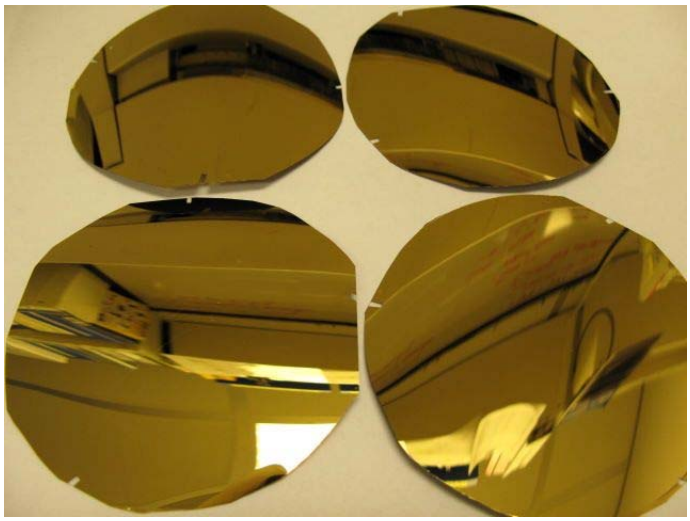
Chemical Hygiene Plan
For

UNIVERSITY OF CALIFORNIA, IRVINE

The Henry Samueli School of Engineering



INTEGRATED NANOSYSTEMS RESEARCH FACILITY

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1.1 Facility Description

The Integrated Nanosystems Research Facility (hereinafter referred to as the INRF lab) occupies the southwest section of the campus second floor of Building 319 Engineering Gateway

1.2 Introduction to Chemical Hygiene Plan

Integrated Nanosystems Research Facility (INRF) is committed to providing safe and healthful working conditions for all Researchers. To this end, this Chemical Hygiene Plan (CHP) establishes policy, responsibilities, and procedures to ensure the safe use of hazardous chemicals in the laboratory. This CHP complies fully with the provisions of the California Occupational Safety and Health Administration (CAL/OSHA) Standard for "Occupational Exposures" to Hazardous Chemicals in the Laboratory.

The bulk of this document deals with general practices to ensure safe and healthful laboratory operations. Standard operating procedures (SOP) addressing specific hazards such as; the changing of cylinders of corrosive, explosive and combustible gases, as well as, an emergency response plan for dealing with release of these gases has been prepared as appendices.

2.1 Purpose

This CHP is designed to document the program that is now in place to protect researcher's health and to ensure that researcher's exposures are below the permissible exposure limits (PELs) established by CAL/OSHA. This CHP is supplemented by standard operating procedures (SOPs) and project-specific health and safety plans for a variety of potential hazards that may exist at the laboratory. This plan provides procedures and practices to ensure the safe use of hazardous chemicals at this facility. The plan specifically addresses:

- Designation of personnel responsible for implementation of the CHP, including the assignment of a Chemical Hygiene Officer (CHO);
- SOP to be followed when laboratory work involves the use of hazardous chemicals;

- Control measures to limit Researchers exposure to hazardous chemicals including engineering controls, work practices, administrative controls, and the use of personal protective equipment;
- Provisions for additional Researchers protection for work with regulated chemicals, including carcinogens;
- Circumstances under which a particular laboratory operation, procedure, or activity shall require approval from the CHO and lab Manager before implementation;
- Measures to ensure the proper functioning and adequate performance of laboratory hoods and other protective equipment;
- Procedures to be followed in the event of an emergency, including the location and proper use of available emergency equipment.

2.2 Scope of Chemical Hygiene Plan

This CHP applies to all Researchers, staff and maintenance personnel working at the laboratory (including contractors and subcontractors) who are engaged in the laboratory use of hazardous chemicals. Visitors must also comply with specific elements so defined.

This CHP is to encompass all laboratory-scale operations (i.e., those bench-scale operations where handling of chemicals can be easily and safely manipulated by one person) involving the use of hazardous chemicals and wastes. Based on the background information provided in Section 1.1, the CHP will cover all activities performed in the laboratories ancillary storage areas.

3.0 Definitions and Information Sources

3.1 Definitions

Action level

The airborne concentration of a hazardous chemical designated in 8 CFR 5155 calculated as an eight-hour time-weighted average that initiates certain required activities such as exposure monitoring and medical surveillance. For chemicals listed in CFR 5515 tables, the action level is defined as 50 percent of the PEL.

Acute Health Effect

An adverse effect on human or animal body with symptoms that develop rapidly.

Acute Toxicity, High
A level of toxicity that may be fatal or cause damage to target organs as a result of a single exposure or exposures of short duration.

Carcinogen
Defined as a substance:
a) Cal/OSHA regulates as a carcinogen;
b) The National Toxicity Program (NTP) lists as "Known to be carcinogens";

Chronic Health Effect
An adverse effect on a human or animal body with symptoms that develop slowly over a long period of time or that recur frequently.

Chronic Toxicity
A level of toxicity that may produce adverse health effects with repeated doses of or exposures to a material over a prolonged period of time.

Energized Equipment
Connected to an energy source or containing residual or stored residual or stored energy. Energy may be electrical, hydraulic, or pneumatic in nature.

Hazardous Chemical
A chemical, for which statistically significant evidence exists, based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed researchers or is specifically listed as hazardous in regulations. The term "health hazard" includes chemicals that are carcinogens; toxic agents; reproductive toxins; irritants; corrosives; sensitizers; hepatotxins; nephrotoxins; neurotoxins; agents that act on the hematopoietic systems; and agents that damage the lung, skin, eyes, or mucous membranes.

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

Laboratory-Scale
Task involving the use of chemical substances in which the containers used for reactions, transfers, and other handling of substances are designed to be easily and safely manipulated by one person.

Laboratory use of Hazardous Chemicals

Laboratory use of hazardous chemicals means the handling or use of such chemicals in which all of the following conditions are met:

- Chemical manipulations are carried out on a " laboratory scale";
- Multiple chemical procedures or chemicals are used;
- The procedures involved are not part of a production process; and
- "Protective laboratory practices and equipment" are available and in common use to minimize the potential for researchers exposure to hazardous chemicals.

Laboratory-Type Hood

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

Laminar Flow Hood

A device having the same general appearance as a laboratory-type hood but differing inasmuch as the air flows from top to bottom to prevent particulate contamination of the products contained within. Laminar flow hoods also are equipped with slot exhaust system to control fumes and vapors from substances contained within.

Regulated Chemical

A chemical that is considered to be particularly hazardous, i.e., so hazardous that the researcher requires protective measures in addition to the provisions of the safe work practices. These chemicals are defined as select carcinogens, reproductive toxins, and chemicals that exhibit a high degree of acute toxicity.

Reproductive Toxin

Any agent has a harmful effect on the adult male or female reproductive system or the developing fetus or child. Such hazards affect people in several ways, including loss of sexual drive, mental disorders, impotence, infertility, sterility, teratogenic effects on the fetus, and transplacental carcinogenesis.

4.0 Responsibilities

4.1 Occupational Health and Safety (OH&S)

4.2 Laboratory Manager

The Laboratory Manager for the facility is responsible for ensuring that the Chemical Hygiene Plan is implemented.

4.3 Chemical Hygiene Officer

The chemical Hygiene Officer (CHO) is responsible for administrating this Plan, is familiar with all aspects of this Plan, all laboratory operations and activities, and the health hazards of the toxic substances used. The individual selected is qualified by experience to provide the necessary technical guidance. Duties of the CHO include, but may not be limited to, the following:

- Work with laboratory manager and researchers to develop and implement appropriate chemical hygiene policies and practices;
- Monitor procurement, use, and disposal of chemicals used in the lab;
- See that appropriate audits are conducted;
- Help laboratory staff develop precautions and adequate facilities;
- Know the current legal requirements concerning regulated substances;
- Seek ways to improve the chemical hygiene program; and
- Review and update the Chemical Hygiene Plan annually.

