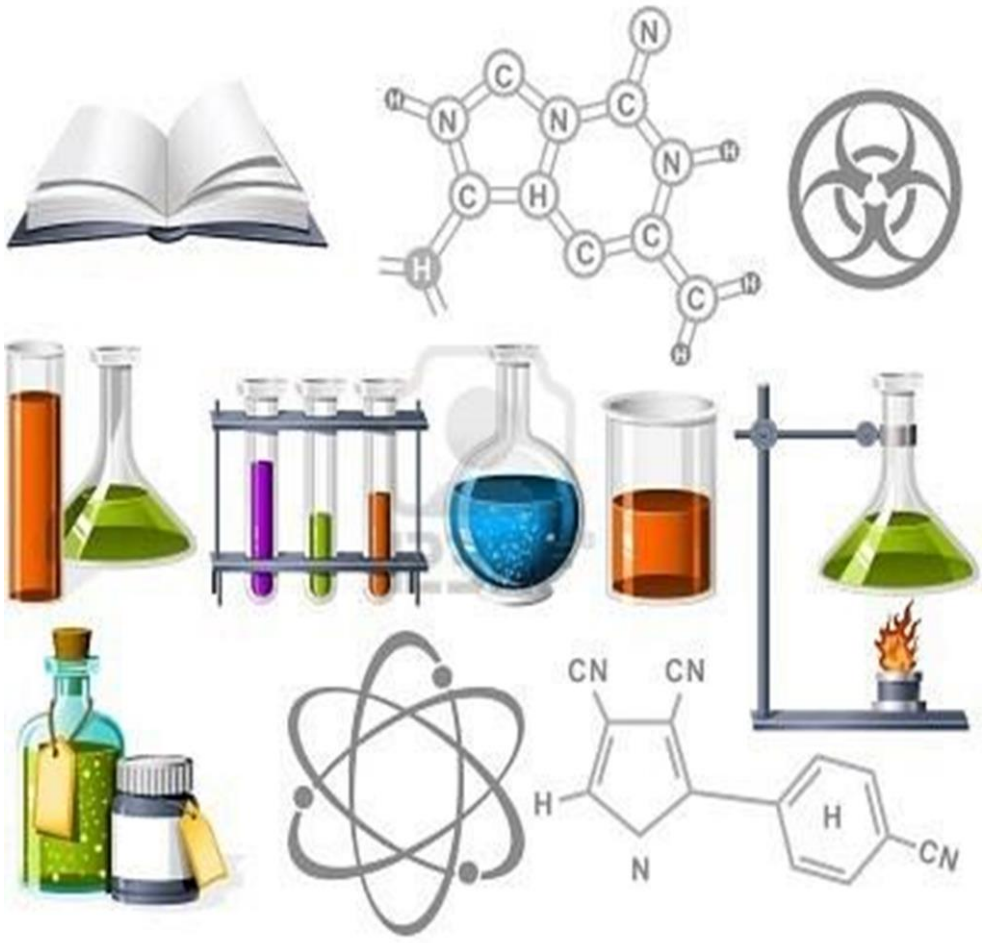
Longwood University

Environmental, Health and Safety Office

Chemical Hygiene Plan



EHS&EM Office
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1.0 INTRODUCTION

1.1 OSHA Standard 29CFR1910.1450, Occupational Exposure to Hazardous Chemicals in Laboratories.

OSHA's Laboratory Standard covers all personnel engaged in the "laboratory use of hazardous chemicals". Laboratory use of hazardous chemicals means the handling or use of 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, nor in any way simulate a production process. Quality control laboratories that are positioned inside industrial settings are excluded from this standard. These laboratories must comply with the appropriate OSHA general industry standard.
- Protective laboratory practices and equipment are available to minimize the potential for employee exposure to hazardous chemicals.

