device, procedures for decontaminating the designated area, and procedures for safe removal of contaminated waste. MIOSHA General Standard Part 91. General Industry Safety and Health Standard Process Safety Management of Highly Hazardous Chemicals contains a list (List of Highly Hazardous Chemicals, Toxins and Reactives) of chemicals that require a written standard operating procedure for use. In all cases, make sure to consult the SDS to determine if a chemical meets the definition of a particularly hazardous substance.

4.4.3 Definitions

a) **Particularly hazardous substances**, by MIOSHA definition, are select carcinogens, reproductive toxins and chemicals with a high degree of acute and chronic toxicity.

b) **Carcinogen** means a substance or a mixture of substances which induce cancer or increase its incidence. Substances and mixtures which have induced benign and malignant tumors in well-performed experimental studies on animals are considered also to be presumed or suspected human carcinogens unless there is strong evidence that the mechanism of tumor formation is not relevant for humans. Classification of a substance or mixture as posing a carcinogenic hazard is based on its inherent properties and does not provide information on the level of the human cancer risk which the use of the substance or mixture may represent. For the purpose of classification for carcinogenicity, substances are allocated to one of two categories based on strength of evidence and additional weight of evidence considerations. In certain instances, route-specific classification may be warranted. These hazard categories are described in the following table. Note: An SOP is required for category 1 and 2 carcinogens.

c) **Reproductive toxins** are defined by MIOSHA as chemicals that affect the reproductive capabilities, including adverse effects on sexual function and fertility in adult males and females, as well as adverse effects on the development of the offspring. Adverse effects on sexual function and fertility means any effect of chemicals that interferes with reproductive ability or sexual capacity. This includes, but is not limited to, alterations to the female and male reproductive system, adverse effects on onset of puberty, gamete production and

transport, reproductive cycle normality, sexual behavior, fertility, parturition, pregnancy outcomes, premature reproductive senescence, or modifications in other functions that are dependent on the integrity of the reproductive systems. Adverse effects on or via lactation are also included in reproductive toxicity, but for classification purposes, such effects are treated separately. Information on reproductive effects will be listed on the SDS. The following table explains the categories of reproductive toxins. Note: An SOP is required for category 1 and 2 reproductive toxins.

As stated earlier, adverse effects on or via lactation are also included in reproductive toxicity, but for classification purposes, such effects are treated separately. The following table addresses lactation:

Hazard Category For Effects On Or Via Lactation	
Effects on or via lactation shall be classified in a separate single category. Chemicals that are absorbed by women and have been shown to interfere with lactation or that may be present (including metabolites) in breast milk in amounts sufficient to cause concern for the health of a breastfed child, shall be classified to indicate this property hazardous to breastfed babies. This classification shall be assigned on the basis of:	
(a)	absorption, metabolism, distribution and excretion studies that indicate the likelihood the substance would be present in potentially toxic levels in breast milk; and/or
(b)	results of one or two generation studies in animals which provide clear evidence of adverse effect in the offspring due to transfer in the milk or adverse effect on the quality of the milk; and/or
(c)	human evidence indicating a hazard to babies during the lactation period.

• **Chemicals with a high degree of acute and chronic toxicity** are not defined in the Laboratory Standard. Therefore, the MIOSHA Hazard Communication values defining the respective categories for acute toxicity and chemicals that demonstrate specific organ toxicity through repeated or prolonged exposures will be used.

Chemicals with a high degree of acute toxicity refers to those adverse effects occurring following oral or dermal administration of a single dose of a substance, or multiple doses given within 24 hours, or an inhalation exposure of 4 hours. Substances can be allocated to one of four toxicity categories based on acute toxicity by the oral, dermal or inhalation route according to the numeric cut-off criteria as shown in Table A.1.1. **At Lake Superior State University, Category 1 and Category 2 chemicals represent those considered to have an acute toxicity hazard and an SOP** is required. Acute toxicity values are expressed as (approximate) LD50 (oral, dermal) or LC50 (inhalation) values or as acute toxicity estimates (ATE). See the footnotes following Table A.1.1 for further explanation on the application of these values. The hazard(s) of a chemical may also be listed on its container label. Additionally, if the hazard of a chemical is not evident from the container label, the SDS will list the specific hazards.

• **Specific Target Organ Toxicity** – **single or repeated exposure** refers to specific target organ toxicity arising from a single or repeated exposure to a chemical. Significant health effects that

can impair function, both reversible and irreversible, immediate and/or delayed can occur from exposure to certain chemicals. Classification identifies the chemical as being a specific target organ toxicant and, as such, it presents a potential for adverse health effects in people who are exposed to it such as significant functional changes, more than transient in nature, in the respiratory system, central or peripheral nervous systems, other organs or other organ systems, including signs of central nervous system depression and effects on special senses (e.g., sight, hearing and sense of smell). Specific target organ toxicity can occur by any route that is relevant for humans, i.e., principally oral, dermal or inhalation. The relevant route of exposure by which the classified substance produces damage will be identified and classification is determined by expert judgment, on the basis of the weight of all evidence available. At Lake Superior State University, those chemicals which are classified as Category 1 and Category 2 having specific target organ toxicity will be considered to have chronic toxicity effects and an SOP is required. A single exposure to a chemical with known specific organ toxicity can be thought of as an acutely toxic chemical and handled as such. Substances that produce toxic effects in humans after repeated exposures are categorized depending on the nature and severity of the effects. The tables on the following pages explain how these categories are determined.