4.4 Laboratory Researchers

It is laboratory researcher's responsibility to plan and conduct laboratory-scale operations in accordance with the Chemical Hygiene Plan and to develop good personal chemical hygiene habits:

. Each individual must exercise prudent and careful work practices to ensure his/her own safety as well as that of fellow researchers.

. Researcher shall not perform any task that jeopardizes individual health and safety.

. Researcher is responsible for notifying staff or lab manager of any potential health or safety hazards that they observe in the laboratory.

. Researcher must conduct their activities in a safe and healthful manner by following the CHP.

. Researcher must use the appropriate SOP for the task (assignment).

. Researcher must incorporate the annual training in the performance of their responsibilities.

5.0 Occupational Exposure Limits

The following procedures will be followed when evaluating exposure of laboratory Researcher:

. It is the responsibility of management to maintain laboratory researchers' exposures to levels as low as reasonably achievable. At a minimum, researcher's exposures to Cal/OSHA regulated substances shall not exceed the action level (or, in the absence of an action level, the PEL).

. Typically, an action level is equivalent to one-half of the PEL. If the action level is exceeded, exposure monitoring shall be performed at least on a Semiannual basis. The requirements for monitoring are listed in section 12.0, Researcher Exposure Assessment.

. Threshold Limit Values (TLVs) are guidelines for airborne concentrations of hazardous materials based on an 8-hour time weighted average. The TLVs are published by the American Conference of Governmental Industrial Hygienists, Inc. (ACGIH) for researcher exposure to certain substances.

. In an evaluation of researcher exposures, the Cal/OSHA PELs are referenced first. If the chemical does not have a published PEL, the TLV will be used.

6.0 Strategy to Implement the Chemical Hygiene Plan

INRF is committed to providing safe and healthful working conditions in laboratories where hazardous chemicals are used. This CHP presents prudent practices for the handling of hazardous chemicals and has been adopted by INRF

as minimum requirements for its laboratory operations at UCI.

6.1 Strategy for Implementation

The strategy for implementing the CHP consists of the following:

. Provide training regarding the CHP and the requirements of the Cal/OSHA standard.

. Evaluate and modify, if necessary, the condition of engineering controls available in the laboratory areas.

. Confirm and enforce safe work practices for major tasks performed in the laboratory.

. Perform routine monitoring where researcher exposures to hazardous chemicals above the action level or PEL may occur.

. Review the following plans/programs on an annual basis:

- Emergency Contingency Plan
- Standard Operating Procedures
- Hazard Communication Program

. Modify the CHP, as needed, due to process changes and material substitutions.

6.2 Self Assessment for Compliance with CHP

The laboratory manager and the CHO must perform as assessment to determine the level of compliance with this plan. The assessment will identify both the areas of the plan with which the laboratory essentially complies and those areas where the laboratory needing improvement. The self assessment shall include, but not be limited to, the following:

. Researcher exposures that may exceed the action level, or in the absence

of the action level, the PEL.

. An evaluation of engineering controls such as laboratory hoods and other local exhaust ventilation.

. Availability/location of safety equipment for use in emergencies

. Availability of personal protective equipment for routing researcher use.

7.0 Training

7.1 Implementation

Laboratory researcher shall receive initial and refresher safety instruction and training, the frequency of which will be determined by the EH&S and laboratory manager.

7.2 Training Course Elements

The training course for the CHP includes the following elements:

. The contents of the Cal/OSHA Occupational Exposures to Hazardous Chemicals in Laboratories standard (29 CFR 1910.1450) and its appendices. The standard is made available to researchers.

. The location and availability of the CHP.

. The PELs for Cal/OSHA-regulated substances and TLVs for other hazardous chemicals where there is no applicable Cal/OSHA standard.

. Signs and symptoms associated with exposures to hazardous chemicals used in the laboratory.

. The location and availability of known reference materials on the hazards, safe handling, storage, and disposal of hazardous chemicals found in the laboratories and other designated work areas including, but not limited to, MSDSs received from chemical suppliers.

. The methods and observations that may be used to detect the presence or release of a hazardous chemical such as breathing-zone air monitoring,

continuous monitoring devices, visual appearance, or odor of hazardous chemicals, when being released.

. The methods researchers can use to protect themselves from these hazards, including specific procedures this facility has implemented to protect researchers from exposure to hazardous chemicals, such as appropriate work practices, emergency procedures and PPE.

Other topics to be presented are as follows:

. Hazard Communication Program shall be the core of every ongoing training program. The MSDSs provide the researcher with pertinent information about each hazardous chemical used in their work area.

. General training in the use and selection of PPE shall be provided to researcher. The MSDS shall be used as a main resource in the selection of PPE. If specific guidelines are not available, the researcher should consult with the Laboratory Manager or CHO.

. Respiratory protection training shall be provided for staff required to wear a respirator. The training shall follow a determination (by medical examination and testing) that the individual can use a respirator.

7.3 Documentation

The training must be documented in accordance with Recordkeeping, Section 16.0 of this plan. Training sessions shall be properly documented by signed attendance sheets and other signed statements. This documentation is placed in the occupational health and safety files.

8.0 Engineering Controls

8.1 Introduction

Chemical safety is accomplished by maintaining an awareness of the chemical hazards and by keeping chemicals under control through a variety of engineered safeguards. Laboratory personnel should be familiar with the proper use of these safeguards and supervisors or principle investigators should be able to detect any malfunction of these safeguards. All engineering controls must be properly

maintained, inspected on a regular basis and never over loaded beyond their design limits.

Several different engineering controls (e.g., general and local exhaust ventilation) are useful to dilute, capture or contain hazardous chemicals.

8.2 Laboratory Ventilation

Laboratory ventilation is comprised of general ventilation and local exhaust ventilation. In the INRF general ventilation is designed to maintain clean room conditions as well as researcher comfort. On the other hand, local exhaust ventilation systems, including laminar flow hoods, laboratory-type exhaust hoods, and ventilated gas safety cabinets, are designed to control hazardous air contamination. Local exhaust ventilation systems shall be used in any operation likely to emit hazardous or irritating concentrations of air contaminants.

8.2.1 General Ventilation

General ventilation with air intakes and exhausts identified and properly located will reduce the intake of contaminated air into the building. General laboratory ventilation shall:

. Ensure that laboratory air is continually being replaced, preventing the increase of air concentrations of volatile chemicals over the workday. Generally 4 to 12 changes of room air per hour provide adequate ventilation.

. Ensure that the movement of air will be from areas of lower contamination potential to areas of higher contamination potential.

. Introduce the conditioned, fresh air uniformly throughout the laboratory with minimum turbulence and no stagnant areas.

. Not be relied on to provide adequate protection by diluting volatile chemicals used within the laboratory.

8.2.2 Laminar Flow Hoods

The following rules apply to the laminar flow hoods with external exhausts:

. A CFM velocity reading of the exhaust duct or equivalent measurement shall be performed after initial installation, alterations or maintenance and at least annually. Records of these tests shall be retained for at least five years.

. A sign shall be posted at the opening of the hood to inform employees when the hood is not working correctly.

. Have a device (e.g., magnetic gauge and alarm) attached to the hood to indicate that the hood is not working correctly.

8.2.3 Laboratory-Type Exhaust Hoods

The following rules apply to the use laboratory-type exhaust hoods:

. Maintain a face velocity of at least 100 feet per minute (fpm). The sash position shall be marked to the acceptable position where the desired face velocity of 100 fpm is achieved.