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A hazardous chemical is defined as a chemical for which there is statistically significant evidence, based on at least one study conducted in accordance with established scientific principles, that acute or chronic health effects may occur in employees who are exposed to the chemical. They include carcinogens, toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, neurotoxins as well as agents that may cause damage to the blood, lungs, skin, eyes or mucous membranes.

1.2 Longwood Chemical Hygiene Plan

The purpose of this Chemical Hygiene Plan (CHP) is to define work practices and procedures to help assure that laboratory faculty and students at the Longwood University laboratory facilities are protected from the safety and health hazards associated with the chemicals with which they work. The CHP is part of the University's compliance with the 29 CFR 1910.1400 OSHA Laboratory Standard. For simplicity, this standard will be referred to as the Lab Standard in this document.

The CHP addresses safety and health-related practices and policies common to all laboratories. Since few laboratory chemicals are without hazards, general precautions for handling all chemicals are presented here, rather than specific guidelines for particular chemicals. Individual laboratories shall develop their own specific laboratory methods to augment this CHP when additional safety and health requirements are necessary.

2.0 RESPONSIBILITIES

2.1 Laboratory Management or Principal Investigator

Longwood faculty has the ultimate responsibility for laboratory safety and must provide the resources and continuing support for chemical hygiene.

2.2 Chemical Hygiene Officer

The Laboratory Director shall serve as the Chemical Hygiene Officer (CHO). The duties of the CHO include:

- Review and evaluate the effectiveness of the CHP at least annually and update it as necessary to assure that workers are protected from the hazards associated with the chemicals used in the laboratory.
- Provide technical assistance on the safe handling, use, storage and disposal of hazardous chemicals.
- Work with faculty, staff and students to develop and implement appropriate chemical hygiene policies and practices.
- Monitor the procurement, use and disposal of chemicals used in the laboratories.
- Assure that appropriate audits are conducted and corrective actions are completed.
- Know the current legal requirements concerning regulated substances.
- Approve the safety procedures for the use of new chemicals.
- Assure the records required by the Laboratory Standard are maintained.
- Seek ways to improve the CHP.
- Assure the faculty and staff complies with the CHP.
- Determine the required level of protective apparel and equipment.
- Assess the effectiveness of the CHP and laboratory safety in general on an annual basis.
- Remain cognizant of the chemicals used in the facility and their associated hazards.

2.3 Laboratory Professors

The laboratory PI (responsible faculty member) has the overall responsibility for chemical hygiene in the laboratory. Their responsibility includes:

- Assure all who work in the laboratories are trained on the CHP.
- Assure compliance and enforcement of the CHP.
- Assure that the necessary protective equipment is available and in working order and that appropriate training has been provided.
- Conduct routine, formal chemical hygiene and housekeeping inspections, including routine inspections of emergency equipment.
- Assure a hazard assessment has been conducted prior to any new materials being introduced into the laboratory.
- Remain cognizant of the chemicals stored and used in the lab and their associated hazards.

- Assure that the labels on the incoming containers of chemicals are not removed or defaced.
- Approve the acquisition and use of chemicals within the lab.
- Assure that emergency contact information is posted on every door to the laboratory.
- Request assistance from the CHO as needed.

2.4 EHS&EM Department

The duties of the EHS&EM include:

- Evaluate and monitor the use of chemicals covered by an OSHA Permissible Exposure Limit (PEL) and assure that appropriate exposure levels are not exceeded.
- Assist the CHO with the maintenance and updating of the CHP.
- Assess the effectiveness of the CHP and laboratory safety in general on an annual basis.

3.0 Laboratory Facilities

3.1 General Ventilation

All laboratory facilities shall be provided with general ventilation systems that direct airflow into the laboratory from non-laboratory areas and exhaust to the exterior of the building. Air intakes and exhausts shall be located so as to avoid the intake of contaminated air and shall assure that the laboratory air is continually replaced, preventing the increase of air concentrations of toxic substances during the workday. General airflow should not be turbulent and should be relatively uniform throughout the lab with no high velocity or static areas. Eight to twelve room air changes per hour is normally adequate general ventilation if local exhaust systems such as hoods are used as the primary method of control.