4.4.4 DESIGNATED AREAS

Work with chemicals requiring an SOP must be conducted in a designated area. Designated areas may include a hood, glove box, portion of a laboratory, or entire laboratory room. Post signs on designated areas and clearly mark/define the boundaries.

• Guidelines/procedures for employees working in designated areas

a) Employees shall:

• Be trained to work with the hazardous chemical and to the chemical specific SOP. Records of training shall be filed with the Human Resource, Safety and Risk Office.

• Use the smallest amount of chemical that is practical.

• Decontaminate a designated area when work is completed.

• Prepare waste according to the SOP.

• Wear appropriate PPE as noted in the SOP.

4.4.5 CORROSIVE CHEMICALS AND CONTACT-HAZARD CHEMICALS

• Corrosive Chemicals produce destruction of skin tissue, namely, visible necrosis through the epidermis and into the dermis, in at least 1 of 3 tested animals after exposure up to a 4-hour duration. Corrosive reactions are typified by ulcers, bleeding, bloody scabs and, by the end of observation at 14 days, by discoloration due to blanching of the skin, complete areas of alopecia and scars. Skin irritation is the production of reversible damage to the skin following the application of a test substance for up to 4 hours. Solid substances (powders) may become corrosive or irritant when moistened or in contact with moist skin or mucous membranes. Likewise, pH extremes like ≤ 2 and ≥ 11.5 may indicate skin effects. In the absence of any other information, a substance is considered corrosive (Skin Category 1) if it has a pH ≤ 2 or a pH ≥ 11.5.

• Contact-Hazard Chemical is an allergen or sensitizer that is so identified in the SDS or label, is so identified in the medical or industrial hygiene literature, or is known to be an allergen or sensitizer that leads to an allergic response following skin contact. Another contact hazard class is respiratory sensitizer, which means a chemical that will lead to hypersensitivity of the

airways following inhalation of the chemical. Sensitization includes two phases: the first phase is induction of specialized immunological memory in an individual by exposure to an allergen. The second phase is elicitation, i.e., production of a cell-mediated or antibody-mediated allergic response by exposure of a sensitized individual to an allergen. Usually, for both skin and respiratory sensitization, lower levels are necessary for elicitation than are required for induction. Evidence that a substance can lead to specific respiratory hypersensitivity will normally be based on human experience. In this context, hypersensitivity is normally seen as asthma, but other hypersensitivity reactions such as rhinitis/conjunctivitis and alveolitis are also considered. The condition will have the clinical character of an allergic reaction. However, immunological mechanisms do not have to be demonstrated.

• Take the following precautions when working with corrosive chemicals and contact- hazard chemicals:

a) Always wear proper PPE, especially eye protection (items may include safety goggles and face shield, gloves known to be resistant to permeation or penetration, laboratory aprons, laboratory coats).

b) Add acids and alkalis to water; never add water to acids or alkalis.

c) Add acid to water slowly, as a great deal of heat will be formed.

d) Provide secondary containment for storage bottles unless bottles are PVC-coated.

e) Treat any accident resulting in contact with the skin or eyes immediately. Wash affected area with large amounts of water for at least 15 minutes. Seek immediate medical attention.

f) Always separate and store acids, alkalis and other corrosive materials below eye level in properly labeled storage cabinets.

g) Store acids away from cyanides.

h) Store acids and bases away from flammable liquids and solvents.

i) Inspect containers frequently for corrosion.

j) Make an effort to minimize quantities according to your application.

4.4.6 PYROPHORIC/WATER REACTIVE CHEMICALS

Pyrophoric and water reactive materials can ignite spontaneously on contact with air, moisture in the air, oxygen, or water. Failure to follow proper handling procedures can result in fire or explosion, leading to serious injuries, death and/or significant damage to facilities. Any handling of a pyrophoric/water reactive material is high risk and must be controlled with adequate system design, supervision and training. These tasks are two person tasks and workers should not work alone. Handle all reactive chemicals with extreme care, and store them away from incompatible chemicals. Wear proper PPE at all times when handling these chemicals. Pyrophoric liquids and solids are defined in the MIOSHA Hazard Communication Part 430 Standard as materials which, even in small quantities, are liable to ignite within five minutes after coming into contact with air. Water reactive chemicals are defined as solid or liquid chemicals which, by interaction with water, are liable to become spontaneously flammable or to give off flammable gases in dangerous

4.4.7 EXPLOSIVES

Explosives can be defined as a solid or liquid chemical that is in itself capable by chemical reaction of producing gas at such a temperature and pressure and at such a speed as to cause damage to the surroundings. An explosive item is an item containing one or more explosive chemicals. An unstable explosive is an explosive, which is thermally unstable and/or too

sensitive for normal handling, transport, or use. The following pictogram indicates explosive properties:

• Some examples of explosive chemicals include the following:

a) ammonium nitrate

b) benzoyl peroxide (explosion-sensitive to shock, heat, and friction)

c) picric acid

d) sodium azide

• Many chemicals form highly explosive compounds when mixed together. Others become highly explosive when allowed to decompose or when exposed to air. Handle chemicals that are known to be potentially explosive with extreme care while wearing proper PPE. When working with these chemicals, make safe handling techniques the number one priority to prevent any accidental mishaps.

4.4.8 ORGANIC PEROXIDES OR PEROXIDE-FORMING CHEMICALS Organic peroxides and peroxide formers are very unstable explosives. They are extremely sensitive to shock, sparks, heat, or other forms of accidental explosive initiation.

