Chemical Hygiene Plan & Lab Safety Plan

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1.0 PURPOSE AND SCOPE

The purpose of the Chemical Hygiene & Lab Safety Plan (CHP) is to provide guidance to WHOI personnel for working safely in the laboratory environment. The CHP complies with the Occupational Safety and Health Administration (OSHA) Laboratory Standard 29 CFR 1910.1450 and describes proper laboratory practices, procedures, protective equipment, and hazard identification. The CHP is available on the WHOI Environmental Health and Safety (EH&S) website. A copy of the CHP should be maintained with or in the Safety Data Sheet (SDS) binder and be readily available to all personnel in the laboratory.

Laboratory personnel at all levels must comply with the requirements of the CHP and participate in all applicable trainings mandated by OSHA. The CHP applies to all WHOI personnel that work in labs, including contractors.

2.0 ROLES AND RESPONSIBILITIES

2.1 Principal Investigator (PI)/Supervisor

- Responsible for the implementation of the CHP within laboratories under their control.
- Provide laboratory specific training and set up a training profile for all laboratory personnel.
- Develop lab-specific procedures for work involving highly hazardous materials. Notify the EH&S Office prior to implementing these lab-specific procedures for a safety evaluation.
- Recognize and control physical and chemical hazards. Implement safe laboratory practices and engineering controls to minimize the potential exposure to hazardous chemicals.
- Ensure that protective equipment is available and in working order, and that appropriate training has been provided.
- Promptly report all work-related injuries, near misses, and unsafe work conditions to the EH&S Office as soon as possible, by submitting an Accident and Incident Report located on the EH&S website.
- As necessary, include health and safety improvements in the budget and research planning process.
- Review emergency procedures and standard operating procedures with all laboratory personnel.
- Maintain an up-to-date chemical inventory using the WHOI Chemical Inventory Database.
- Ensure that storage is appropriate for any chemical being ordered.
- Maintain an up-to-date Safety Data Sheet (SDS) binder. Paper copies for each chemical must be readily available in the laboratory.
- Routinely inspect eyewashes, safety showers, fire extinguishers and other emergency/safety equipment to ensure that they have been inspected and are not obstructed.
- Attend required training.

2.2 Laboratory Personnel (Includes students, volunteers, minors, contractors, guests, and researchers)

- Responsible for performing operations within the scope of the CHP.
- Review and understand the CHP and applicable laboratory specific procedures in their entirety before beginning work in the laboratory or with hazardous chemicals.
- Conduct all operations in accordance with the CHP and other health and safety related procedures.
- Review and comply with proper protocols before using hazardous equipment and materials.
- Promptly report all work-related injuries and near misses or unsafe work conditions to the PI/Supervisor and submit an Accident and Incident Report.
- Attend required training.
2.3 Environmental Health and Safety Office (EH&S)

- Maintain the CHP.
- Provide assistance and support to the PIs/Supervisor and laboratory personnel concerning the appropriate storage, handling, and disposal of hazardous chemicals.
- Provide assistance concerning personal protective equipment (PPE), engineering controls, and laboratory safety equipment.
- Facilitate compliance with the CHP, through training, laboratory inspections, and other actions.
- Review and evaluate the effectiveness of the CHP at least annually and update it as necessary.
- Conduct exposure assessments as necessary.
- Supervise or assist in cleanup and/or decontamination of hazardous spills.
- Assist laboratory personnel in the development of lab-specific procedures and the selection of engineering controls and PPE.
- Investigate accidents, spills and near misses in the laboratory.
- The Safety and Health Officer (SHO) works within EH&S Office and serves as the Chemical Hygiene Officer (CHO) in accordance with the OSHA Laboratory Standard.

3.0 HAZARD EVALUATION

Before the proper controls can be selected, PIs/supervisors and lab personnel should identify physical and health hazards and conduct a hazard evaluation of the process, activity, or material. Every hazard evaluation should first determine if the hazardous conditions can be prevented, e.g., substituting with a less hazardous material or process. Physical hazards in the lab may include but are not limited to explosions, fires, compressed gases, cryogens, high-pressure reactions, vacuum work, ultraviolet light, electrocution, slip, trip, falls, and ergonomic hazards. Health hazards in the lab may include but are not limited to acute toxicity, skin corrosion and irritation, carcinogenicity, and respiratory sensitization. A hazard evaluation may include reviewing information from a chemical container label, SDS, manufacturer, EH&S website, and other resources as needed, identifying route(s) of exposure, evaluating the process/activity to determine if an exposure evaluation is needed. See Section 5.0 for examples of various hazards. The EH&S Office is responsible for conducting and documenting exposure evaluations. When working in a certified fume hood and in accordance with the CHP, exposure monitoring of chemicals is not usually warranted or practical in laboratories since chemicals are typically used for a short period of time, in small quantities, and exposures are safely controlled by the fume hood. An exposure evaluation will be conducted if:

- There is reason to believe that exposure levels for a chemical exceed either the action level or the permissible exposure limit.
- Personnel suspect or report they have been exposed to a chemical or show signs and symptoms of exposure. Personnel should notify the EH&S Office and request an exposure evaluation.

3.1 Routes of Exposure

Chemical exposures can occur by four major routes of entry: absorption, inhalation, ingestion, and injection.

3.1.1 Absorption
Absorption of chemicals through the skin or mucous membranes can be a common chemical exposure route in the lab. Spills and splashes can result in skin contamination. In addition, lab personnel may unknowingly contaminate themselves when they touch work surfaces, glassware, or equipment contaminated with chemicals. Chemicals can also enter the body when contaminated hands touch the mouth, nose, eyes, sores or cuts. A chemistry professor at Dartmouth College spilled a couple of drops of dimethyl mercury on her latex glove during an experiment and died 10 months later from mercury poisoning.

3.1.2 Inhalation

Chemicals that can enter the body via inhalation include gases, vapors of volatile liquids, mists/sprays, particles, fibers, and dusts. Chemicals in the form of dusts and particulates can become airborne when transferred from one container to another. Lab operations that may produce inhalation hazards include weighing, stirring, pouring, pipetting, injections with a needle and syringe, and removing caps and stoppers. Splashes created from spills and vigorous shaking and mixing may also produce inhalation hazards.

3.1.3 Ingestion

Ingestion of chemicals can result from hand-to-mouth contact, consuming contaminated food or drink, smoking cigarettes that have come in contact with contaminated hands, placing part of the hand or a writing tool that has been in contaminated hands into the mouth, applying makeup, etc. Wash hands immediately after handling any chemical substance and before leaving the lab.

3.1.4 Injection

Chemical exposure by means of injection can inadvertently occur when handling chemically contaminated items such as broken glass, plastic, pipettes, needles, razor blades, or other items capable of causing punctures, cuts, or abrasions to the skin. Non-lab personnel, such as custodial workers must be protected from this form of exposure by putting all "sharps" in rigid containers.

4.0 CONTROL MEASURES

The use of prevention is important to the overall application of controls. The proper selection of a hazard or exposure control may involve the following considerations:

- All hazards can be controlled to some degree and by some method;
- More than one control may be useful or required; and
- Controls may not completely eliminate the hazard.