3.2 Laboratory Hoods

A laboratory hood with 2.5 linear feet of hood space per person shall be provided for those working with chemicals. The personnel working with chemicals shall verify that the hood is functioning properly before each use. In addition, all hoods shall be inspected four times per year and the results posted on the hood and reported in writing to the CHO and EHS&EM Office. Hood flow rates are to be measured and recorded on an inspection tag attached to the individual hood. Hoods not meeting the minimum performance rating of **80 linear feet per minute with the sash open 18 inches (or open to the indicator latch)** are to be marked with a red magnetic **"Out of Service"** sign until such time that they are functioning properly.

Proper procedures for using a laboratory hood are covered in Section 4.6.

3.3 Eyewashes

Each laboratory shall be equipped with eyewash capable of providing a gentle stream or spray of aerated water for at least 15 minutes. The minimum flow rate shall be 1.5 liters per minute. The

eyewash shall be located as close to the safety shower as possible, so that the eyes may be rinsed while the body is being showered. Eyewashes shall be accessible from any point in the lab within 10 seconds and be no more than 100 feet from the hazard. For strong acids or caustics, eyewash fountains shall be adjacent to or within 10 feet of the hazard. The proper location of eyewashes is specified in the ANSI Z358.1 Standard. All eyewashes shall be inspected monthly and the results recorded on a tag attached to the eyewash.

3.4 Safety Showers

Each chemical laboratory shall be equipped with a safety shower for the immediate first-aid treatment of personnel contaminated with hazardous chemicals and for extinguishing clothing fires. Each shower shall be equipped with a quick-opening valve that can remain open without being held and requires manual closing. Safety showers shall be capable of delivering 30 gallons per minute for at least 15 minutes. Safety showers shall be accessible from any point in the lab within 10 seconds and be no more than 100 feet from the hazard. The proper location for safety showers is specified in the ANSI Z358.2 Standard. Scissors shall be located at each shower. These may be used to cut off contaminated clothing. Safety showers shall be inspected monthly and the results recorded on a tag attached to the shower.

3.5 Laboratory Sinks

A laboratory sink is essential for safety in the laboratory. Employees must wash their hands with soap and water after removal of gloves, before leaving the laboratory, or when skin comes in contact with chemicals. The sink is also used for washing equipment that comes in contact with chemicals. Sinks may only be used for aqueous, non-hazardous materials and be kept clean and free of debris. Sink drains must have a screen or appropriate cover to prevent solid material from entering the drain.

4.0 Standard Operating Procedures (SOPs) for Laboratory Chemicals

4.1 General Safety Procedures

All laboratory personnel should adhere to the following general safety procedures:

- Know the safety policies and procedures that are applicable to the task at hand.
- Determine the potential physical and chemical hazards and appropriate safety precautions before beginning any new or modified procedure.
- Know the location of all emergency equipment in the laboratory and the proper procedures for use.
- Be familiar with all laboratory emergency procedures such as spill clean-up, accident reporting and evacuation routes.
- Be alert to unsafe conditions and actions and alert the CHO or laboratory supervisor.
- Report unusual odors as soon as they are detected.
- Avoid exposure to chemicals by using laboratory hoods, following the correct procedures and using the proper personal protective equipment.
- Do not smell or taste chemicals.
- Mouth pipetting is forbidden. Use suction bulbs or other pipetting devices.