. Monitor with a calibrated instrument (equivalent to a hot wire anemometer) on an annual basis, and post the results of the survey prominently near the opening of the hood. The face velocity will be resurveyed whenever there is a change in the system, such as, a new exhaust hood or the addition or deletion of a local exhaust hood.

. Have a device (e.g., magnetic gauge and alarm) attached to the hood, which alarms when the hood is not working correctly.

. The laboratory hood shall not be used for chemical handling or sample analysis <u>unless</u> a face velocity of 100 fpm is achieved.

- The hood will be taken out of service when it is unable to achieve a face velocity of 80 fpm with the sash fully open.

- A sign shall be posted at the opening of the hood to inform researchers that the hood is not working correctly.

- The face velocity must be measured after repairs are complete to confirm that the hood is working correctly before it is returned to service.\

. Laboratory hoods are meant to be work areas and are not to be used for chemical storage. Materials shall be kept to a minimum and placed where they will not block vents or reduce airflow.

. Ensure that equipment and materials kept in hoods do not reduce airflow to unsafe levels.

. The exhaust air from laboratory hoods and other types of local exhaust ventilation must be discharged in a manner that entry into the buildings air supply is minimized.

. Maintain usage records as required for environmental record keeping.

8.2.4 Gas Safety Cabinets and Associated Safety Systems

The laboratory is equipped with ventilated gas safety cabinets for the storage of hazardous compressed gases, which are designed to allow 150-200 linear feet per minute of air to pass through the cabinet with the door open. The doors are self-closing. The cabinets allow for the separation of gases, to satisfy both, the national, and local fire and building codes and provides protection in the event of component failure or leakage.

. **Piping**. All toxic gases are distributed from the gas cabinets and within double walled stainless steel tubing from the gas cabinets to the point of use. The annular space is vented back to the gas cabinet and is under negative pressure should leakage occur. Detectors provided in the fume exhaust duct can detect leakage and trigger an alarm.

. **Unusual Gas Flow Detection.** The gas safety cabinets are equipped with automatic emergency shutdown systems, which detect unsafe or unusual gas delivery systems conditions, give immediate warnings, and if warranted, initiate automatic shutoff of process gas flow.

. **Leakage Detection.** The present system monitors all rooms in which toxic or flammable gases are used. A low-level warning and alarm level detection system provides early warning at very low levels of exposure (settings to be determined by INRF) and provides emergency shutdown of all toxic and flammable gases at (threshold Limit Value) TLV levels for the toxics and at 20% of the lower explosive limit for the flammables.

  Monitors in the exhaust ducting detect emergency releases. The flow-restrictive orifices limit toxic gas discharges to a level of less than ½ IDLH (immediately dangerous to life or health) when diluted with the total exhaust stream. If a higher concentration of toxic gas is detected, the gas monitor shuts off all gases. These functions protect neighbors and personnel on the roof or general area of the scrubber discharge levels of toxics.

. **Loss of Exhaust.** All gases which can pose a hazardous condition, i.e., toxic or flammable gases, will be shut down in the event of a loss of exhaust. With the air handler outside dampers set to balance the air flow as designed, nearly full exhaust flow rates will be maintained when the air handlers are off. Air handlers will be off only in the event of an equipment failure (belts, motor, etc.) or for maintenance. Even if the gases were still in under these conditions the system is safe, since approximately 30 air changes per hour flow through the H-6 area due to exhaust system operation alone. In any event, if the exhaust were to be significantly reduced in flow, all toxic gases would be shut down.

8.3 Equipment Maintenance

The following rules apply to equipment maintenance:

. Good equipment maintenance is important for safe, efficient operations. Equipment failure may increase the risk of researcher exposure to hazardous chemicals. If the operation cannot be performed safely, the process will not continue. Equipment must be inspected and maintained regularly in accordance with manufacturer-recommended service schedules.

. The laboratory hoods shall be tested annually in accordance with INRF procedure.

. Maintenance plans will include a procedure that ensures that a device that is out of service is properly locked out and/or tagged out.

. All equipment repairs shall be performed by trained individuals.

8.4 Alteration of Laboratories or Engineering Controls

Proposed alterations of facilities or controls must include the following:

. The CHO shall review all proposed changes concerning the laboratories, and storage areas, to ensure that health and safety issues are adequately addressed. Major facility changes must be coordinated with the OH&S Manager or other health and safety experts. Equipment Safety Certification per established Safety Procedure (SP 2-4) is required for equipment relocation or set up of new equipment.

  Additionally, there may be environmental concerns, permit requirements, significant cost and recovery delays.

9.0 Laboratory Safe Work Practices

9.1 General

. Understand and implement the requirements of the CHP.

. Ensure that all researchers and visitors wear safety glasses at all times while in the laboratory except while using microscopes. Contact lenses shall not be worn in the laboratory by researchers.

. Wear proper clean room clothing.

. Wear chemical goggles or face shield while working with large quantities of hazardous liquids or heating concentrated acids.

. Inspect gloves before use, making sure that the gloves provide adequate protection from the hazardous chemicals being used per MSDSs and/or analytical operational procedures.

. Immediately remove any safety equipment, such as a laboratory garb suspected of being contaminated; obtain and use a new laboratory garb, replace safety equipment when contaminated.

. Know what emergency equipment will be necessary in the event of an accident or spill and be familiar with its operation.

. Immediately notify management of any unsafe condition, including safety equipment that is damaged or inoperative.

. Mechanical pipetting aids must be used for all pipetting procedures. Mouth pipetting is prohibited.

. Use a rubber or polyethylene carrier to transport single glass bottles of chemicals one gallon or larger from stockroom/storeroom and within the laboratory. Plastic-coated glass bottles with polypropylene caps, which can satisfy a 4 foot drop test, are available and can serve as both the storage vessel and the unbreakable outer container combined.

. Hands and face should be washed before eating and drinking.

. Do not smell or taste chemicals or samples.

. Food, drink, gum, cosmetics, and smoking materials that have been contaminated are potential routes for exposure to hazardous substances. Do not eat, drink, smoke, chew gum or tobacco products or apply cosmetics or lip balm in the laboratory. Wash hands and face before conducting these activities in areas outside the laboratory.

. Food should be stored, handled and consumed in an area free of hazardous chemicals. Food must not be stored in a refrigerator dedicated to chemical storage or other laboratory use.

. Glassware or utensils that have been used for laboratory operations must never be used to prepare or contain food or beverages.

9.2 Housekeeping

There is a definite relationship between safety performance and orderliness in the laboratory. When housekeeping standards fall, safety performance inevitably deteriorates. The following housekeeping practices should be followed to minimize exposure:

. The work area shall be kept clean and chemicals and equipment shall be properly labeled and stored.

. Access to exits, emergency equipment, electrical control panels, etc., shall not be blocked. All electrical panels shall be marked as to loads they service.

. Equipment caches and tops of storage cabinets shall not be used as storage areas.

. Unlabeled containers and chemical wastes shall be disposed of promptly by appropriate procedures. Materials and chemicals that are no longer needed must not be allowed to accumulate in the laboratory.

. Floors shall be cleaned regularly; settled dust can absorb or absorb chemicals and may pose respiratory hazards.

. Spilled chemicals shall be cleaned up promptly and the material disposed of properly according to applicable waste disposal guidelines.

9.3 Storage of Chemicals

The correct storage of chemicals serves to eliminate the potential for a fire or a release of hazardous chemicals resulting from a chemical reaction. The containment of volatile chemicals also serves to reduce researcher exposures to airborne chemicals. The following are rules concerning chemical storage:

9.3.1 General

. Laboratory storage of chemicals shall be limited to the smallest practical amount. Chemicals no longer in use shall be disposed in accordance with INRF procedure 7-1.