Engineering controls, administrative controls, and personal protective equipment (PPE) are traditional approaches used to control hazards and exposures.

4.1 Engineering Controls minimize exposure by either reducing or removing the hazard at the source or isolating the worker from the hazard. Engineering controls include, but are not limited to process change, substitution, isolation, ventilation, and source modification.

- Process change – changing a process to make it less hazardous (e.g., paint dipping in place of paint spraying).
- Substitution – Substituting for a less hazardous material, equipment, or process (e.g., use of soap and water in place of solvents, use of automated instead of manually operating equipment).
• **Isolation** – Separating personnel from hazardous operations, processes, equipment, or environments (e.g., use of control rooms, physically separating personnel and equipment, barriers placed between personnel and hazardous operations).

• **Ventilation** – Two fundamental approaches: general exhaust (dilution of air contaminants) and local exhaust of air contaminants.

• **Source modification** – Changing a hazard source to make it less hazardous (e.g., wetting dust particles or lowering the temperature of liquids to reduce off-gassing and vaporization).

4.2 **Administrative Controls** include work practice controls, SDS, signs, labels, safety guidelines, procedures, rules, supervision, training, and by scheduling tasks in ways that minimize exposure levels.

4.2.1 **Work Practice Controls** alter the manner in which a task is performed. Some work practice controls include (1) changing existing work practices to follow proper procedures that minimize exposures; (2) inspecting and maintaining process and control equipment on a regular basis; (3) implementing good housekeeping practices; (4) providing good supervision; and (5) prohibiting food, drink, smoking, chewing tobacco or gum, and applying cosmetics in chemical use areas.

4.2.2 **Safety Data Sheets (SDS)**

SDSs are documents created by the chemical manufacturer that describe the substance. Some information found on an SDS includes: hazardous and physical characteristics, handling requirements, storage and disposal information, and signs and symptoms of exposure. SDSs must remain on file for 30 years after employment.

If you work with hazardous chemicals, you are required by OSHA to review and have up-to-date SDSs that are readily available for each chemical. PIs/Supervisors are responsible for obtaining SDSs for their chemicals. Paper copies are required, as electronic copies may not always be available. For spaces/labs with multiple chemicals, an SDS binder must be readily available to all emergency response personnel, regulatory inspectors, and everyone working with the hazardous chemicals. EH&S recommends that SDS binders be located outside the lab and wall-mounted. The EH&S Office will supply SDS binders and wall-mounted holders.

4.2.3 **Signs and Labels**

All hazardous materials, hazardous waste, chemical containers, and chemical storage areas shall be appropriately labeled indicating the hazards present and any other relevant regulatory requirements. All chemical containers at WHOI must be labeled regardless of size and whether or not they are hazardous. For small chemical containers, the label can be placed on the secondary containment bin, tray, or rack. Labeling of all chemical containers assists emergency personnel and others in identifying what is and what is not hazardous should a spill occur or other emergency situation arise.

Original labels on chemical containers must not be removed or defaced. Labels must be in English and they must contain the complete name of the chemical and be traceable or easily linked to the appropriate SDS (chemical formulas are not allowed). The manufacturer’s label is generally sufficient to meet OSHA labeling requirements and should be replaced only if it becomes damaged or illegible.

Chemical container labeling is the responsibility of the individual who fills and/or uses the chemicals. All containers into which chemicals are transferred also need to be legibly labeled in English and include the name of the chemical and appropriate hazard warnings (chemical formulas are not allowed). In addition to the OSHA Hazcom 2012 labeling system, the National Fire Protection Association (NFPA) 704 labeling system may be used at WHOI. The NFPA system requires the chemical name to be listed along with health, flammability, reactivity and specific hazard ratings. The stockroom supplies these labels. Refer to the NFPA Chemical Labeling Guideline on the EH&S website for further instruction.
WARNING: The NFPA 704 and OSHA Hazcom 2012 labels have different hazard ranking systems. See Appendix A for a description of the two labeling systems.

Refrigerators or freezers containing either chemicals or food should be appropriately labeled, e.g., chemicals only, no food or drink, or food and drink only. Food/drink and chemicals cannot be stored together.

4.3 Personal Protective Equipment (PPE)

Each potentially hazardous task must be evaluated on a case by case basis to identify appropriate controls, including PPE. Feasible engineering controls are always preferable and should be implemented first, as PPE does not eliminate the hazard. PPE shall be inspected before each use to ensure that there are no defects that may lead to an exposure. Ensure that all PPE is compatible with the chemical to be used. For hazardous materials, review the SDS to determine the necessary PPE. Refer to the Personal Protective Equipment Guideline on the EH&S website for further instruction.

4.3.1 Laboratory Attire

When performing work with hazardous materials, personnel should adequately cover all exposed parts of their body to prevent unnecessary chemical exposure. The wearing of shorts and skirts are prohibited in laboratories. Shirts must be worn in the laboratory at all times. Avoid flowing sleeves.

4.3.2 Eye/Face Protection

ANSI Z87 approved safety glasses are recommended for all personnel in all laboratories. Safety glasses are required for all personnel working with hazardous substances. Chemical splash goggles are required wherever there is a possibility of a spill, a splash of a liquid, or infiltration of a dust-producing particle. Face shields are worn in conjunction with either safety glasses or splash goggles. Face shields are required when protection of the entire face is needed, e.g., hazardous splashes, grinding, etc.

4.3.3 Foot Protection

Close-toed shoes are required in the lab when working with hazardous materials. Bare feet, sandals, high heeled, perforated, woven, canvas, and open-toe shoes are prohibited in labs.

4.3.4 Hearing Protection

Personnel who are exposed to noise in excess of 85 dB (A) are required to wear approved hearing protection in the form of earmuffs or earplugs. Rule of thumb: raising your voice to communicate at arm’s length from someone indicates potentially hazardous noise levels. Most cutting and grinding operations, for example, requires the use of hearing protection. As with other occupational hazards, feasible and effective engineering controls are preferred, e.g., enclosures/wrappings, absorbing materials, vibration isolation, and structural dampening.

4.3.5 Gloves

When handling hazardous chemicals, lab personnel shall select and wear the appropriate gloves. No single glove can provide appropriate protection in every work situation. It is important to assess the hazards in each task and select a glove that provides the required protection and minimum required dexterity. Below are general recommendations for glove selection and use:

- Similar gloves supplied by different manufacturers may not offer the same level of protection; therefore, the manufacturer’s glove selection chart(s) should be reviewed.
- Select gloves which are resistant to the chemicals you may be exposed to.
- Select gloves of the correct size and fitting; gloves that are too small are uncomfortable and may tear whereas larger gloves may interfere with dexterity.
• Before use, check gloves (even new ones) for physical damage such as tears or pin holes and for previous chemical damage - this is especially important when dealing with dangerous materials such as hydrofluoric acid.
• Some gloves, especially lightweight disposables, may be flammable and may need to be protected from open flames or hot work.
• When removing gloves, do so in a way that avoids the contaminated exterior contacting the skin.
• Wash hands after removing gloves.
• Many factors affect the breakthrough times of glove materials including: thickness of glove material, chemical concentration, amount of chemical that comes into contact with the glove, length of time the glove is exposed to the chemical, temperature at which the work is done, and possibility of abrasion or puncture.
• Do not attempt to re-use disposable gloves.