- Follow acceptable waste disposal practices.
- Assure that all chemicals are correctly labeled.
- Post warnings when unusual hazards exist.
- Use equipment for its originally designed purpose only.
- Do not use damaged glassware. Order coated glassware whenever possible.
- Know how and where to properly store chemicals.
- Keep all chemicals in closed, clean containers.
- Use an approved chemical fume hood when pouring, mixing, heating or handling any chemicals.
- Horseplay of any kind is strictly forbidden in the laboratory. Avoid practical jokes or other behavior that may confuse, startle or distract another worker.
- Always close chemical containers after pouring out the required quantity for a procedure. Do not allow chemicals to evaporate into the general room air.
- Do not use any chemical from a container when the contents are in doubt due to missing or damaged labels.
- Purchase the minimum amount of chemicals necessary to accomplish your work. Dispense only the minimum amount necessary for immediate use.
- Vent apparatus that may discharge toxic chemicals. This includes vacuum pumps and distillation columns.
- Inspect gloves and other protective equipment prior to use.
- Avoid direct contact with any chemical.

4.2 Eating, Drinking and Smoking

- Eating, drinking, applying cosmetics and personal smoking is not permitted in any laboratory.
- Wash hands thoroughly before eating, drinking or smoking.
- Do not store food or beverages in the same refrigerator with chemicals.
- Refrigerators used to store food must have signs posted on them indicating “Food Storage Only”.
- Never use glassware or utensils that have been used in the laboratory to prepare or consume food or beverages.

4.3 Housekeeping

Safety performance, chemical exposure and good housekeeping practices in the laboratory are directly related to each other. The workplace should be kept clean and orderly and chemicals and equipment should be stored in the appropriate areas when not in use. The following housekeeping practices should be adhered to:

- Work areas should be kept clean and free of obstructions. Clean up should follow the completion of any operation and/or at the end of each workday. Clean up spills immediately.
- Access to emergency equipment such as showers, eyewashes and exits should never be blocked, even temporarily.
- Equipment and chemicals should be stored properly.

4.4 Inspections

Laboratory personnel shall conduct formal housekeeping and chemical hygiene inspections on a monthly basis. The results are to be recorded, signed by the laboratory manager and submitted to the CHO. Work orders should be submitted to correct any issues identified.

4.5 Labeling of Containers

- No container shall be accepted without an adequate identifying label. Manufacturers, importers and distributors are required to label chemical containers with their name and address, the identity of the chemical and appropriate hazard warnings.
- Labels on incoming containers shall not be destroyed, removed or defaced unless immediately replaced with another label containing the required information.
- Chemicals dispensed by employees into secondary or transfer containers (such as safety cans and spray bottles) for use within Longwood University facilities, shall be labeled with the identity of the chemical. This does not apply to chemicals transferred for immediate use by the employee filling the container.
- Immediate use is defined as the time during the employee's work shift for a given day.
- Piping systems used for chemical, gas, air, water, vacuum or steam transport within the laboratory shall be labeled with their content and direction of flow. See Appendix M for the proper color coding of piping systems.

4.6 Laboratory Hood Procedures

The following general guidelines shall be observed for safe and effective use of all laboratory hoods:

- Verify the hood has been maintained and inspected according to the procedures in Section 3.2. Never use an inoperable laboratory hood or one that has been red-tagged.
- No storage of chemicals in the hood is allowed. Do not allow stored chemicals to block vents or airflow.
- Fume hoods should be used for one of two purposes, either procedural use or storage, but not both.
- When the hood is being used, keep the sash as low as possible to increase the inward velocity of the air.
- Do not place your face inside the hood. Keep the sash low enough that it will protect your face in the event of an explosion or splash.
- The apparatus inside the hood should be placed on the floor of the hood at least six inches away from the front edge.
- Place plastic trays under chemicals stored in a hood.
- Personnel should be aware of the procedures to follow in the event of a power failure or other hood failure.

4.7 Laboratory Method Transfer or Scale-up

When a laboratory method is being transferred from one group to another or the method is scaled up from bench top, a "Method Transfer Request Form" (Appendix F) must be completed. This will assure that the receiving party is prepared for a safe transfer.