    . Stockroom/storerooms shall be secure, with limited access, and shall provide appropriate storage by class/type of chemical. Chemicals should be stored according to chemical compatibility, not in alphabetical order or by stock number. Fire is the major hazard in chemical storage. NFPA 30, Flammable and Combustible Liquid code (1990) establishes requirements for the types of storage and

maximum quantities of chemicals that can be stored in a storeroom or laboratory.

9.3.2 Definitions

For the purpose of this document, the following definitions are provided:

. The flashpoint of a liquid is defined as the temperature at which the liquid gives off vapor sufficient to form an ignitable mixture with air near the surface of the liquid.

. The auto-ignition temperature is defined as the lowest temperature to which any part of a vapor-air to gas-air mixture must be raised by application of any source of heat to produce combustion that will propagate itself.

. A flammable liquid is any liquid with a flashpoint below 100 F and a vapor pressure less than 40 pounds per square inch (absolute pressure) at 100 F. For the purpose of this CHP, flammable liquids are classified as follows:

Class 1A – flashpoint less than 73 F (22.8 C).
Boiling point less than 100 F (37.8 C).

Class 1B – Flashpoint less than 73 F (22.8 C).
Boiling point at or greater than 100 F (37.8 C).

Class 1C – Flashpoint at or greater than 73 F (22.8 C).
Boiling point at or greater than 100 F (37.8 C).

. A combustible liquid is any liquid with a flash point at or above 100 F. Combustible liquids are divided into three subclasses (II, IIIA, and IIIB)

Class II – Flashpoint at or greater than 100 F (37.8 C) and below 140 F (60 C).

Class IIIA – Flashpoint at or greater than 140 F (60 C) and below 200 F.

Class IIIB – Flashpoint at or greater than 200 F.

9.3.3 Storage Containers and Areas

The storage of chemicals indoors must meet the requirements of NFPA 30, Flammable and combustible Liquid code. Criteria are provided for the following.

. Laboratories
. Flammable liquid storage cabinets
. Separate inside storage areas that meet all design criteria (NFPA 30)
. Inside rooms that do not meet all design criteria (NFPA 30)

9.3.4 Flammable Liquid Storage Cabinets

The following are guidelines for flammable storage cabinets:

. Flammable solvent storage cabinets shall be installed according to guidelines published by the NFP Publication 30 Flammable and Combustible Liquid code.
. Cabinets designed for the safe storage of flammable chemicals can only be used if properly maintained. Cabinets are generally made of double-walled construction and are made of 18-gauge steel. The doors are 2 inches above the base, and the cabinet is liquid-proof to that point. The manufacturer's information should always be read and prudent safety practices should be followed. These include the following:

  - Store only compatible materials inside the cabinet. (See Subsection 9.3.5 for detailed instructions).

  - Store chemicals of similar vapor density together when using mechanical ventilation (e.g., heavier-than-air vapors are vented through the bottom vent, and lighter-than-air vapors through the top vent).

  - Do not store paper or cardboard inside the cabinets with the chemicals.

  - Do not store quantities greater than the stated capacity of the cabinet.

The quantities of flammable chemicals in a storage cabinet shall not exceed:

. 120 gallons of Class I, II, and IIIA liquids
. Maximum of 60 gallons of Class I and II liquids
. No more than three flammable liquid storage cabinets per room.

9.3.5 Storage of Incompatible Chemicals

Because many chemicals are incompatible with others, proper storage procedures should be followed to avoid their contact with each other. Table 9-3 presents a partial list of chemicals and the chemicals with which they are incompatible. For satellite accumulation of RVRA hazardous waste, additional information on chemical incompatibility is provided in section 11.0 Waste Disposal.

Table 9-3 List of Incompatible chemicals

Chemical	Incompatible chemicals
Acetic Acid	Chromic acid, nitric acid, perchloric acid, hydroxyl-containing compounds, ethylene glycol, peroxides, and permanganates
Acetone	Concentrated nitric, sulfuric, perchloric and chromic acid mixtures and certain plastic materials.
Acetylene	Chlorine, bromine, copper, silver, brass (red) fluorine, mercury and oxygen
Ammonium nitrate	Acids, metal powders, flammable liquids, chlorates, nitrates, sulfur, finely divided organics or combustibles.
Ammonium hydroxide	Acids
Ammonium iodine	Acids and oxidizing agents
Ammonium sulfide	Acids
Carbon tetrachloride	Sodium

Chlorine	Ammonia, acetylene, butadiene, butane, methane, propane (or other petroleum gases), hydrogen, sodium carbide, benzene, finely divided metals and turpentine
Chromic acid	Acetic acid, acetone, naphthalene, camphor glycerin, turpentine, alcohol and most flammable organic compounds
Copper	Acetylene or hydrogen peroxide
Chemical	Incompatible chemicals
Cyanides	Acids
Diethyl ether	nitric acid (concentrated and fuming) and other strong oxidizing agents (dichromate, permanganate) heat or aluminum
Flammable liquids	Ammonium nitrate, chromatic acid, hydrogen peroxide, nitric acid, sodium peroxide, halogens
Hydrochloric acid	Bases or manganese dioxide
Hydrocyanic acid	Nitric acid or alkalis
Hydrogen peroxide	Copper, chromium, iron, most metals or their salts, any flammable liquid, combustible materials, aniline, and nitro methane
Hydrofluoric acid (Anhydrous)	Ammonia, aqueous or anhydrous
Hydrogen sulfide	fuming nitric acid, oxidizing gases, heat and most common metals
Mercury	Acetylene, fulminic acid, ammonia, and concentrated nitric acid

Nitric acid	Acetic acid, aniline, chromic acid, hydrocyanic acid, hydrogen sulfide, flammable liquids, flammable gases, nitratable substances such as organic compounds including diethyl ether and methyl isobutyl ketone (hexone) and bases
Oxygen	Oils, grease, hydrogen, flammable liquids, solids or gases
Sulfuric acid	Chlorates, per chlorates, permanganates, water and bases

Note: For a complete listing of chemical incompatibilities, consult the MSDS file maintained within the Hazard Communication Program.

9.4 Flammability Hazards

The following procedures should be followed with regard to flammability hazards:

. Open flames are prohibited unless approved in advance by the Laboratory Manager, OH&S person, and CHO. Before igniting an open flame in the laboratory, remove all flammable substances from the immediate area. Check all containers of flammable materials in the area to ensure that they are tightly closed.

. Notify other occupants in the laboratory before lighting a flame.

. Do not use an open flame to heat a flammable liquid or to carry out a distillation under reduce pressure.

. Use an open flame only when necessary and extinguish it when it is no longer needed.

. When volatile flammable materials may be present, use only non-sparking electrical equipment.

9.5 Corrosive Chemicals

A corrosive chemical is any material that poses an imminent danger of disintegration or chemical change in inanimate matter or destruction of organic tissues. The following considerations should be taken when using corrosive chemicals:

. Before handling these chemicals, the researcher should locate the nearest safety shower, eye shower and fire extinguisher.

. The proper protective equipment should be worn e.g., chemical goggles, face shield, long-sleeve garment or plastic sleeves, rubber aprons and rubber gloves. The extent of protective clothing will depend upon the quantity of chemical being handled. Titrations would require chemical goggles, whereas acid cleaning of glassware would require all the above items.

. Chemical splash goggles are the minimum eye protection required when handling acid or alkaline in all cases except:

- When transporting conventionally closed and protected containers
- When using 0.1N or less acid or alkali

. When diluting concentrated solutions, the acid or base should be added to the water.

. All containers of acids and alkalis should be provided with secondary containment (e.g., plastic spill tray) when stored under laboratory hoods.

. Corrosive chemicals, either solid or liquid, shall not be stored on shelves above eye level under any conditions.

. When being transported, corrosive chemicals stored in glass or metal containers must be kept in a plastic or rubber backup container of sufficient size to contain the material should the original container break. Plastic bottles containing reagent chemicals do not require a backup container.