• Organic peroxides may have one or more of the following properties:

a) Be liable to explosive decomposition

b) Burn rapidly

c) Be sensitive to impact or friction

d) React dangerously with other substances

• Substances can form peroxides upon standing or when in contact with air. After peroxides form, they may dry in the threads on the container's top or may become concentrated if the chemical is distilled. Dry or concentrated peroxides formed in this manner are highly explosive. Some examples include the following:

a) aldehydes

b) ethers, especially cyclic ethers, and ethers derived from primary and secondary alcohols (ethyl ether, isopropyl ether)

c) most alkenes (cyclohexene, cyclooctene)

d) vinyl and vinylidene compounds (vinyl acetate, vinylidene chloride)

• Label all peroxide-forming chemicals with the date the container was received from the supplier and the date the container was first opened, even if the chemical contains inhibitors to retard peroxide formation. Use or dispose of any peroxide-forming chemical prior to the expiration date.

• A physical inventory must be performed annually to verify active inventory records. All peroxide-forming chemicals have a limited shelf life, whether the container is opened or not. Storage past these limits is discouraged, as highly explosive compounds are likely to form.

• If in doubt of the stability of the chemical, do not move it until you have received directions from the Lab Manager. Dried crystals or residues are indications of a highly explosive state.

• Store shock and heat sensitive chemicals in a dedicated cabinet.

• For further information on handling and storage limits of Peroxidizable Compounds.

4.4.9 FLAMMABLE LIQUIDS

Flammable liquid means a liquid having a flash point of not more than 93°C (199.4°F). The flash point means the minimum temperature at which a liquid gives off vapor in sufficient

concentration to form an ignitable mixture with air near the surface of the liquid, as determined by standardized ASTM methods. Consult the chemical label or SDS to determine the flash point of a chemical.

• A flammable liquid shall be classified in one of four categories:

Criteria for Flammable Liquids

Category	**Criteria**
1	Flash point < 23°C (73.4°F) and initial boiling point ≤ 35°C (95°F)
2	Flash point < 23°C (73.4°F) and initial boiling point > 35°C (95°F)
3*	Flash point ≥ 23°C (73.4°F) and ≤ 60°C (140°F)
4**	Flash point > 60°C (140°F) and ≤ 93°C (199.4°F)

Reference: MIOSHA Hazard Communication Part 430, Appendix B

• Note: *When a Category 4 flammable liquid is heated for use to within 16.7 °C (30 °F) of its flashpoint, it shall be handled in accordance with the requirements for a Category 3 liquid with a flashpoint at or above 37.8 °C (100 °F). **When liquid with a flashpoint greater than 93 °C (199.4 °F) is heated for use to within 16.7 °C (30 °F) of its flashpoint, it shall be handled in accordance with the requirements for a Category 4 flammable liquid.

• Note the following storage precautions when working with flammable liquids:

a) Keep flammable liquids in appropriate containers and store them in flammable liquid storage cabinets away from any possible ignition source.

b) Keep solvents in safety cans. Drums and five-gallon containers are not allowed in laboratories unless stored in a flammable liquid cabinet or safety can.

c) Store flammable solvents requiring refrigeration in refrigerators/freezers engineered with no internal components that could trigger an explosion.

d) Do not store flammable liquids, including waste stock, in exits and stairways.

• Maximum allowable container capacity for flammable liquids:

Container Type	Category 1	Category 2	Category 3	Category 4
Glass or Approved plastic	1 pint	1 quart	1 gallon	1 gallon
Metal (other than DOT drums)	1 gallon	5 gallons	5 gallons	5 gallons
Safety cans	2 gallons	5 gallons	5 gallons	5 gallons

Reference: MIOSHA General Industry Safety Standards, Part 75. Flammable Liquids

Exception: Glass containers up to one gallon in size are permitted for storage of flammable liquids if the required purity would be adversely affected by storage in a metal or approved plastic container, or if the liquid would cause excessive corrosion or degradation of the metal or approved plastic container.

Per MIOSHA Part 75, 1910.106(d)(3)(i), not more than 60 gallons of Category 1, 2, or 3 flammable liquids, nor more than 120 gallons of Category 4 flammable liquids may be stored in a storage cabinet.

• When using flammable liquids:

a) Avoid handling the liquids around open flames.

b) Handle only appropriate quantities of liquids at any given time.

c) Handle only in well-ventilated areas.

d) Keep containers, beakers, etc. closed or covered when possible to avoid release of flammable vapors.

e) Never use an open flame for heating flammable solvents.

f) Keep hot plates, Glascol heaters, and water baths at a moderate heat setting.

g) Do not fill flasks more than half-full and use boiling chips when heating.

4.4.10 OXIDIZERS

Oxidizer means a chemical, other than a blasting agent or explosive, that initiates or promotes combustion in other materials, thereby causing fire either of itself or through the release of oxygen or other gases. Oxidizers may be in the form of a gas, liquid or solid. Consult the SDS for proper safe handling techniques.

• Store oxidizers away from flammable/combustible liquids and other combustible materials. Store compressed gas cylinders of oxygen at least 20 feet from flammables or separate by a firewall.