4.3.6 Lab Coats, Protective Suits & Aprons

Lab coats are recommended for use in the laboratories at all times and are required when working with hazardous materials. Refer to the Lab Coat Procedure on the EH&S website. Aprons and protective suits may be required for protection from hazardous splashes. Aprons and protective suits should be properly handled to avoid cross-contamination.

4.3.7 Respiratory Protection

Any operation that generates harmful airborne levels of dusts, fumes, sprays, mists, fog, smoke, vapors, or gases or that may involve oxygen-deficient atmospheres requires the use of effective exposure controls. This must be accomplished, where feasible, by effective engineering control measures (e.g., enclosure or confinement of the operation, lab hood, local exhaust ventilation, and substitution of less toxic materials). When effective engineering controls are not feasible or while they are being implemented, appropriate respiratory protection must be used. Respirators shall be selected and used in accordance with the requirements of 29 CFR 1910.134. Refer to the Respiratory Protection Program on the EH&S website and contact the SHO.

5.0 STANDARD OPERATING PROCEDURES

5.1 Emergency Response Procedures

The time to prepare for an emergency is before it happens. Accidents and spills involving chemicals and possible exposures are required to be reported to the PI/Supervisor and the EH&S Office. For hazardous materials release and spill procedures, personnel must follow the procedures detailed in the Comprehensive Emergency Management Plan (CEMP) located on the EH&S website, which are summarized below. The best spill procedure is prevention, which includes:

- Read the SDS for all chemicals and follow recommended storage, use and disposal practices.
- Use secondary containers when storing chemicals, chemical waste, and when transporting bottles of liquid chemicals. Use and store the smallest quantities possible.
- Keep work areas free of clutter.

Incidental and Hazardous Spills:

In general, two types of chemical spills can occur at WHOI: incidental and hazardous.

An incidental spill is a chemical spill an individual can clean up without assistance. Examples include a small spill or a low hazard spill. The spill may be cleaned by lab personnel if they feel confident in their knowledge of the chemical and have the ability and equipment to safely clean up the spill. Incidental spill procedures include:
• Attend to any person that has been exposed to the material, utilizing emergency eyewashes, showers, and phoning for assistance if required. If emergency eyewashes or showers are needed, the First Aid Team should be notified by calling X2911 or 508-289-2911 from cell phone.
• Alert all other personnel that may be affected by the spill.
• If the spill involves a flammable or combustible material, shutoff all potential ignition sources such as ovens, appliances, burners, etc.
• Keep fume hoods running to dilute and/or remove vapors.
• Limit the area of the spill as much as possible by using absorbent materials that are available in chemical spill kits throughout the Institution.
• After cleanup, manage the contaminated materials as hazardous waste and notify the EH&S Office of the spill.

A hazardous spill is a chemical spill requiring the assistance from the EH&S office or outside responders. Examples include an unknown chemical spill, a highly hazardous spill, or a large spill. Hazardous spill procedures include:
• Report the emergency by calling X2911 or 508-289-2911 from cell phone.
• Attend to any person that has been exposed to the material, utilizing emergency eyewashes and showers if safe to do so.
• Personnel exposed to chemicals should seek immediate medical attention and the SDS should go with the person to the emergency room.
• Warn others in the area.
• Evacuate to a safe area.

5.2 Laboratory General Safety Rules

A list of Laboratory General Safety Rules exists on the EH&S website and includes some of the following items:
• Procedures described in this CHP are designed to minimize or prevent exposure to hazardous chemicals. Implementation of the CHP should be a regular, continuing effort.
• The PI/Supervisor must restrict access to laboratories to authorized personnel only.
• Working alone in the laboratory under any conditions is not advised, particularly when hazardous procedures are being conducted. If you must work outside of normal working hours, inform your supervisor and arrange for Security to check with you periodically.
• Practical jokes and/or other inappropriate and unprofessional behavior in the laboratory are forbidden.
• Smelling chemicals to determine identity is strictly prohibited.
• Wash hands and arms thoroughly before leaving the lab, even if gloves have been worn.
• Storage, handling, and consumption of food and beverage in laboratories are strictly prohibited unless in designated food areas away from chemical use.
• When transporting hazardous chemicals, laboratory personnel should use a cart or a bottle carrier.
• Pets are forbidden in laboratories at all times.
• Perform hazard evaluations prior to initiation of new experiments or procedures. Appropriate protective measures, including engineering controls, administrative controls, and personal protective equipment must be identified and implemented.
• To minimize chemical exposures, precautions for safe chemical handling, storage and disposal should be implemented. Use less hazardous materials, implement engineering controls whenever feasible, and use PPE.
• The permissible exposure limits (PEL) and threshold limit values (TLV) established by OSHA and other organizations should be observed. An effective way to prevent exposure to airborne substances is to prevent their escape into the working atmosphere by using chemical fume hoods, other ventilation devices, and keeping chemical containers tightly sealed.
• Avoid leaving hazardous experiments or operations unattended whenever possible. If you must leave a hazardous experiment unattended, keep the lights on, restrict access to the laboratory, and post an
Unattended Experiment Placard. A template for an Unattended Experiment is available on the EH&S website.

5.3 **Vacuum Procedures**
Vacuum work can result in an implosion creating potential hazards of flying glass, splattering chemicals and fire. All vacuum operations must be set up and operated with careful consideration of the potential hazards. The following safety considerations should be implemented where necessary:

- When feasible, an explosion shield (e.g., Plexiglas or other transparent shield) or other engineering control to protect operators, should be used.
- PPE, such as safety glasses, chemical goggles, and/or face shields should be used.
- Do not allow water, solvents and corrosive gases to be drawn into vacuum systems. Protect pumps with cold traps and vent their exhaust into an exhaust hood.
- Assemble vacuum apparatus in a manner that avoids strain, particularly to the neck of the flask.
- Avoid putting pressure on a vacuum line to prevent glass apparatus from exploding.
- When possible, avoid using mechanical vacuum pumps for distillation or concentration operations when using large quantities of volatile materials. An air aspirated pump is preferred over water aspirated pump to help prevent sink disposal of hazardous materials.
- Isolate and protect the setup from accidental damage and high traffic areas.
- Post a warning sign if an operation will be unattended for an extended period of time.

5.4 **Housekeeping**

- Good housekeeping is essential to the health and safety of all laboratory personnel.
- For both safety and efficiency, laboratories should be kept orderly and uncluttered, with chemicals and equipment being properly labeled and stored.
- Chemicals should be returned to designated storage locations upon completion of each operation or at the end of shift.
- Chemicals should not be stored on floors, bench tops or in hoods.
- Floors, shelves, benches, and access ways shall be kept free of debris and unnecessary apparatus.
- Access to emergency equipment, eyewashes, safety showers, exits, and fire extinguishers should never be blocked.
- All equipment shall be kept clean and examined periodically for deterioration.
- All spills shall be cleaned up promptly and disposed of properly.
- Routinely clean work surfaces that have come in contact with chemicals using a warm solution of soap and water or other sufficient cleaning method to ensure surfaces are free of visible chemical residue. Surfaces may include fume hoods (inside and out), bench tops, floors, equipment, refrigerators and sinks.