. The one exception to the preceding two rules is where containers of titration acid or alkali solutions are evaluated to permit gravity flow; however, the container must be polyethylene and be protected from falling by a fixed rod or barrier.

9.6 Equipment Guarding

Equipment will be guarded in the following ways:

. All mechanical equipment shall be furnished with guards that prevent access to electrical connections or moving parts (such as the belts and pulleys of a vacuum pump). The INRF staff shall inspect equipment before using it to ensure that the guards are in place and functioning.

. Careful design of guards is vital. An ineffective guard can be worse that none at all because it can give a false sense of security. Emergency shutoff devices may be needed in addition to electrical and mechanical guarding.

9.7 Glassware

Accidents involving glassware are the leading cause of all laboratory injuries. The following are procedures for preventing such accidents:

. Careful handling and storage procedures must be used to avoid damaging glassware. Chipped, cracked or stressed items shall be repaired or appropriately disposed of.

. Adequate hand protection must be used when inserting rubber stoppers or corks into glass tubing or when placing rubber tubing on glass hose connections. Tubing shall be fire polished or rounded and lubricated, and hands must be held close together to limit movement of glass if fracture occurs. The use of plastic or metal connectors should be considered.

. Pressurized glass containers shall be contained in a secondary non-glass container to prevent fragmentation of an explosion occurs.

. Gloves must be used when picking up broken glass. (Small pieces should be swept into a dustpan with a brush).

. Proper instruction must be provided in the use of glass equipment designed for specialized tasks that may represent unusual risks for the first-time users. For example, separatory funnels containing volatile solvents can develop considerable pressure during use.

. Glass-blowing operations are not permitted.

9.8 Shielding

In general, safety shall be used for any operation having the potential for explosion such as:

. Whenever a reaction is attempted for the first time (small quantities of reactants must be used to minimize hazards);

Vacuum-jacketed or pressurized glass apparatus must be handled with extreme care to prevent implosions. Only glassware designed for vacuum work will be used for that purpose.

9.9 Electrical Hazards

The following precautions should be taken to avoid electrical hazards:

9.9.1 Outlets

. Electrical outlets must have a grounding connection (three-pronged plug) or an approved insulated casing.

. The Occupational Health and Safety Officer and Lab Manager will permit and issue extension cords on a required basis, see INRF procedure 9-2.

. Outlets must be identified by control panel and circuit so they can quickly be turned off.

. Outlets shall be located so as to minimize the possibility of water or chemicals being accidentally spilled on them.

. Hood outlets should be located outside the hood to prevent the production of sparks inside the hood when a device is plugged in. This location also permits the researcher to disconnect electrical devices from outside the hood.

9.9.2 Wiring

Wiring that is worn or frayed must be eliminated.

9.9.3 Electrical Control Panels

. Electrical control panels shall not be obstructed.

. Electrical control panel circuits must be labeled to identify rated amperage, room and equipment, and/or outlets they serve.

9.9.4 Refrigerators and Freezers

. Refrigerators that are not explosion proof shall be clearly labeled as such.

. Explosion-proof refrigerators and freezers shall be used when flammable liquids must be refrigerated. These refrigerators have modified internal wiring that eliminates ignition sources and sealed external motors and switches.

9.9.5 Portable Heaters

. Laboratory use of portable heaters is prohibited when flammable materials are present.

. The use of a portable heater must be approved by the Laboratory Manager/OH&S Person.

9.9.5 Static Electricity

. Protective clothing made of plastic or synthetic material in combination with low absolute humidity promotes static electricity indoors in the winter.

9.10 Lockout and Tagout of Energized Sources

9.10.1 Purpose

This procedure provides a uniform method for tagging and locking out machinery or equipment that is being worked on or is otherwise unsafe. This will prevent the possibility of setting moving parts in motion, energizing electrical circuits, or opening valves while work is being performed. All researchers must comply with these procedures.

The requirements of this procedure shall apply to circuit breakers, switches, or other power source controls, air or hydraulic valves controlling the operations of equipment, and valves controlling the flow of liquids or gases.

9.10.2 Procedure

See INRF Safety Procedures 9.1 and inform Laboratory Manager.

9.11 Containers Under Vacuum

Systems under vacuum (e.g., glass vessels, Dewar flasks, desiccators, cold traps, and vacuum distillation apparatus) represent a potential safety hazard due to the danger of implosion. The following rules should be adhered to when working with containers under vacuum:

. An explosion shield may be used to contain the implosion or to direct the flying pieces away from the researcher.

. CAUTION – Water, solvents or corrosive gases shall not be drawn into a building vacuum system. A water aspirator shall be used as the vacuum source.

9.12 Pressurized Containers

Pressurized systems represent a potential safety hazard due to the danger of explosion. The following rules should be adhered to when working with pressurized containers:

. The container shall be wrapped with fiberglass tape to contain debris should the container explode under pressure. Alternately the container shall be enclosed in a secondary non-glass container.

. An explosion shield may be used to contain the explosion or to direct the flying pieces away from the researcher.

. The researcher shall use a face shield or safety glasses as PPE.

. If the reaction cannot be opened directly to the air, an inert gas purge and bubbler system shall be used in conjunction with a venting system.

Alternatively, the system may be exhausted to an appropriate exhaust ventilation system.

. Pressurized apparatus shall have an appropriate relief device.

. Reactions must never be carried out in, nor heat applied to an apparatus that is a closed system unless it is designed and tested to withstand pressure.

9.13 Compressed Gas Cylinders

Compressed gases have the potential to simultaneously expose the researcher to both safety and health hazards. The following rules should be adhered to when working with compressed gas cylinders:

. Flammable gases under pressure may diffuse throughout the laboratory and present a fire or explosion threat.

. The pressure of compressed gases is frequently at 1.500 to 2,000 psi, which makes the cylinder a potential rocket or fragmentation bomb; therefore, extreme caution is required. All cylinders shall be securely restrained.

. Safety glasses shall be worn when handling compressed gas cylinders.

9.13.1 Storage/Handling

The following storage/handling rules should be followed for compressed gas cylinders:

. Cylinders should be stored in an upright position (where they are unlikely to be knocked over) in well-ventilated, dry areas. All storage and use of compressed gases should be in compliance with Cal/OSHA regulations (29 CFR 1910.101-105).

. Cylinders of compressed gases must be handled as high energy sources.

. Cylinders of oxygen and flammable gases must be separated by 20 feet, or a non-combustible wall.

. Cylinders of all sizes (empty or full) must be <u>restrained individually</u> by chains or a suitable stand to prevent them from falling.

. When storing or moving cylinders the protective valve caps must be securely in place to protect the valve stems. Cylinders should not be allowed to knock together.

. When moving cylinders, they should be strapped to specially designed, wheeled carts to ensure stability. A cylinder should never be lifted by the valve cap.

. Cylinders must not be exposed to temperatures higher the 55 C. Some rupture devices on cylinders will release at about 65 C. Some small cylinders, such as, lecture bottles, are not fitted with rupture devices and may explode if exposed to high temperatures.

. Cylinders must not be used as rollers.

9.13.2 Operation

The following procedures must be followed while operating compressed gas cylinders:

. Use the appropriate regulator on each gas cylinder. Adapters or homemade modifications can be dangerous and are prohibited.

. Do not use oxygen in place of air.

, Do not put oil or grease on the high-pressure side of an oxygen, chlorine, or other oxidizing agent cylinder. An explosion can result.

. Do not use a flame to detect leaks.

. Use toxic, flammable, or reactive gases only in gas safety cabinets or in equipment designed for their use.

. Never direct high-pressure gases at anyone.