• Some examples of oxidizers include the following:

a) chlorate compounds (potassium chlorate)

b) permanganate compounds (potassium permanganate)

c) nitrate compounds (potassium nitrate, uranyl nitrate, zinc nitrate)

d) acid dichromate

e) chromic acid

f) chromium trioxide

g) hydrogen peroxide (>30%)

h) nitric acid

i) sodium peroxide

j) sulfuric acid

k) chlorine gas

l) manganese dioxide

m) perchloric acid

4.4.11 PERCHLORIC ACID

Perchloric acid is an extremely hazardous and powerful oxidizing agent. Contact with combustible materials (wood, paper, grease, oil and most organic compounds) can cause these materials to become extremely flammable, and they may explode spontaneously or with impact, friction, or heating. Fumes from perchloric acid may form explosive metal perchlorates in fume hoods causing explosions. This chemical requires special precautions when handling.

• The following rules apply to the use of perchloric acid:

• Use of perchloric acid is restricted to specially designed perchloric acid hoods.

• Use of perchloric acid requires the approval of the Human Resource, Safety and Risk Office.

• Use of perchloric acid requires a standard operating procedure along with special training on the specific safety hazards that are present with perchloric acid during use.

4.4.12 PICRIC ACID

Picric acid (trinitrophenol) is explosive when it is dry. Picric acid in a solution of at least 10% water is considered flammable but not explosive. Picric acid in a solution less than 10% water is considered explosive and should not be handled. Dry picric acid can accumulate on the

outer surface of the container or in cap threads. Dry picric acid in cap threads is not always visible and can present a significant friction-sensitive hazard. Extreme caution should be given to containers with metal caps containing any solution of picric acid. Shock-sensitive picrates are formed when picric acid vapors come in contact with metals such as copper, lead or zinc. Contact with concrete floors can also form sensitive calcium picrate salts.

• Extreme caution should be exercised when encountering bottles of picric acid with the following characteristics:

a) Little or no moisture content within the bottle.

b) A metal cap on the container.

c) Any observable needle-like structures within the container.

d) Any sign of accumulation on the surface of the bottle.

In any of these cases, contact the Human Resource, Safety and Risk Office immediately, and do not attempt to move the container. Qualified safety personnel with appropriate safety equipment will move it. This container is highly explosive!

4.4.13 FORMALDEHYDE

Formaldehyde is a colorless gas that has a bitter odor. Formalin is an aqueous solution containing 37-50 percent formaldehyde. Overexposure to formaldehyde can lead to serious health concerns.

- The MIOSHA Formaldehyde Standard (Part 306) establishes a 0.75 ppm permissible exposure limit (PEL), 2.0 ppm short term exposure limit (STEL) and a 0.5 ppm action limit. The standard requires exposure monitoring and enrollment in the medical surveillance program for employees exposed above the action level or STEL.
- Exposure to formaldehyde can occur through inhalation, ingestion, skin contact or contact with body openings such as the eyes and nose. Follow these guidelines when working with formaldehyde:

  a) Wear proper PPE as determined from the standard operating procedures developed for each procedure involving formaldehyde.

  b) Minimize exposures through the use of engineering controls and workplace practices.

  c) If required, participate in the medical surveillance program.
- Contact the Environmental health and Safety Specialist for exposure monitoring of all procedures where formaldehyde is used outside of a fume hood.
- For areas where exposure monitoring has been conducted and levels are found to be above the PEL or STEL, the area must be posted with the following information:

  DANGER FORMALDEHYDE IRRITANT AND POTENTIAL CANCER HAZARD AUTHORIZED PERSONNEL ONLY.
- Label receptacles containing formaldehyde as follows:

  FORMALDEHYDE POTENTIAL CANCER HAZARD.

4.4.14 BENZENE

Benzene is a colorless to light yellow liquid with an aromatic odor. It is flammable and is a known human carcinogen and a possible reproductive toxin. It can be found as either a liquid or a vapor, and has a high evaporation rate. Because of this high evaporation rate, benzene liquid can quickly vaporize, generating increased concern for respiratory and fire hazards. The MIOSHA Benzene Standard (Part 311) establishes a 1.0 ppm PEL, 5 ppm STEL and a 0.5 ppm

action limit. The standard requires exposure monitoring and enrollment in the medical surveillance program for employees exposed to benzene above the action level.

• Follow these guidelines when working with benzene:

a) Wear proper PPE as determined from the standard operating procedures developed for each procedure involving the use of benzene.

b) Minimize exposure through the use of engineering controls and workplace practices.

c) If required, participate in the medical surveillance program.

• Contact the Human Resource, Safety and Risk Office for exposure monitoring of all procedures where benzene is used outside of a fume hood.

- For areas where exposure monitoring has been conducted and levels are found to be above the PEL or STEL, the area must be posted with the following information:

DANGER
BENZENE
CANCER HAZARD
AUTHORIZED PERSONAL ONLY
RESPIRATOR REQUIRED

- Label receptacles containing benzene as follows:

DANGER
CONTAINS BENZENE
CANCER HAZARD

4.4.15 LIQUID NITROGEN –

Liquid Nitrogen is a cryogenic material, which means it is maintained at a very low temperature. Since it is a cryogenic, it has to be stored in a Dewar, which holds the liquid nitrogen in a vacuum as it boils at or below -196°C/-321°F. Dewars are specific to the contained material, so confirm the right type of Dewar is used for liquid nitrogen before purchase and use.