4.8 Material Safety Data Sheets

The Material Safety Data Sheet (MSDS) is a format for describing a chemical or product, its potential hazards, ways to minimize the hazards, first-aid and emergency procedures and the recommended exposure limits. It is the responsibility of the lab manager to ensure all chemicals have a MSDS on file at the laboratory. Their responsibility includes assuring every chemical used in the laboratory is included in our chemical inventory and that we have the proper MSDSs. The chemical inventory is maintained in our CISPro Global database. The MSDS database is maintained by the CHO and EHS&EM Office.

Any chemical shipped to, mailed to or provided to Longwood University without a MSDS shall be stored in the stockroom and not released for use until a MSDS is available. If a mixture without a known single MSDS is brought onto Longwood property, a copy of the MSDS for each ingredient in the mixture shall be provided.

Each lab shall have access to the MSDS database through Cis-Pro. Contractors shall be provided with copies of the MSDSs upon request.

4.9 Personal Protective Equipment

Foot Protection. No sandals or open-toed shoes are to be worn in the laboratories. Full coverage shoes are appropriate. Where safety shoes are required the employee must be responsible for their purchase.

Safety Glasses. Safety glasses with attached sideshields are required in all laboratories. Safety glasses with sideshields must meet the requirements of ANSI Z87.1.

Contact Lenses. Contact lenses shall not be worn when working with chemicals. The lenses can trap particulates or chemicals against the eye, causing damage. Contact lenses also restrict the ability to irrigate the eye in the event of a splash. If contacts are required for medical reasons, a doctor's request must be submitted to the ESH&EM and safety goggles must be worn in all safety glasses areas.

Faceshields and Goggles. Faceshields and/or goggles are required when the potential for flying objects or chemical splash exists. These must be worn over the safety glasses. The appropriate type of faceshield, safety eyeglasses of goggles may be purchased through the EHS&EM Office.

Laboratory Coats. Laboratory coats shall be worn when working in any laboratory or when working with chemicals. A laboratory coat can provide protection against contact with dirt and minor chemical splashes or spills. It also provides protection for the user's clothing. The lab coat does not however, significantly resist penetration by organic liquids or concentrated acids and bases. If the coat becomes

contaminated, it should be removed immediately and disposed of as hazardous waste. When the lab coat gets dirty, obtain another one from the. Do NOT take it home and launder it. Dispose of it in the trash.

Laboratory coats shall not be worn in the cafeteria, break areas, lecture room or restrooms so chemical contamination is not spread to areas outside of the laboratories. Lab coats must be removed before exiting a laboratory except by those employees traveling from one lab to another in their normal duties and by auditors, inspection teams and visitors who are not involved in laboratory work activities.

Aprons. Rubber aprons can provide better protection from corrosives and irritating liquids. Aprons should be worn over the lab coats when transferring or handling larger containers of chemicals or when there is a significant risk of splashes. Aprons should be cleaned after use to prevent the inadvertent spread of chemical contamination. Aprons are available from the stockroom.

Gloves. When working with corrosive liquids, or with allergenic, sensitizing or toxic chemicals, wear gloves made from a material known to be resistant to permeation by the chemical. Information on permeation resistance can be obtained from the CHO. Inspect gloves for tears, punctures, pinhole leaks or signs of degradation before each use. A wide variety of gloves is available from the stockroom. This includes thermal resistant, chemical resistant and cut resistant gloves.

Respirators. Respiratory protection may be necessary to supplement existing inhalation exposure controls. Respirator users must be trained, fit-tested and receive the proper medical evaluation required by the OSHA Respiratory Protection Standard.