. Do not use compressed gas or compressed air in excess of then pounds per square inch to blow away dust dirt or chips from clothing while it is being worn.

. Be aware that rapid release of a compressed gas will cause an unsecured gas hose to whip dangerously. It also may build up a static charge that could ignite a combustible gas.

. Do not extinguish a flame involving a highly combustible gas until the source of gas has been shut off; otherwise, it can re-ignite causing an explosion.

. Never bleed cylinders completely empty. Leave a slight pressure to keep contaminants out.

. Promptly remove the regulators from empty cylinders and replace the protective valve cap at once. Mark the cylinder empty and move it to storage.

9.14 Warning Signs and Labels

Laboratory areas that have special or unusual hazards must be posted with warning signs. Standard signs and symbols have been established for several special situations, such as radioactivity hazards, fire hazards, etc. Signs and labels and their purposes are listed here:

. Signs shall be posted to show the locations of safety showers, eye wash stations, exits, and fire extinguishes. Extinguishes should be labeled to show the type of fire for which they are intended.

. Signs shall be prominently posted showing location of safety items such as:
- Eye wash stations
- Safety showers
- Fire extinguishes
- Emergency exits (floor plans with marked routs and “you are here” indicators).

. Chemicals shall be labeled with appropriate information and warnings on the health and safety hazards associated with use of the chemical (e.g., the NFPA diamond).

. Waste containers shall be labeled for the type of waste that can be safely deposited in them.

9.15 Review of New Procedures

Major new procedures must be reviewed and approved by the Laboratory Manager, OH&S Manager and the CHO before they are performed. Potential health and safety hazards will be addressed and resolved. If the operation cannot be performed safely, it will not be initiated.

9.16 Unattended Operations

For laboratory-scale operations carried out continuously or overnight, it is essential to plan for interruptions in utility services such as electricity, water and inert gas. Operations shall be reviewed for safety and designed with built-in measures to control hazards in case of failure. If feasible, routine inspections of the operation shall be scheduled. In all cases, the laboratory lights in the immediate area must be left on, and appropriate sign must be placed on the door with telephone numbers listed for emergency contacts.

One particular hazard frequently encountered is failure of cooling water supplies. A variety of devices can be used that 1) automatically regulate water pressure to avoid surges that might rupture the water lines, or 2) monitor the water flow so that its failure will automatically turn off electrical connections and water supply valves.

9.17 Working Alone

Working alone in the laboratory is prohibited, unless approved by the Laboratory Manager and OH&S Manager. The following are the rules governing this:

. Individuals working in separate laboratories after staff hours must make periodic checks of each other.

. Hazardous chemical procedures shall not be performed by and unaccompanied laboratory worker.

. The Laboratory Manager has the responsibility for determining whether the work requires special safety precautions.

9.18 Guidelines to Stop Unsafe Operation

The following procedures should be used to "stop work" and document the resolution of a problem. All researchers have the authority to stop an unsafe operation. It is the responsibility of the Laboratory Manager and OH&S Manager to ensure that a proper review is performed by individuals qualified to establish safe work practices.

. Researcher has the right and responsibility to inform his supervisor if engineering controls are not operating properly, if administrative controls or work practices are not being followed, of if PPE is not available to perform the task safely.

. Researcher shall seek direction form the CHO concerning whether performance of any task is unsafe.

. When performance of a task is deemed unsafe, work shall stop and the researcher shall notify the CHO and Laboratory Manager.

. The work may not proceed until the CHO conduct an appropriate review. Work may not proceed until all parties deem the operation to be safe and agree that work may proceed.

10.0 Procedures and Precautions for Working with Regulated Chemicals

10.1 Introduction

For additional researcher protection, Cal/OSHA has designated a number of chemicals that must be handled with special precautions designed to eliminate or reduce researcher exposure. For purposes of the laboratory standard, Cal/OSHA indicated that special consideration should be given to specific Cal/OSHA regulated chemicals found in 8 CAC 5155 and to chemicals classified in the following groups:

. Selected carcinogen
. Reproductive toxins
. Substances of high acute toxicity

The following regulated chemicals are on the chemical inventory list at the laboratory:

Carcinogens
- Chromium
- Mercury

Reproductive toxin
- Ethyl alcohol

Substances of high acute toxicity
- Chlorine
- Diborane
- Dichlorosilane
- Phosphine
- Silane
- Hydrofluoric acid

This section describes some of the general work practices and precautions for work involving regulated chemicals.

10.2 Work Practices

The following work practices should be followed when working with regulated chemicals:

. All regulated chemicals in concentrations greater that 0.1 percent must be identified, along with the task for which they are used.

. Only researchers who have received training on appropriate control measures associated hazards, proper safety, and disposal procedures are permitted to perform operations involving regulated chemicals.

. Regulated chemicals shall only be used in designated areas of the laboratory. Designated areas include the laboratory hoods and designated equipment.

. Designated areas must be posted with signs carrying the appropriate warning, such as:

  - "Warning – Carcinogen used in this Area. Cancer Hazard. Authorized Personnel Only"

- "Warning – Reproductive Toxin. Read Specific Procedures for Use"

- "Warning – Toxic Chemicals Used in this Area"

. Containers of regulated chemicals with vapor pressure (i.e., greater that 40 mm Hg) shall only be opened inside of an operating laboratory hood or gas safety cabinet. Containers that have been opened but not emptied must be covered and sealed before being removed from the hood and transported to the storage area. The storage area shall be posted with an appropriate warning sign.

. The smallest amount of reagent necessary for successful completion of the process should be used.

. Required environmental records must be maintained.

10.3 Reproductive Hazards

Specific chemicals have been identified as being particularly hazardous to the fetus or have an affinity to cross the placenta and bioaccumulate in the fetus. A list of reproductive toxins is provided in Section 10.1. The following should be followed:

. Women of childbearing age should be aware of the chemicals they use and, specifically, the presence of any reproductive toxins. Because the period of greatest susceptibility to reproductive toxins is the first 8 to 12 weeks of pregnancy, which includes a period when a woman may not know she is pregnant, women of childbearing potential should be careful to avoid skin contact with all chemicals. Potential inhalation of chemical vapors should be controlled to levels as low as reasonable through the use of engineering controls and work practices as described in Sections 8 and 9.

. Women shall notify their supervisor and the medical department when they know that they are pregnant.

. Upon such notification, the CHO or designated representative shall make a preliminary assessment of the work environment. If this assessment reveals there is a potential for exposure to reproductive toxins, controls must be implemented to eliminate the exposure. If this is not feasible, the Human

Relations Department must be informed of the inability to accommodate the pregnant researcher.

10.4 Personal Protective Equipment (PPE)

Researchers are provided with and required to wear the specified PPE (long sleeves, sleeve protectors, gloves, etc.) when handling regulated materials in a fume hood. The following PPR is required:

. Safety glasses will be worn at all times. The glasses should be of a design to "wrap around" the eyes; similar to visitor overlay glasses. If not available, chemical goggles shall be worn.

. Appropriate PPE for all operations shall include, but not be limited to, laboratory coat, gloves, and full shoes.

. Wear shoes that provide protection to the entire foot (e.g., leather). Certain types of shoes do not provide adequate protection, e.g., cloth, sneakers, sandals, or perforated shoes. The CHO may review and approve specific types of shoes including safety shoes that are acceptable for work in the laboratory.

. The use of PPE such as respiratory protection should only be implemented as a temporary measure until the engineering controls can be installed, or as a permanent measure when it is determined that engineering work practice or administrative controls are unable to reduce the exposure below the PRL. Researchers wearing respirators shall be apprised of the requirements of the Cal/OSHA respiratory protection standard are trained in the use of the equipment and satisfy the medical requirements specified in 8 CCR 5144.