• Safety Hazards Associated with Handling Liquid Nitrogen:

a) The extremely low temperatures of the liquid can cause severe frostbite or eye damage upon contact. Items in contact with liquid nitrogen become extremely cold, so touching these items may result in damaged flesh. OSHA recommends to not rub any affected skin from contact because it can further tissue damage; instead, place the body part in a warm water bath not above 40°C/140°F, and never use dry heat. In addition, many objects become brittle upon contact with liquid nitrogen and may shatter when cold, such as common glass and large solid plastics, and can send pieces of the material flying.

b) On vaporization, liquid nitrogen expands by a factor of 700; one liter of liquid nitrogen becomes 24.6 cubic feet of nitrogen gas. This expansion factor can cause explosion of a sealed container. This release of nitrogen can also displace oxygen in the room and cause asphyxiation (lack of oxygen) without warning. It is important to note that nitrogen is not poisonous to humans since it makes up 78% of the atmosphere (21% oxygen, 1% other), but oxygen levels below 19.5% is a concern.

c) Because the boiling point of oxygen is higher than that of nitrogen, oxygen can condense from the air into liquid nitrogen. If Dewars and insulated flasks containing liquid nitrogen are

left uncovered for an extended period of time, liquid oxygen can build up, which may cause violent reactions and a fire could result.

- Personal Protective Equipment (PPE) Required When Handling Liquid Nitrogen:
  a) Safety goggles, unvented (not safety glasses) – Required at all times.
  b) Face shield – Required when pouring or filling.
  c) Insulated gloves should be loose-fitting or with an elastic cuff so they can be thrown off if liquid pours inside – Required when pouring or filling.
  d) A lab coat or long sleeves is required to minimize skin contact. In addition, pant legs should be worn on the outside of boots or work shoes when filling Dewars to prevent injury in the event of spillage. A lab coat or long sleeves is required when pouring or filling.
- Rules and Precautions for Handling Liquid Nitrogen:
  a) You must have department approval prior to handling liquid nitrogen.
  b) Always wear PPE when handling liquid nitrogen.
  c) Use liquid nitrogen only in well-ventilated places. Nitrogen is colorless and odorless – the cloud it forms when you pour liquid nitrogen is condensed water vapor from the air, not nitrogen gas.
  d) Do not allow any liquid nitrogen to touch any part of your body or become trapped in clothing near the skin.
  e) Do not touch any item that has been immersed in liquid nitrogen until it has warmed to room temperature.
  f) Do not store liquid nitrogen in any container with a tight-fitting lid. A tightly sealed container will build up pressure as the liquid boils and may explode after a short time. Use only approved unsealed containers. Do not store liquid nitrogen for long periods in an uncovered container. Use only fittings that have been designed specifically for the use with cryogenic liquids, as non-specialized equipment may crack or fail. Do not transport liquid nitrogen in wide-mouthed glass Dewars not protected with safety tape.
  g) Never dip a hollow tube or funnel into liquid nitrogen; it may spurt liquid.
  h) Never ride in an elevator with liquid nitrogen. When using passenger elevators, use an elevator key to prevent the door from being opened by unauthorized people. If a key is not available, then station a person at each floor to ensure no one enters.
  i) Always make sure that containers of liquid nitrogen are suitably vented and unlikely to be blocked due to ice formation.
  j) Proper disposal does not include dumping on the floor, which can instigate asphyxiation, or dumping down the drain. Any time liquid nitrogen is mixed with a hazardous material; both together must be disposed of as hazardous material.
  k) Do not fill cylinders or Dewars to more than 80% of capacity, since expansion of gases during warming may cause excessive pressure build-up.
    - For those authorized to fill Dewars:
    1. Always fill warm Dewars slowly to reduce temperature shock effects and to minimize splashing.
    2. Note that outside of normal working hours (M-F 8:00a.m.-5:00p.m.) no one is allowed to transfer liquid nitrogen from the Dow loading dock area without a second trained

person present. Failure of a container or a large spillage could result in asphyxiation at a time when you are unlikely to be found or able to get assistance.

4.4.16 NANOMATERIALS

Nanomaterials are defined as materials with at least one external dimension (length, width or depth) in the size range from approximately 1-100 nanometers. Nanomaterials can be reagents, catalysts, or the desired product of research. Engineered nanomaterials are intentionally made for specific purposes, such as shape, size, properties, or content. They have unique properties and functions because of their nano-scale size and dimensions. Often, the behavior of nanomaterials may depend more on surface area than particle composition itself.

• Examples of engineered nanomaterials include carbon buckeyballs or fullerenes; carbon nanotubes; metal or metal oxide nanoparticles (e.g., gold, titanium dioxide) and quantum dots.

• Very little is known about the safety risks that engineered nanomaterials might pose, beyond some data indicating that they possess certain properties associated with safety hazards in traditional materials. Depending on their composition and structure, some nanomaterials may initiate catalytic reactions that, based on their chemical composition, would not otherwise be anticipated.

• Nanomaterials fall under OSHA General Industry Standards, which includes established exposure limits for naturally occurring nanomaterials. Although there are currently no established (legal) exposure limits (US or International) for Engineered Nanomaterials, NIOSH has developed Recommended Exposure Limits (RELs) for carbon nanotubes (8- hr TWA 1 µg/m3) and nano-titanium dioxide (8-hr TWA 0.3 mg/m3). When controlling potential exposures within a workplace, NIOSH has recommended a hierarchical approach to reduce worker exposures.

• There must be an approved Standard Operating Procedure (SOP) in place before work begins with nanomaterials and all personnel working with nanomaterials must be trained and adhere to all components of the SOP, including required PPE.

• Restrict access to the laboratory where nanomaterials are used and display proper signage indicating nanomaterials are present.