5.5 **Chemical Procurement and Inventory Controls**

5.5.1 **Procurement**
The decision to procure a chemical initiates the commitment to handle and use the chemical properly from initial receipt to ultimate disposal. Chemical purchases should be evaluated for regulatory, safety and environmental considerations before the orders are placed. If possible, order the least hazardous chemical and the smallest quantity needed to complete the experiment. Chemicals must be ordered using a purchase requisition form, or be purchased through the authorized Speedy Order Systems (SOS) program currently in place. SOS program participants include Corp Brothers, Fisher, and Sigma-Aldrich. The Procurement Department will assist you with the placement of chemical orders. Contact the Procurement Department for further instruction.

5.5.2 **Chemical Inventory Database**
PIs/Supervisors or their designees are responsible for entering their chemical inventory electronically into the WHOI Chemical Inventory Database located on the EH&S website. The inventory should be printed from the database and kept with the SDS binder to ensure that it is readily available to personnel. The inventory shall be kept up-to-date. If you need assistance with the Chemical Inventory Database, contact the Safety & Health Office (SHO) who also functions as the administrator of the Chemical Inventory Database.

5.5.3 The Toxic Substances Control Act

Chemical substances that are imported or exported may be subject to U.S. EPA Toxic Substances Control Act (TSCA) requirements. In addition, significant adverse health affects may need to be reported. A summary of the importation and exportation requirements is provided below. Refer to the TSCA Guideline on the EH&S website for detailed instructions or contact the SHO.

Importation of Chemicals: A TSCA Import Certification Form (refer to the TSCA Guideline on the EH&S website) must be completed for any chemical substances that are brought into the U.S. by any means, including: through U.S. Customs, shipped by mail service, hand carried, or other importation mode.

An importer must declare whether a chemical substance is regulated under TSCA with a POSITIVE CERTIFICATION or not regulated with a NEGATIVE CERTIFICATION on the TSCA Import Certification Form. If a chemical supply vendor or distributor, such as Fisher Scientific, imports chemicals for WHOI’s use, that vendor is the importer of record and must comply with TSCA’s importation requirements and they may use their own importation certification form.

Exportation of Chemicals: TSCA requires the completion of the TSCA Export Notification Form (refer to the TSCA Guideline on the EH&S website) prior to the exportation of chemical substances that are contained on EPA’s Current List of Chemical Substances Subject to TSCA Section 12(B) Export Notification Requirements. A link to this list is located on the EH&S website.

5.5.4 Department of Homeland Security Chemicals of Interest

Department of Homeland Security (DHS) promulgated the Chemical Facility Anti-Terrorism Standards (CFATS) Interim Final Rule. Appendix A of the CFATS regulation lists the DHS chemicals of interest (COI) and their corresponding Screening Threshold Quantities (STQ). If WHOI possesses or later comes into possession of a COI at or above the specified STQ or if DHS determines that WHOI presents a high level of security risk, WHOI will have to comply with the substantive requirements of CFATS – e.g., preparing a Security Vulnerability Assessment, developing and implementing a Site Security Plan, etc. The potential penalties for non-compliance with these chemical safety/security regulations are civil and criminal penalties, including cessation of operations by the DHS. To maintain compliance with DHS requirements:

- **PIs/Supervisors and Lab personnel** are responsible for reviewing the COI list prior to purchasing a chemical. EH&S discourages the use of low threshold COIs and will encourage substitution or disposal. The COI list is available on the EH&S website.

- If you plan to procure a COI with a low STQ of cumulative 100g (CUM 100), A Placarded Amount (APA), or 2.2 pounds, you must notify the SHO at X2244 prior to purchasing the chemical for review/approval. Consider substituting with a chemical not listed as a COI. If your research absolutely requires a COI with a low STQ, limit your quantities to the least amount possible.

- The SHO will periodically review the Chemical Inventory Database to screen for COIs.

5.6 Chemical Storage
Segregation – Chemicals shall be segregated appropriately by hazardous characteristic and compatibility, not alphabetically, in a well identified area. Incompatible chemicals shall be physically segregated. For example, acids and bases should be separated by using a secondary containment bin or stored at separate locations. Oxidizers should not be stored with or adjacent to flammable chemicals.

Containers – Chemicals shall be stored in containers with which they are compatible. For example, acids should not be stored in metal containers. Safety coated bottles reduce the chance of a release if the bottle accidently drops. Glass bottles should not be stored above eye level or on floors. All chemicals must be properly labeled as described in Section 4.2.3. Chemical containers should be examined periodically (at least annually) for replacement, disposal, deterioration, and container integrity.

Storage – Minimize the quantity of chemicals in storage and implement just-in-time chemical inventory process, where possible. Acids, bases, flammables, and other hazardous liquids should be stored in labeled cabinets and at minimum quantities. Chemicals which are incompatible should not be stored together. Ensure that caps on all chemical containers are tightly closed to prevent evaporation of contents.

General storage requirements:
- Flammable chemicals that require refrigeration shall only be stored in refrigerators or freezers approved and rated for flammable storage.
- Flammable chemicals should be stored in safety cabinets in secondary containment. Storage outside a flammable storage cabinet shall not exceed a total of 10 gallons. An approved and rated flammable storage cabinet is required for 10 or more gallons with no more than 60 gallons of Class I flammables per cabinet. Store all flammable chemicals away from heat sources such as open flames, exhausts, and laboratory ovens. Refer to the Flammable and Combustible Liquid Storage Guideline on the EH&S website for further instruction.
- Acids and bases should be stored in labeled cabinets, separated by secondary containment. Organic and inorganic (mineral) acids must also be segregated using a secondary containment bin or stored at separate locations.
- Mineral acids (nitric, sulfuric, phosphoric, and hydrochloric) should be separated from flammable and combustible materials.
- Acid-sensitive materials such as cyanides and sulfides should be stored separate from acids.
- Highly toxic or reactive chemicals should be stored in sealed unbreakable secondary containers.

5.7 Bonding and Grounding

Bonding and grounding of flammable liquid transfer containers is extremely important to reduce the risk of explosion and fire due to static electricity that builds up during the transfer of flammable liquids. Bonding prevents the generation of static electricity by minimizing the electrical potential between two objects, such as a dispensing drum and a safety can. Grounding minimizes the electrical potential between the containers and the ground. Bonding and grounding should be used when transferring Class I flammable liquids, those with a flash point below 100 F (ethyl ether, benzene, xylene, and acetone) in metal equipment in order to avoid static generated sparks.

5.8 Open Flame Procedures

To prevent fires and burns, appropriate safety controls must be implemented when using Bunsen burners, handheld propane torches, and similar open flame devices. Conduct open flame procedures on a non-combustible surface and keep away from materials that may be combustible. DO NOT leave open flame procedures unattended.