10.5 Waste Disposal

The following procedures shall be followed during disposal of wastes:

. Contaminated protective clothing shall be disposed of in an appropriate waste disposal area.

. All waste materials shall be disposed of in compliance with local, state, and federal regulations in a manner that prevents contamination of non-designated areas.

. Laboratory researchers shall be trained to handle small laboratory spills involving particularly hazardous substances.

. Spill kits shall be made available and located in a readily accessible area of the laboratory.

. Waste collection areas or satellite disposal sites shall be posted appropriately. The area shall be secured to allow limited access to authorized personnel only.

. Waste disposal containers shall be clearly labeled with appropriate warnings.

. When operations permit, containers of polyethylene or other chemically resistant material shall be in place to collect accidental breakage of apparatus or spills of toxic materials. An absorbent plastic-backed paper may be used to collect small spills.

. The mixing of hazardous and non-hazardous wastes is prohibited.

10.6 Safety/Emergency Equipment

The following items pertain to the location of safety/emergency equipment:

. The locations of safety showers, eye wash stations, exits, fire extinguishes, and first-aid kits shall be posted.

. The locations of safety equipment shall be reviewed during the training program.

10.7 Emergencies

The following procedures shall be followed in emergency situations:

. In case of emergency, steps will be taken to prevent migration of regulated chemicals beyond the designated area.

. Any equipment, material, or other item taken into a designated area shall be decontaminated prior to its removal from the designated area.

. Decontamination procedures shall be established and implemented to remove residual hazardous chemicals from the surfaces of materials and equipment.

11.0 Waste Management

11.1 Hazardous Waste Management Program

Refer to INRF Safety Procedure 7-1, Hazardous Material and Waste Control Program. The waste disposal program specifies how waste is to be collected, segregated, stored, and transported and included consideration of what materials can be recycled or treated prior to disposal.

. All waste containers must be properly labeled and disposed of according to SP 7-1.

. Waste should be removed from the laboratory to a central waste storage area at least once per week, or as soon as the volume of water reaches 5 gallons, whichever is sooner. Waste must be disposed of within 90 days of the accumulation start date on the container.

11.2 Waste Handling Practices

The following practices shall also be adhered to:

. Chemicals used for specific projects must be ordered in the smallest available quantities that are sufficient to meet project needs. This practice will minimize potential hazardous waste.

. Evaporation in laboratory fume hoods shall not be used as a means for disposal of waste chemicals.

. Disposal by recycling or chemical decontamination should be used whenever possible.

. Mixing of non-hazardous and hazardous wastes should be avoided. Such a mixture will have to be regulated as a hazardous waste, which increases the cost and responsibility associated with the waste.

. Resource Conservation and Recovery Act (RCRA)-regulated hazardous wastes shall not be discharged to the sewage system.

. RCRA-regulated hazardous waste shall be disposed of in a RCRA-permitted TSDF currently in compliance with all permits.

. Spills or leaks of hazardous waste should be avoided. Through a preventive maintenance program and inspections, a facility can minimize spills and leaks, and thereby the amount of wastes generated. (Spill cleanup materials for hazardous wastes are regulated as hazardous wastes.)

. Incineration of combustible laboratory wastes should be considered as the most desirable waste disposal option when practical.

12.0 Employee Exposure

12.1 Purpose

Exposure assessment-The CHO and Laboratory Manager shall review routine operations to assess the potential for release of chemicals and to determine whether that is a need for researcher exposure monitoring. The following items shall be evaluated:

. Chemicals (amount and percentage concentration thereof) in use

. Toxicity of substances used (TLVs, PELs)

. Physical properties of the chemical(s) in use (I.e., physical state, vapor pressure, etc.)

. Likelihood of release of toxic materials as a result of reaction or handling

. Engineering controls in place or protective equipment available for use

. Previous experience and accidents involving the operation

. Air monitoring data for the operation

. Complaints, odors, or symptoms of exposure reported by researchers performing the operation or at locations nearby

. Any reason to believe that the action level has been exceeded

. Availability of additional engineering controls or PPE

Based on this qualitative exposure assessment environmental monitoring may be conducted for selected chemicals.

12.2 Criteria of "Reasonable" Suspicion of Exposure

The following are examples of some events or circumstances that may be reasonably considered as evidence that exposure to toxic substances may have occurred:

. Researcher has skin or eye contact with a chemical substance

. Odor is noticed

. Health symptoms attributable to the chemical in use are manifested (e.g., headache, rash, nausea, coughing, tearing, irritation or redness of eyes, irritation of nose or throat, dizziness or loss of motor dexterity or judgment that resembles drunkenness

. Some or all symptoms disappear when person is taken away from the chemical and into fresh air

. Symptoms previously experienced recur soon after person resumes working with the chemical

. Complaints are received from more that one person in the same work area

12.3 Initial Researcher Exposure Monitoring

Researcher exposure to hazardous chemicals will be monitored if there is reason to believe that exposure levels exceed the action level (or in the absence of an action level, the PEL). Sampling and analytical methods such as those published by the National Institute for Occupational Safety and Health (NIOSH) and Cal/OSHA should be used to assess researcher exposure. The exposure monitoring data will be reviewed by the CHO or a qualified health and safety representative to determine if exposures may exceed the action level.

12.4 Periodic Researcher Exposure Monitoring

If the initial monitoring indicates that researcher exposures exceed the action level (or in the absence of the action level, the PEL), the Laboratory Manager shall make arrangements for a complete evaluation of the task by a qualified Hygienist. The evaluation should consider the need for additional engineering controls, work practice modifications, or administrative controls to reduce the exposure. Operations that result in exposures above the PELs shall be suspended until adequate controls can be implemented. Monitoring shall be repeated to document the effectiveness of the changes in reducing exposures below the action level. Those Cal/OSHA regulated chemicals that have specific monitoring requirements will be addressed on an individual basis as required.

12.5 Researcher Notification of Monitoring Results

Researchers will be notifies of any monitoring results in writing (either individually or by posting results in a prominent location that is accessible to researchers) within 15 days following receipt of the monitoring results.

12.6 Protocol to Evaluate Suspected Exposure Incidents

When a complaint regarding possible hazardous chemical exposure is received, it shall be documented in a short memo that also includes the appropriate action to be taken. If no further evaluation of the event is deemed necessary, the reason for this decision should be clearly stated in the memo. If it is decided that the complaint should be investigated, a formal evaluation will be undertaken. The evaluation should be conducted by a responsible group of persons (i.e., the Laboratory Manager, the CHO, and others) with the assistance of a qualified health and safety professional or hygienist. The investigation may include the following:

. Interviewing the complainant and/or potentially exposed person, if they are not one in the same

. Listing essential information about the circumstances of the complaint, including:

- Chemical in use at the time of the incident
- Chemicals being used by others in the immediate area
- Chemicals stored in that area

- Symptoms of exposure
- How symptoms compare with information in the MSDSs for those chemicals in the area
- Status of control measures, such as fume hoods and PPE
- Availability of air sampling data for similar work operation

. Evaluation of engineering controls and work practices in use when the exposure occurred

NOTE: the use or failure to use PPE, control measures, and Standard Operating or Safety Procedures might contribute to the cause of over exposure. THE PURPOSE OF THE EXPOSURE EVALUATION IS TO DETERMINE IF AN EXPOSURE SIGNIFICANT IN TERMS OF EMPLOYEE HELATH AND SAFETY HAS TAKEN PLACE – NOT TO ASSIGN FAULT.

A report shall be prepared that documents the circumstances contributing to the over exposure and recommends action to prevent a recurrence. This report shall be reviewed by the CHO and an occupational physician.

13.0 Medical Surveillance Program

13.1 Purpose

The purpose of the medical surveillance program is to provide the following:

. Initial determination of researcher's physical ability to perform the assigned task through the medical examination

. On-going surveillance through periodic update physical examinations

. Research-related illness and injury: treatment, follow-up visits, return to research and restrictions.