4.5 CHEMICAL DISTRIBUTION/STORAGE/INVENTORY/DISPOSAL

4.5.1 ORDERING CHEMICALS

• Prior to ordering chemicals, do the following:

a) Check the chemical inventory to verify that the chemical is not already available in the department.

b) Obtain information concerning proper handling, storage and disposal of the chemical.

c) Determine the minimum amount of chemical needed to complete the work. Do not order extra amounts of chemicals that will not be used in a timely manner.

• Chemicals must arrive with the proper hazard communications labeling and SDS. Do not accept a chemical container without the proper hazard communications labeling.

4.5.2 CHEMICAL STOCK AREAS AND STORE AREAS

Stock areas are defined as areas where chemicals are mixed, repackaged and/or distributed for laboratory use. Store areas are defined as areas where chemicals are stored with no manipulation of chemicals.

• Store hazardous materials, when not in immediate use, in an environmentally controlled, stock area, store area, or storage cabinet.
• Do not use store areas as preparation or repackaging areas.
• Record the removal of any chemical or apparatus for inventory purposes.
• Do not transport chemicals from the stock area unless they are in a secondary container.
• Wear proper PPE when moving chemicals.

4.5.3 TRANSPORTING CHEMICALS ON CAMPUS

• Use secondary containers, such as a bucket, to hand carry hazardous chemicals, concentrated acids, flammable solvents, or other corrosives.
• Wear proper PPE when moving chemicals.

4.5.4 CHEMICAL STORAGE

• Follow these general procedures for storage of chemicals:
a) Conduct routine inspections to check containers for deterioration and integrity.
b) Store the smallest amounts of hazardous materials as practical in the laboratory.
c) Do not use fume hoods as storage areas for chemicals, unless labeled “This Hood is for Storage Only”.
d) Store chemicals in cabinets or on shelves, not on the floor.
e) Store chemicals according to hazard class, not alphabetically.
f) Do not store incompatible materials together.
g) Secure bottle caps to prevent accidental spills and minimize odors.
h) Provide spill trays in liquid storage areas.
i) Store large quantities and heavy chemicals on lower shelves. Store only lightweight or small quantities above eye level.
j) Do not store corrosive materials of any quantity above eye level.
k) Wear appropriate PPE, including eye protection, when handling chemicals stored above eye level.
l) Keep a ladder or step stool available for reaching overhead storage.
m) Store chemicals away from heat and direct sunlight.
n) Conduct periodic, scheduled inventories. Return chemicals not required for the present work to the stock areas for storage or proper disposal.
o) Avoid containers derived from disposable food products in labs where hazardous chemicals are used.

• Flammable liquid storage

a) Store flammable liquids, when not stored in flammable storage containers and when not in use, in flammable storage cabinets designed specifically for and labeled as “Flammable Liquids”. Do not store other materials in the cabinet.
b) Store plastic squeeze bottles that contain flammable materials (normally used for rinse purposes) in a flammable storage cabinet at the end of the workday.
c) Follow the guidelines in MIOSHA General Industry Standard Part 75 Flammable Liquids Standard.

• Corrosive liquid storage

a) Store mineral acids, such as sulfuric and hydrochloric acids, in acid storage cabinets.
b) Store bases and solutions of bases separately from acids.

c) Store oxidizing acids, such as nitric and perchloric acids, with oxidizing materials and away from organics.

d) Store organic acids, such as acetic and formic acids, with flammable materials.

• Oxidizer Storage (see definition in section 4.4.8)

a) Store oxidizers, such as hydrogen peroxide and chlorine bleach, away from all organic materials and reducing agents.

b) Do not store near any combustible materials.

• Compressed Gas Storage

a) Chain or secure all gas cylinders to a permanent fixture and store with the caps on when not in use.

b) Store oxygen cylinders away from fuels and other combustible materials.

c) Mark empty cylinders as “Empty” and store away from other cylinders.

d) Toxic Gases:

•Toxic gas cylinders must be dated when they arrive. Order only the smallest quantity needed for the work.

• Toxic gases must be stored and used in a ventilated gas cabinet, exhausted enclosure, or a ventilated separate gas storage room.

• Toxic gases that are kept for more than one year can degrade, or the cylinder and connections can degrade in such a way as to become very unstable and dangerous. In general, all toxic gas cylinders should be turned in to the Human Resource, Safety and Risk Office for disposal when no longer in use or within one year from the delivery date.

• Emergency procedures should be made clear to all involved, including personnel from adjacent labs.

• Fume hoods and other ventilation needs to be tested before use and checked frequently during projects involving toxic gas.

• For transportation guidance, see section 4.5.3.

• Toxic chemicals and high risk chemicals

a) Store toxic materials separately from other chemicals.

b) Store in a vented cabinet.

c) Store materials that are highly acute toxins and other high-risk chemicals with the parent container inside an unbreakable secondary container.

d) Post specific warning signs on the storage area.

e) Maintain records of use and disposal.

• Reactive chemicals

a) Store reactive chemicals away from other chemicals.

b) Store water reactive chemicals in cabinets protected from the fire sprinkler system or other water sources.

c) Store specified reactive materials under either inert atmosphere and/or refrigeration.

d) Inventory materials that may form organic peroxides and dispose of them at the time of expiration.

e) Store explosive materials as specified by the manufacturer. Only knowledgeable and trained individuals may handle these materials.