5.9 Procedures for Highly Hazardous Materials

Highly hazardous materials have the potential to cause serious injury, death, and/or property damage. Prior to highly hazardous materials entering a laboratory, PIs and supervisors must conduct a hazard assessment and
develop written lab-specific safety procedures or equivalent procedures that communicate safety requirements for highly hazardous materials used in the lab. Refer to the Laboratory-Specific Procedure Guideline on the EH&S website. PIs and supervisors are also responsible for ensuring their staff is trained in, and follow, applicable lab-specific safety procedures. Care should be taken to identify situations where a change in procedure, such as scaling up the quantity of a reagent, or shortening reaction time, may create a highly hazardous situation. Large quantities of concentrated materials with a National Fire Protection Association (NFPA) rating of 4 in any category may also be considered highly hazardous. The list below provides some examples of highly hazardous materials, but should not be considered a comprehensive listing. PIs and supervisors should use these examples as a guide to identify highly hazardous materials in their lab(s).

**Explosives/Flammables/Reactives**

- Materials that pose an explosion hazard when exposed to heat, shock, impact, light, friction, or other suitable ignition source
- Experiments that can generate high pressures and present a significant explosion hazard
- Highly flammable materials with a relatively low flash point or auto-ignition temperature
- Unstable/highly reactive materials that react vigorously with common materials (e.g. water or air)
- Pyrophoric chemicals

**Toxins**

- Highly toxic materials where a relatively small exposure could lead to serious injury or death, such as concentrated mercuric chloride

**Corrosives**

- Highly corrosive materials that can be fatal or cause serious injury, such as hydrofluoric acid
- Handling large quantities of concentrated acids such nitric or hydrochloric acid (i.e., dispensing from a full 4 L bottle) could be highly hazardous

### 5.10 Categories of Hazardous Materials

A hazardous material is any chemical which is a physical hazard or a health hazard and has the potential to cause harm to humans, the environment, and property. Hazardous materials may also have the potential to become highly hazardous materials, therefore, a hazard evaluation must be conducted by the user to make that determination. Chemicals that are health hazards include but are not limited to: carcinogens, toxics, 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. Chemicals that are physical hazards include but are not limited to: combustible liquids, compressed gases, explosives, flammables, organic peroxides, oxidizers, pyrophorics, and water-reactives.

The PI/Supervisor shall ensure that all lab personnel are aware of the locations, hazards, and appropriate control measures for work involving hazardous materials. Prudent lab practices must be implemented by all lab personnel when handling hazardous materials. General categories of hazardous materials that may be present in labs are described below but should not be considered a comprehensive listing. PIs and supervisors should use these examples as a guide to identify hazardous materials in their lab(s).

**Combustible Dust** – Is any finely divided solid material that presents a fire or explosion hazard when dispersed and ignited in the air. Any area or location with more than a 1/8 inch build-up of combustible dust is considered hazardous. Refer to the Combustible Dust Safety Procedure on the EH&S website for further instruction.
**Compressed Gases** – A variety of hazards may be present when working with compressed gas cylinders, including high pressure, flammability, toxicity, and rapid release of contents. Refer to the Compressed Gas Cylinder Safety Procedure on the EH&S website for further instruction.

**Controlled Substances** – A controlled substance is a drug or other substance, or immediate precursor, regulated by the Drug Enforcement Agency (DEA) under schedules I-V. It is the responsibility of the PI/Supervisor to obtain and maintain a permit/registration for all controlled substances used at WHOI and to comply with all applicable requirements. The possession and use of controlled substances requires a permit/registration from both DEA and Massachusetts Department of Public Health Drug Control Program. Refer to the Controlled Substances Guideline on the EH&S website for further instruction.

**Corrosive Chemicals** – Isolate corrosive chemicals from incompatible chemicals. Acids and bases can cause severe tissue damage depending on the corrosivity of the chemical. Exercise extreme caution when handling these types of chemicals.

**Cryogenic Liquids** - Cryogenic liquids are liquefied gases that are kept in their liquid state at very low temperatures and are associated with various hazards including: extreme cold, asphyxiation, pressure, and toxicity. Lab personnel must be properly trained to handle and use cryogenics. Appropriate personal protective equipment must be worn such as safety glasses or goggles with a face shield, loose-fitting insulated gloves, and a buttoned lab coat. Refer to the Cryogenics Liquid Safety Guideline on the EH&S website for further instruction.

**Ethidium Bromide (EtBr)** is a potent mutagen and moderately toxic after an acute exposure. It can be absorbed through skin, so it is important to avoid any direct contact with the chemical. EtBr is an irritant to the skin, eyes, mouth, and upper respiratory tract. Consider using a less toxic chemical (e.g., SYBR Safe™ DNA gel stain) to reduce potential hazardous exposures and amounts of hazardous waste generated. EtBr work areas must be posted: *Ethidium Bromide – Caution: Mutagen and Carcinogen*. Refer to the Ethidium Bromide Safety Procedure on the EH&S website for further instruction.

**Flammable/Combustible Liquid** - is any substance that is easily ignited, burns intensely, or has a rapid rate of flame spread. For regulatory convenience, flammable and combustible liquids are defined together as any liquid with a flash point below 140° F. The quantity of flammable liquids stored in a laboratory should be kept to a minimum. Isolate flammable liquids from ignition sources and incompatible chemicals, e.g. oxidizers. Refer to the Flammable and Combustible Liquid Storage Guideline on the EH&S website for further instruction.

**Highly Toxic Chemicals** - Chemicals with a high level of acute toxicity have the ability to cause harmful local and systemic effects after a single exposure. Chemicals of unknown toxicity, including synthesis of new chemicals, must be treated as toxic/hazardous until fully characterized. A highly toxic chemical falls within any of the following categories:

(a) A chemical that has a median lethal dose (LD (50)) of 50 milligrams or less per kilogram of body weight when administered orally to albino rats weighing between 200 and 300 grams each.

(b) A chemical that has a median lethal dose (LD (50)) 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.

(c) A chemical that has a median lethal concentration (LC (50)) 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 two and three kilograms each.

**Hydrofluoric Acid** – (HF) is an extremely corrosive acid used for many purposes including mineral digestion, surface cleaning, etching and biological staining. HF is very aggressive physiologically because of the fluoride ion. When exposed to air, concentrated solutions and anhydrous hydrofluoric acid produce pungent fumes which are especially dangerous. Burns with concentrated HF can be very serious, with the potential for significant...
complications due to fluoride toxicity. Every effort must be made to prevent exposure to HF. Refer to the Hydrofluoric Acid Safety Guideline on the EH&S website for further instruction.

**Lead** - is a neurotoxin, reproductive toxin, hematologic (blood) toxin, confirmed animal carcinogen, and can pose other significant health hazards if the material is not safely handled. Personal protective equipment such as gloves should be worn when handling lead weights or lead-contaminated items. Thoroughly wash hands, arms, and face after handling lead. Do not eat, drink, or smoke in or around areas where lead is handled or stored. Transport and store lead in secondary containers to minimize the spreading of lead dust. Refer to the Lead Weight Handling and Storage Safety Guideline on the EH&S website for further instruction.