. Exit physical examinations

13.2 Scope of Medical Surveillance Program

Medical surveillance shall be performed for all researchers who may handle hazardous chemicals as part of their assignment. The surveillance shall be performed before any laboratory scale work begins.

13.3 Performance of Consultation/Examinations

All medical examination and consultation will be performed by or under the direct supervision of a licensed physician without cost to the researcher and at a reasonable time and place.

Additional medical examinations shall be performed under the following circumstances:

. Whenever a researcher develops signs or symptoms associated with a hazardous chemical to which he or she may have been exposed, the researcher shall be given the opportunity to receive an appropriate medical examination

. When exposure monitoring reveals an exposure level routinely above the action level (or in the absence of an action level, the PEL) for an Cal/OSHA regulated substance for which there are exposure monitoring and medical surveillance requirements, medical surveillance shall be established for the affected researcher as prescribed by the particular standard.

. Whenever an event occurs in the laboratory, such as a spill, leak, explosion or other occurrence resulting in the likelihood of a hazardous exposure, the affected researcher shall be given the opportunity for a medical consultation to determine if a medical examination is needed.

In the event of exposure, the following information shall be provided to the physician:

. Identity of the hazardous chemical(s) in the researcher's work area

. Description of the conditions under which the exposure occurred, including quantitative exposure data, if available; and

. A description of signs and symptoms of exposure that the researcher is experiencing, if any
. A copy of the MSDS for the chemical(s) involved

The physician shall provide a written opinion on specific finding related to exposure including:

. Any recommendation for further medical follow-up

. The results of the medical examination and any associated tests

. Any medical; condition that may be revealed in the course of the examination that could place the researcher at increased risk as a result of exposure to hazardous chemicals; and

. A statement that the researcher has 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.

13.4 Monitoring and Medical Records

An integral part of the medical program is the maintenance of researcher exposure monitoring and medical records. This procedure will be used for these data.

13.5 First Aid

First Aid is the immediate care of a person who has been injured or has suddenly taken ill. It is intended to prevent death or further illness and injury and to relieve pain until medical aid can be obtained. The objectives of first aid are to:

- Control condition that might endanger life;
- Prevent further injury;
- Relieve pain, prevent contamination, and treat for shock; and
- Make the patient as comfortable as possible.

The Laboratory Manager will ensure that the following first aid provisions are met:

. Quick response to aid the victim involved in an accident or spill can help minimize the damage that results. The following guidelines are useful when chemicals are splashed on a researcher:

- Eye contact: Immediately flush eyes with water for at least 15 minutes. Seek medical attention.
-
- Ingestion: Encourage the individual to drink large amounts of water. Seek medical attention.

- Skin contact: Immediately begin flushing the affected area with water while removing contaminated clothing. Continue flushing for 15 minutes and use the safety shower when skin contact is extensive. Seek medical attention, taking the MSDS (if possible) to the clinic, doctor or hospital.

- Cleanup: Immediately determine the chemicals involved and use appropriate PPE, clean up the spill, and properly dispose of the materials. If clean up is unsafe or impractical, contain the spill and notify the emergency coordinator.

. First aid kits are provided and are readily available if an accident occurs.

14.0 Hazard Communication Program

14.1 **Overview of Program**

UCI-INRF has developed a Hazard communication Program which fully complies with Cal/OSHA's Hazard Communication Standard, 8 CCR 5194. The major elements are as follows:

. Inventory and location of chemicals currently is use

. Approval for the use of new chemicals

. Labeling primary and secondary storage containers with information about the consequences of overexposure

. Collection and maintenance of current MSDSs for all chemicals in the laboratory inventory

. Training for all laboratory researchers concerning the nature and scope of the Hazard Communication Standard and elements of the UCI-INRF Hazard Communication Program

14.2 **Chemical Handling**

The chemical inventory shall be updated at least annually to reflect each chemical substance and the quantity on hand. The Laboratory Manager shall maintain the updated inventory.

Labels shall be retained on all chemicals in use, and they must include , at a minimum, the following information:

- Identity of the hazardous chemical
- Specific information concerning potential health and safety hazards
- Name and address of the chemical company

14.3 Chemical Information and Training

The MSDSs are readily available to the laboratory researchers as copies are located in the laboratory access area. The Laboratory Manager is responsible for maintaining the MSDS files.

A training program shall be presented to all laboratory personnel that provides the following:

. Procedures for determining the use of the MSDS for potential health, fire, or reactivity hazards that are likely to be encountered in the handling, application, or use of a chemical.

. The CHO or his/her designee shall train researchers in the safe use of a new chemical before the chemical is released for use in a laboratory.

. Training on methods and observations that may be used to detect the presence or release of a hazardous chemical in the work area (such as personal monitoring, visual appearance, odor, etc.).

14.4 New Chemicals

The Laboratory Manager or his/her designee and the CHO shall review and approve the procurement of new chemicals. The following procedures will be adhered to:

. Hazardous chemicals new to the laboratory will be reviewed by the CHO, and the Health and Safety coordinator, BEFORE placing orders. Before placement of the initial order, use of substitutes (chemicals already in inventory) will be considered while review of the new MSDSs, methodology, instrumentation, PPE, and training continues.

. The CHO or his./her designee shall train researchers in the safe use of a new chemical before the chemical is released for use in the laboratory.

. New hazardous chemical orders (second order) will not be placed until the CHO has reviewed and approved the continued use of the new chemical. The chemical inventory must be updated as new chemicals are approved for use.

. No new chemicals shall be obtained unless a Chemical Inventory Request (CIR) is submitted to and approved by the Occupational Health and Safety Office.

. Free samples and trial materials shall NOT be released until the materials have satisfied the requirements of the CHP and the MSDS have been reviewed and approved by the CHO.

15.0 Contingency Procedures

15.1 Emergency Preparedness Plan

Procedures which describe actions laboratory personnel must take in the event of an emergency are addressed in the UCI-INRF Emergency Preparedness Plan. This plan provides specific information and procedures for dealing with hazardous materials incidents, as well as, floods, major fires, bomb threats, civil disorder, terrorist threats/activities and aircraft crashes.

15.2 Toxic Gas Emergency Response Plan

a specific Emergency Response Plan addressing releases of highly toxic clean room gases is provided in a separate document. The Plan includes detailed information of the following:

. Building evacuation procedures and routes

. Location of specific emergency/safety equipment including fire extinguishes, eye wash fountains, safety showers, emergency exit signs and lights, fire alarm pull boxes, spill cleanup nets, and emergency air packs (SCBA's)

. Safety equipment operating procedures

. Actions to take in the event of personal injury associated with chemical exposure (i.e., chemical burns, inhalation)

. Mechanism for reporting accidents/emergencies

. Telephone numbers of designated facility emergency coordinators, police and fire departments and hospitals

For purposes of the CHP, the laboratory Emergency contingency Plan must be adhered to in its entirety, and should be reviewed on an annual basis.

16.0 Record Keeping

Records of exposure monitoring and any medical consultations and evaluations, including tests or written opinions shall be maintained, transferred, and made available to employees.

16.0 Audit Program

17.1 Purpose

An audit program ascertains whether the procedures, work practices and equipment set forth in this CHP are being properly implemented and utilized to ensure the safety and health of all researchers who work with hazardous chemicals.

17.2 Inspections

The CHO will conduct monthly inspections of the laboratories and other work areas defined in Section 2.2 of this CHP to document any deficiencies relative to the various elements of this CHP. Compliance with waste handling and record

keeping requirements shall also be evaluated. Deficiencies noted during the inspection will be corrected as soon as possible (or immediately if the deficiency is an imminent hazard).