4.5.5 CHEMICAL INVENTORY

Maintain an inventory of all hazardous chemicals. Update the inventory at least annually and forward a copy upon request to the Human Resource, Safety and Risk Office for regulatory reporting.

4.5.6 SHIPPING HAZARDOUS CHEMICALS

Do not ship hazardous chemicals using commercial vendors without prior approval from the Human Resource, Safety and Risk Office. The Department of Transportation has very specific regulations governing the shipping of hazardous materials. Failure to comply with these regulations could result in severe penalties. Contact the Human Resource, Safety and Risk Office with any questions regarding shipping of hazardous materials.

4.5.7 EMPLOYEE TRANSPORTING OF CHEMICALS OUTSIDE THE FACILITY

• Do not transport any chemical or hazardous material outside of the University without prior approval from the Human Resource, Safety and Risk Office.

• The employee is responsible for ensuring that the Department of Transportation regulations on shipping chemicals are not violated by transporting chemicals in a private car or on a commercial carrier. The Human Resource, Safety and Risk Office will assist with any questions regarding these regulations.

4.5.8 HAZARDOUS WASTE DISPOSAL

Note: Contact the Human Resource, Safety and Risk Office for the proper disposal requirements and methods for all chemical wastes. Keep a detailed inventory of the contents and quantities of waste placed into the waste container.

• What is a hazardous waste?

Hazardous waste is defined in the Federal Resource Conservation and Recovery Act (RCRA). Waste is considered toxic and/or hazardous according to RCRA if it will “cause or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible illness; or pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, disposed of, or otherwise managed.” In particular, RCRA regulations (40 CFR 261 and 262) specify that a waste is hazardous if it is a listed waste or has the characteristics of a hazardous waste. A hazardous waste meets any of the following conditions:

a) Has been named as a hazardous waste and listed as such in the regulations (see Appendix F for listed wastes).

b) Exhibits any of the characteristics of a hazardous waste (ignitable, corrosive, reactive, toxic) = characteristic hazardous waste (see Appendix G for more details on a characteristic hazardous waste).

c) A mixture containing a listed hazardous waste and a nonhazardous waste.

d) A waste derived from the treatment, storage, or disposal of a listed hazardous waste.

• Mixture Rule

A listed hazardous waste plus a non-hazardous waste is always a hazardous waste. A characteristic hazardous waste plus a non-hazardous waste may or may not be a hazardous waste depending on whether the resulting waste demonstrates characteristics of a hazardous waste. See the Human Resource, Safety and Risk Office if there are any questions on whether a waste is hazardous or not.

• Waste disposal

a) The following procedures apply to hazardous waste containers in laboratories:

• Place a “Hazardous Waste” label on hazardous waste containers before any waste is put into it. Include the words “hazardous waste” on the label along with a description of the waste.
• Keep containers closed when not in use.
• Use only containers that are in good condition.
• Keep containers under the generator’s control.
• Inspect containers on a regular basis.
• Keep an inventory of the contents. Record the name and amount of each chemical added to the waste container along with the date it was added.
• When adding new waste to a container, check to see that the new waste is compatible with the original contents.
• Date waste containers when waste is first placed in the container.
• A container is full when the liquid level reaches close to, but not all the way to the top of the container. This will prevent the build-up of excessive vapors while ensuring adequate room for expansion.

b) Disposal of experimental compounds

• Dispose of experimental compounds of unknown toxicity as hazardous waste.
• Label the container with your name, department, and chemical structure.
• Do not, under any circumstances, dispose of unknown compounds down the drain or in the laboratory trash bins.

c) Drain disposal of chemicals

• Salts, sugars, and starches that do not contain any hazardous material may be put down the drain if they present no possibility of coagulation within the drain.
• “Neutral” buffer solutions (pH between 6 and 8) may be put down the drain.
• Drain disposal of all other chemicals is prohibited.

d) Laboratory glass waste

Glass should not go into the regular trash can. Lab glass should be disposed of in the labeled broken glass disposal receptacle. The rules for the glass waste are as follows:
• Clean glass only.
• No liquids.
• No highly toxic residues.
• No needles or razor blades.

e) Sharps Waste

“Sharps” items include needles, syringes, lancets, and razor blades. These items should be collected in a leak proof, puncture-resistant container labeled for sharps collection.

4.5.9 LABORATORY DECOMMISSIONING CRITERIA

If you are leaving the University or simply moving your laboratory to another location, you must properly decommission your laboratory. Each department should come up with a strategy to address the following:
• Hazardous chemical waste and unwanted chemicals should be disposed through the Lab Manager at least 14 days prior to the actual move date.
• Before leaving the laboratory, all chemical storage areas should be completely clean. Wipe down all surfaces, and empty shelves, cabinets, and drawers. If non-fixed chemical storage

equipment (corrosive cabinets, flammable liquid storage cabinets, laboratory refrigerators and freezers) are relocated, they must be decontaminated prior to moving.

• Clean out all fume hoods. All research apparatus must be decontaminated prior to moving.

• If non-laboratory personnel are involved with moving research apparatus, the apparatus must be decontaminated.

• All unnecessary compressed gas cylinders should be removed prior to leaving the laboratory. Compressed gas cylinders must be properly secured and capped when they are transported. Compressed gas cylinders must be transported in an approved cylinder cart.

• Practice good general housekeeping. All papers, rags, empty bottles, boxes etc. should be properly disposed of prior to vacating the laboratory.