**Oxidizers** – can initiate or promote combustion in other materials. Examples include potassium permanganate, silver nitrate, sodium dichromate, and nitric acid (>70% concentration). Keep these chemicals in a tightly closed container and store in a cool, dry, ventilated area. Isolate from incompatible chemicals (e.g., organic solvents) and ignition sources. Avoid storage on wood floors and separate from incompatibles, combustibles, organic or other readily oxidizable materials.

**Particularly Hazardous Substances** – include select carcinogens, reproductive toxins, and chemicals with high acute toxicity (also known as “highly toxic”) according to OSHA 29 CFR 1910.1450. Provisions for additional protection for work with these substances include:

- Establish a designated area
- Use of containment devices such as fume hoods or glove boxes
- Decontaminate work surfaces

**Perchloric Acid** - is extremely dangerous because it is a very strong oxidizer. When perchloric acid reacts with organic material, an explosive reaction product may be formed. It is essential that such materials not accumulate in the hood ductwork. Refer to the Laboratory Hoods Guideline on the EH&S website for further instruction.

**Pyrophoric Chemicals** – can spontaneously ignite in air. Pyrophorics are extremely reactive toward oxygen and in most cases, water, and must never be exposed to the atmosphere. Examples include some finely divided metals, metal hydrides, alloys of reactive metals, and iron sulfides. Pyrophoric chemicals can be handled and stored safely as long as all exposure to atmospheric oxygen and moisture is avoided. Solids must be transferred under an inert atmosphere or otherwise protected. Failure to follow proper handling techniques could result in serious injury. Combustible materials, including paper products, should not be allowed to come in contact with any pyrophorics. A UCLA researcher used a plastic syringe to extract from a sealed container a small quantity of t-butyl-lithium, a chemical compound that ignites instantly when exposed to air. As she withdrew the liquid, the syringe came apart in her hands, spewing flaming chemicals. She had not been properly trained and was not wearing protective clothing when the experiment exploded, spreading second- and third-degree burns over her body. She died a few weeks later.

**Reproductive Toxins** - May affect the reproductive health of women or men. These hazards may cause problems such as infertility, miscarriage, and birth defects. Reproductive toxins may affect the parent, developing child (even after birth), or both. OSHA defines reproductive toxins as chemicals which affect the reproductive capabilities including chromosomal damage (mutations) and effects on fetuses (teratogenesis). Examples include mercury and lead compounds. The use of reproductive toxins in the lab must be identified and exposure control measures must be implemented. Lab personnel may consult with EH&S before the start of any lab activity involving reproductive toxins.

**Select Carcinogen** - means any substance which meets one of the following criteria:

- It is regulated by OSHA as a carcinogen such as formaldehyde; or
• It is listed under the category, "known to be carcinogens," such as benzene, in the Annual Report on Carcinogens published by the National Toxicology Program (NTP) (latest edition); or

• It is listed under Group 1, "carcinogenic to humans," such as cadmium, by the International Agency for research on Cancer Monographs (IARC) (latest editions); or

• It is listed in either Group 2A or 2B by IARC as a suspected human carcinogen.

**Time Sensitive Chemicals** - develop additional hazards upon prolonged storage. Examples include peroxidizables, polynitrated aromatics, chloroform and anhydrous HF. All time-sensitive chemicals shall be immediately dated when they are received from the manufacturer and dated when opened in the laboratory for use. Purchase the smallest quantity that is practical for all time-sensitive chemicals. Substitution for a less hazardous chemical is preferable. For peroxidizables, periodically test for peroxides using peroxide indicator strips. Never, under any circumstances, touch or attempt to open a container of a peroxide-forming liquid if there are crystals around the cap and/or in the bottle. The friction of unscrewing the cap could detonate the bottle. Refer to the Time Sensitive Guideline on the EH&S website for further instruction.

**Water-Reactive Chemicals** – react violently with water. Alkali metals (e.g., lithium, sodium, and potassium), many organometallic compounds, and some hydrides react with water to produce heat and flammable hydrogen gas, which ignites or combines explosively with atmospheric oxygen. Some anhydrous metal hydrides (aluminum bromide), oxides (calcium oxide), and nonmetal oxides (sulfur trioxide) and halides (phosphorous pentachloride) react exothermically with water, resulting in a violent reaction if there is insufficient coolant water to dissipate the heat produced. Store these in a cool, dry, and well-ventilated location. Protect from moisture and separate from incompatibles.

### 5.11 Waste Management

**Hazardous waste** is any solid, liquid, sludge, or containerized gas that is discarded, has served its intended use, is a by-product, and exhibits any of the following characteristics: flammable, corrosive, reactive, or toxic. PIs/Supervisors and all laboratory personnel are responsible for the proper identification, labeling, storage, management, and waste minimization of all hazardous waste generated in their laboratory. Refer to the Hazardous Waste Generator Procedure on the EH&S website for further instruction.

**P-Listed Waste** is acutely hazardous by reactivity and/or toxicity and are highly regulated by the U.S. Environmental Protection Agency. Limit your inventory and minimize the generation of all acutely hazardous waste. Refer to the Hardous Waste Generator Procedure on the EH&S website for the listing of P-Listed waste.

**Sharps** are devices or objects capable of cutting or piercing. This includes items such as hypodermic syringes, scalpels, razor blades, and broken glass items such as Pasteur pipettes, capillary tubes, and microscope slides. This definition specifically excludes most broken laboratory or non-laboratory glassware and bottles which are generally collected in yellow, puncture-resistance, plastic drums. Use an approved sharps container for safe handling and storage of sharps waste. A sharps container must be a rigid, plastic, leak proof, puncture-resistant, and break-resistant container. Do not overfill these containers. Refer to the Sharps Handling and Disposal Guideline on the EH&S website for further instruction.

**Universal Waste** in Massachusetts is classified as fluorescent lamps, hazardous batteries, thermostats, mercury containing lamps, pesticides, and mercury containing devices that cannot be disposed in the general trash. Hazardous batteries include hazardous materials, such as lithium (primary, non-rechargeable), nickel cadmium, lead acid, and nickel metal hydride. Refer to the Universal Waste Management Procedure on the EH&S website for further instruction.
**Biological Waste** (recombinant DNA and RG2 and above) must be decontaminated by autoclaving or with an appropriate chemical disinfectant. Refer to the WHOI Biosafety Manual on the EH&S website for further instruction.

6.0 **EQUIPMENT, MAINTENANCE, AND INSPECTIONS**

6.1 **Chemical Fume Hoods**

A properly functioning and correctly used fume hood will control vapors, dusts, and mists released from volatile liquids. Fume hoods can also contain spills. Fume hoods are inspected and certified once a year by a Facilities Department contractor; however, PIs/Supervisors are responsible for ensuring that their fume hood(s) has an updated certification label and is functioning.