4.6 CHEMICAL EMERGENCY ACTION

Prior to working with chemicals in the laboratory, locate the following items:

• Eyewash
• Emergency shower
• First aid kit
• Fire extinguisher
• Spill-control kit
• Emergency shut-off valves
• Telephone
• Emergency phone numbers (names of contact personnel should be listed on the Lab Safety Posters in each lab, and it is recommended that phone numbers of contact personnel are posted near phones)

4.6.1 Hazardous Spill Response

Any spill of a hazardous material is considered dangerous, and steps to remediate must be taken immediately. Spills are classified as either hazardous or incidental. A hazardous spill is an emergency of unknown nature, a situation which may be immediately dangerous to life and health, is a threat to personnel and/or the public, threatens the surrounding area or facility, and/or involves a toxic gas leak, or a toxic, corrosive, or reactive hazardous material.

In the event of a hazardous chemical spill, do the following:

• Eliminate all sources of ignition and evacuate the immediate area.
• Close all doors leading into the spill area.
• If applicable, assist contaminated persons to a safety shower or eyewash station.
• Notify LSSU Public Safety at 906-635-2100. Call 911.
• Report the spill immediately to your supervisor and to the Human Resource, Safety and Risk Office. Report whether the spill has entered the air, ground, sanitary or storm sewers, or any surface water.
• Members of a hazardous cleanup response team will clean up all hazardous spills.

4.6.2 Incidental Spill Response

An incidental spill creates no fire hazard and involves low to moderately toxic materials in small amounts, which can be absorbed, neutralized, contained or otherwise controlled by employees in the immediate release area.

In the event of an incidental spill, do the following:

• In general, incidental spills can be cleaned up by the individual who was using, storing, or transporting the material spilled, as long as they are properly trained and use approved spill

cleanup kits and PPE. If the individual is not properly trained, another trained individual should be called for the cleanup.

• Assess the hazard.
• Wear appropriate PPE. At a minimum, this requires gloves, lab coat, and safety glasses/goggles.
• Isolate/barricade the affected area.
• Notify a coworker that you are cleaning up the spill.
• Neutralize strong acids and bases.
• Contain and clean up the spill with approved cleanup kits located either in the laboratory or in the stockroom.
• Dispose of all chemical spill cleanup material as hazardous waste.
• Complete an incident report for the spill clean-up.
• If you are not trained to cleanup spills, call the Human Resource, Safety and Risk Office. Remain at the scene to serve as a resource.

4.6.3 Mercury Spills

Mercury vapors are highly toxic. All spills of mercury, no matter how small, are considered toxic and must be cleaned up by a trained employee. All collected mercury must be disposed of as hazardous waste.

In the event of a mercury spill, do the following:

• Isolate/barricade the area.
• Call Public Safety 906-635-2100.
• Remain at the scene to serve as a resource.
• Reference the Mercury Spill Response Procedure.

4.6.4 Personal Chemical Exposure

Chemical exposure can lead to irritation or burns of the skin, eyes, throat, and lungs, dizziness, headaches, disorientation or unconsciousness, or damage to internal organs.

• If your eyes get splashed with a chemical:
a) Immediately flush them in the nearest eyewash fountain for 15 minutes.
b) Keep your eyes open while washing them.
c) Seek medical attention.
• If your skin comes in contact with a chemical:
a) Flush the area with water for 15 minutes and remove contaminated clothes.
b) If large areas are exposed, go to the emergency chemical shower and begin flushing with water at once while removing clothes in the shower. Continue flushing with water for 15 minutes.
c) Seek medical attention.
• If you inhale a chemical, immediately move to fresh air.
a) Seek medical attention.
• If you ingest a chemical, you may or may not induce vomiting depending on the chemical.
a) Refer to the SDS for recommended first aid. Never induce vomiting when corrosives are ingested.
b) Seek medical attention.

4.6.5 Detection of Chemical Odors

The human nose cannot and should not be relied on as an adequate warning device against chemical hazards.

a) If a release or spill is suspected, immediately secure any operating equipment and leave the area.
b) Call Public Safety.
c) Do not return to the area until given the approval to do so.

4.6.6 Fire

In the event of a fire, do the following:

• Activate the fire alarm pull station.
• Clear the area of all personnel. Instruct all personnel to evacuate the facility.
• If it can be done safely, and if you are trained in the use of a fire extinguisher, attempt to extinguish the fire using a portable fire extinguisher. Keep the PASS system in mind when using any fire extinguisher in a fire situation.
• P=Pull A=Aim S= Squeeze S=Sweep Note: If the fire spreads from its origin or is not put out within 30 seconds, evacuate immediately. Pull the fire extinguisher pin aim the nozzle at the base of the fire squeeze the handle sweep the base of the fire from side to side.
• Confine the fire by closing doors as you leave the area.
• Stay near the building to advise emergency personnel on the nature of the fire and to make sure everyone is accounted for.

4.6.7 Utility Failure

• The interruption of any utility service either scheduled or from natural causes, is considered an emergency event.
• If the ventilation system shuts down, cease and safely shut down any operations in ventilated areas. Close and secure all chemical containers. If ventilation is shut down for 20 minutes or longer, building must be evacuated. Do not re-enter building until notified by emergency personnel or the emergency coordinator.
• Loss of water can affect cooling systems. Shut down any procedure using circulating cooling water.

4.6.8 Reporting Injuries

• If anyone is in need of emergency medical attention, call LSSU Public Safety 906-635-2100 for assistance. Indicate the nature of the problem, your identification, and your location.