Basic guidelines for operating a fume hood include the following:
- Check to see if the fume hood has been certified within the last year (label with date).
- Confirm that the chemical can be used in the fume hood.
- Conduct procedure at least six inches behind the plane of the sash.
- Never put your head inside a fume hood to check an experiment.
- Work with the sash at the lowest position possible to protect your face and torso.
- Do not clutter the fume hood with bottles, chemicals, or equipment as it restricts airflow and work space.
- Immediately report any suspected fume hood malfunctions to the Facilities Department.
- Limit foot traffic behind you that may create competing air currents.

6.2 **Perchloric Acid Fume Hoods**

Procedures with perchloric acid require specifically designed hoods. Refer to the Perchloric Acid Hoods – Design and Usage Considerations Guideline on the EH&S website for further instruction. Organic materials and those incompatible with perchloric acid shall not be used in the perchloric acid hood. The user is responsible for ensuring that the perchloric acid hood is washed down after each use. PIs/Supervisors shall train all laboratory personnel on how to properly wash down the hood. The fume hood should be labeled for perchloric acid use only. The Facilities Department will certify the hood on an annual basis.

6.3 **Laminar Flow Hoods**

These are clean benches that use a blower to force air through a HEPA filter over a work surface. After the air is filtered, it may be forced in either a horizontal or vertical direction, depending on the type of laminar flow. Laminar flow hoods are used for creating a "clean" workspace where samples/specimens are protected from contamination. These types of hoods are not used in applications where toxic or biohazardous aerosols will be produced because they do not offer protection to personnel.

6.4 **Eyewash Units (Drench Hoses)**

In case of an exposure to hazardous substances, a reliable, clean source of water must be available to rinse your eyes and other body parts. An eyewash unit is used to irrigate and flush the eyes. A hand-held drench hose is a flexible hose connected to a water supply used to irrigate and flush the eyes, face and body areas. Drench hoses within labs should be tested on a weekly basis by lab personnel to ensure a clean source of water and a properly functioning unit. PIs/Supervisors must keep the eyewash device free from obstruction. PIs/Supervisors are responsible for training all lab personnel on the nearest eyewash location and how to use the device.

The PI/Supervisor or lab personnel should do the following each week:
- Activate the eyewash and let the water run to flush out rust and bacteria.
- Water should be lukewarm and clear.
- Look for problems with the operation of the eyewash, such as low water pressure or no water at all. If problems are identified, contact the Facilities Department.

6.5 Safety Showers

In case of an exposure to hazardous substances, a reliable, clean source of water must be available to rinse contaminants from the body. Safety showers are either located in the laboratory or in the hallway. PIs/Supervisors must ensure that the safety shower is free from obstruction. PIs/Supervisors are responsible for ensuring all laboratory personnel are aware of the nearest safety shower location and how to use the device. The Facilities Department is responsible for routinely inspecting WHOI’s safety showers.

6.6 Laboratory Inspections

An EH&S representative will coordinate and conduct annual laboratory safety inspections. Inspections will include a walk-through of the selected area(s) and will cover lab safety, PPE, waste management, and related topics. Area representatives should use the results as a guide to identify and correct similar and/or other environmental, health and safety issues in their area(s). Refer to the Safety Inspection Guideline on the EH&S website for further instruction.

7.0 INFORMATION AND TRAINING

The PI/Supervisor is responsible for ensuring that all personnel that work in their lab are properly trained. All lab personnel must complete required training, including lab-specific training, training from the EH&S Office, read and understand the CHP, review SDSs, and other applicable procedures.

7.1 Training

Laboratory specific training begins prior to the start of work in the laboratory. PIs/Supervisors are responsible for providing orientation and lab-specific training that includes hazardous protocols and/or equipment and reviews emergency procedures.

The EH&S Office provides several OSHA and EPA mandated trainings including CHP, hazardous waste generator training, and general safety awareness. The training schedule and course descriptions are located on the EH&S website under the training link. Review the employee safety checklist to determine if additional training may be required depending on the specific work activities, e.g., radiation safety, biosafety, etc.

7.2 Recordkeeping

The EH&S Office maintains EH&S training records and any occupational exposure assessment records. PI/Supervisors are responsible for documenting and maintaining orientation and lab-specific training records in the lab.

8.0 PRIOR APPROVAL OF LABORATORY ACTIVITIES

When a procedure or activity has the potential to create an Immediately Dangerous to Life or Health (IDLH) condition, prior approval is needed from the EH&S Office. An example of an IDLH environment is a procedure with an extremely toxic substance that if it were released in an uncontrolled manner has the potential to seriously injure or cause death to lab personnel, building occupants, or emergency response personnel. Another example is a procedure that may have the potential to cause an explosion when systems are under significant pressure. It is the responsibility of the PI/Supervisor to inform the EH&S Office (x3347) of any research activities that could create
an IDLH environment. EH&S will coordinate with lab personnel to conduct a safety review to ensure that the proper controls are in place.

9.0 MEDICAL CONSULTATION AND EXAMINATIONS

Medical Surveillance
- If at any time lab personnel believe they have been significantly exposed to hazardous materials they should seek immediate medical attention and contact the EH&S Office at X3347 as soon as possible for a follow-up evaluation. All medical examinations shall be performed by or under the direct supervision of a licensed physician and shall be provided to lab personnel at a reasonable time and free of cost.
- Whenever lab personnel develop signs or symptoms associated with a hazardous chemical to which they may have been exposed in the laboratory, they shall be provided an opportunity to receive an appropriate medical examination.
- Whenever an event takes place in the work area such as a spill, leak, explosion or other occurrence resulting in the likelihood of a hazardous exposure, the affected lab personnel shall be provided an opportunity for a medical consultation. Such consultation shall be for the purpose of determining the need for a medical examination.

Information provided to the physician
- The identity of the hazardous chemical(s) to which lab personnel may have been exposed and the SDS;
- A description of the conditions under which the exposure occurred including quantitative exposure data, if available; and
- A description of the signs and symptoms of exposure that lab personnel are experiencing, if any.

Physician's written opinion
- Any recommendation for further medical follow-up.
- The results of the medical examination and any associated tests.
- Any medical condition which may be revealed in the course of the examination which may place lab personnel at increased risk as a result of exposure to a hazardous workplace.
- A statement that the lab personnel have been informed by the physician of the results of the consultation or medical examination and any medical condition that may require further examination or treatment.
- The written opinion shall not reveal specific findings of diagnoses unrelated to occupational exposure.

10.0 LAB RENOVATION / MOVE / RELOCATION PROCEDURES

All hazardous materials impacted by lab renovation/move/relocation activities must be properly managed. This will protect WHOI personnel and outside contractors from exposure to hazards. This section applies to lab personnel engaged in the following:
- leaving WHOI and closing his/her lab,
- retiring and closing his/her lab,
- relocating his/her lab to a different location on campus,
- renovating his/her lab, or
- leaving WHOI but transferring responsibility of his/her lab to another PI.

It is the responsibility of the PI or their designee to:
- Notify EH&S of a lab renovation/move/relocation as soon as possible.
- Contact EH&S for assistance with hazardous material moves. The transportation of hazardous materials must be in compliance with the Department of Transportation regulations. Unknown or unlabeled chemical containers cannot be transported.
• Ensure all hazardous materials are properly moved, disposed, or transferred to another PI. Check with your Department to see if unwanted chemicals can be recycled. Chemicals must not be abandoned.
• Unneeded gas cylinders must be returned to vendor or transferred to another PI.
• Tag all hazardous waste and complete a waste pickup request on-line.
• Ensure all chemical containers are properly labeled with the full name and hazard(s). Do not leave any unknowns.
• Refrigerator(s)/freezer(s) must be cleaned out and washed down.
• Clean surfaces and equipment that have come in contact with chemicals using a warm solution of soap and water or other sufficient cleaning method to ensure surfaces are free of visible chemical residue. This may include fume hoods (inside and out), bench tops, floors, equipment, refrigerators and sinks.
• If applicable, properly wash down perchloric acid hoods.
• Remove or deface biohazard labels following appropriate disinfection procedures.
• Contact the Radiation Safety Officer at X3788 or X2242 for proper closeout procedures for radioactive materials.
• Update the chemical inventory on the WHOI chemical inventory database.
• Request a walk-through of your lab from EH&S at X2244 or X3347 after these procedures have been completed to ensure there are no exposure hazards.
APPENDIX A – Comparison of NFPA 704 and Hazcom 2012 Labels

<table>
<thead>
<tr>
<th>Purpose</th>
<th>NFPA 704</th>
<th>HazCom 2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provides basic information for emergency personnel responding to a fire or spill and those planning for emergency response.</td>
<td>Informs workers about the hazards of chemicals in workplace under normal conditions of use and foreseeable emergencies.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Number System: NFPA Rating and OSHA's Classification System</th>
<th>0-4</th>
<th>1-4</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 = least hazardous</td>
<td>1 = most severe hazard</td>
<td></td>
</tr>
<tr>
<td>4 = most hazardous</td>
<td>4 = least severe hazard</td>
<td></td>
</tr>
</tbody>
</table>

- The Hazard category numbers are NOT required to be on labels but are required on SDSs in Section 2.
- Numbers are used to CLASSIFY hazards to determine what label information is required.

<table>
<thead>
<tr>
<th>Information Provided on Label</th>
<th>NFPA 704</th>
<th>HazCom 2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health Hazards on Label</td>
<td>Acute (short term) health hazards ONLY. Acute hazards are more typical for emergency response applications. Chronic health effects are not covered by NFPA 704.</td>
<td>Acute (short term) and chronic (long term) health hazards. Both acute and chronic health effects are relevant for employees working with chemicals day after day. Health hazards include acute hazards such as eye irritants, simple asphyxiants, and skin corrosives as well as chronic hazards such as carcinogens.</td>
</tr>
</tbody>
</table>

| Flammability/Physical Hazards on Label | NFPA divides flammability and instability hazards into two separate numbers on the label. Flammability in red section. Instability in yellow section. | A broad range of physical hazard classes are listed on the label including explosives, flammables, oxidizers, reactives, pyrophorics, combustible dusts and corrosives. |


| Other | The hazard category numbers found in section 2 of the HC2012 compliant SDSs are NOT to be used to fill in the NFPA 704 diamond. | Supplemental information may also appear on the label such as any hazards not otherwise classified, and directions for use. |


For more information:

[ NFPA | OSHA ]
The substance: "NOMIXUP 7042012"

To create an OSHA label per HazCom 2012:

**Step 1:** Perform the classification in accordance with Appendix A: Health Hazards & Appendix B Physical Hazards of 29 CFR 1910.1200 — this is where you find the criteria for each hazard class and hazard category.

- Class: Flammable Gas, Category 1
- Class: Carcinogen, Category 1B
- Class: Specific Target Organ Toxicity (Single Exposure), Category 3
- Class: Substances and Mixtures Which, in Contact with Water, Emit Flammable Gases, Category 3

**Step 2:** Gather labeling information (Pictograms, Signal Word, Hazard Statements) from Appendix C of 29 CFR 1910.1200 based on the chemical’s hazard class and category.

**Step 3:** Create the Label

To Create NFPA 704 label:

**Step 1:** Collect information on hazards from applicable sections of SDS. Some SDSs may provide the NFPA diamond symbol with hazard rating numbers filled in already. **Note: Do NOT use the hazard category numbers given in section 2 of HazCom 2012 compliant SDS on 704 label!**

If the diamond is not provided on the SDS you can obtain the information under the following sections of the SDS. Note that additional information may be provided in other sections of the SDS.

- Health hazard information under Section 11
- Flammability information under Section 9
- Instability information under Section 10
- Special information under Section 9, 10, 11

**Step 2:** Obtain current edition copy of NFPA 704 or view online at www.nfpa.org/704. Compare the criteria on the SDS sections as shown above with the criteria shown in Tables 5.2 (Health), 6.2 (Flammability), 7.2 (Instability) and 8.2 (Special Hazards).

**Step 3:** Place numbers for the degree of hazard associated with the criteria obtained in Step 2 in the correct quadrant of NFPA 704 placard.

For more information:

[OSHA](https://www.osha.gov)  
[NFPA](https://www.nfpa.org)
Hazard Communication Standard Pictogram

The Hazard Communication Standard (HCS) requires pictograms on labels to alert users to the chemical hazards to which they may be exposed. Each pictogram consists of a symbol on a white background framed within a red border and represents a distinct hazard class. The pictogram on the label is determined by the chemical hazard classification.

**HCS Pictograms and Hazards**

<table>
<thead>
<tr>
<th>Health Hazard</th>
<th>Flame</th>
<th>Exclamation Mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Carcinogen</td>
<td>• Harmful</td>
<td>• Irritant (skin and eye)</td>
</tr>
<tr>
<td>• Mutagenicity</td>
<td>• Pneumotoxic</td>
<td>• Skin Sensitizer</td>
</tr>
<tr>
<td>• Reproductive toxicity</td>
<td>• Toxicological</td>
<td>• Acute Toxicity (inhalation)</td>
</tr>
<tr>
<td>• Respiratory Sensitizer</td>
<td>• Skin S‒ reactive</td>
<td>• Nervous Effects</td>
</tr>
<tr>
<td>• Target Organ Toxicity</td>
<td>• Eyes‒ reactive</td>
<td>• Respiratory Tract</td>
</tr>
<tr>
<td>• Aquatic toxicity</td>
<td>• Eye S‒ reactive</td>
<td>• Irritant</td>
</tr>
<tr>
<td>• Reproductive</td>
<td></td>
<td>• Hazards due to Clean Up (Non‒fatal)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Gas Cylinder</th>
<th>Corrosion</th>
<th>Exploding Bomb</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Cylinders Under Pressure</td>
<td>• Skin Corrosion/ Burns</td>
<td>• Explosives</td>
</tr>
<tr>
<td></td>
<td>• Eye Damage</td>
<td>• Self-Reactions</td>
</tr>
<tr>
<td></td>
<td>• Corrosion to Metals</td>
<td>• Organic Peroxides</td>
</tr>
</tbody>
</table>

For more information:
OSHA QuickCard

For more information:
www.osha.gov  1-800-321-Osha (6742)