4.10 Storage of Chemicals

The following guidelines shall be followed for storing chemicals:

- Never store chemicals in alphabetical order. Segregate according to hazard class or compatibility, and then place alphabetically. A list of some incompatible chemicals is included in **Appendix A.**
- Return all chemicals to their appropriate storage area at the end of the workday.
- Store chemicals on sturdy shelving that has a raised lip edging or some tip over protection, or in cabinets with doors.
- Never store chemicals in aisles, stairways, under stairways, hallways, on floors, on desk or in front of emergency equipment.
- Do not store chemicals in hoods unless the hood is a designated storage area and is not used for lab procedures. Plastic trays should be placed under the chemicals to contain spills.
- Stored chemicals must be tightly closed and labeled. Exposure to heat or direct sunlight should be avoided.
- Never stack bottles on top of each other.
- Flammable liquids should be stored in approved containers such as safety cans with spring-loaded closures and flame arrester screens.

- All flammable chemicals, when not in use, shall be wiped clean and stored inside a flammable material cabinet.
- Keep flammable material cabinet doors closed at all times.
- Follow the manufacturer's established quantity limits for flammable material storage cabinets. Do not overload the cabinet.
- Flammable or unstable chemicals that should be refrigerated must be stored in an approved explosion-resistant refrigerator that has been labeled as such.
- The amount of each chemical stored in a laboratory should be kept as low as possible.
- Stored chemicals should be examined periodically for deterioration, shelf life and container integrity.

4.11 Unattended Experiments.

No dangerous experiment will be run unattended unless it is fail-safe. A dangerous experiment is one that will impose an immediate threat to life, if there is a loss of water pressure, electricity or hood operation. Those experiments that cannot be safely isolated shall not be performed unattended unless a suitable alarm/monitor is present and functioning. For all unattended operations, leave the lights on, place an appropriate sign on the door and provide for the containment of toxic substances in the event of a failure of the utility services. Appendix N contains the "Unattended Experiment" notification form.

4.12 Warning Signs

Laboratory areas that have special or unusual hazards shall be posted with warning signs such as radiological hazard, compressed gases, lasers, fire hazards, toxic chemicals etc. Emergency contact information shall be posted on the door to every laboratory.

4.13 Working After Hours / Working Alone

There may be occasions when it is necessary to work alone with chemicals or after normal working hours. Normal working hours are considered to be 8:00 AM to 5:00 PM. In the event that this is necessary, complete the form that is in Appendix O of this document. As always, sign in with Security prior to reporting to your work location and post the approval on the door leading to the work location.

It is essential that laboratory personnel do not work alone under the following circumstances:

- Working with particularly hazardous substances.
- A risk assessment indicates risk factors for potential exposures that cannot be eliminated.
- Work instructions covering the specific safety precautions for the task to be conducted are not available.

5.0 SPECIAL CHEMICAL PRECAUTIONS

5.1 Compressed Gases

Many laboratory operations require the use of compressed gases for analytical or instrument operations. Compressed gases present a unique hazard. Gases may be combustible, explosive, corrosive, poisonous, inert or a combination of hazards. If the gas is flammable, flash points lower than room temperature compounded by high rates of diffusion present a danger of fire or explosion. Additional hazards of reactivity and toxicity of the gas, as well as asphyxiation, can be caused by high concentrations of even "harmless" gases such as nitrogen.

Storage Area. Large quantities of cylinders should be stored in an approved gas cylinder storage area. Cylinders must be stored in a well ventilated area with their protective cap screwed on and the cylinder secured (strapped or chained). Separate flammables and oxidizers. Full and empty cylinders shall be stored separately.

Laboratory Use. NFPA 45 "Fire Protection for Laboratories Using Chemicals" specifies the number of cylinders of flammable gases, oxidizing gases, liquefied flammable gases and gases with a health hazard rating of 3 or 4 that may be in use in a laboratory. This information may be obtained from the CHO. Cylinders in the laboratory shall be safely secured with a strap or chain to prevent tipping. Cylinders may be attached to a bench top, individually to a wall, placed in a holding cage or have a non-tip base attached. The contents of the cylinder shall be clearly identified for easy, quick and complete determination by any lab worker. All gas lines leading from a compressed gas supply shall be clearly labeled to identify the gas. A complete list of compressed gases in use in a laboratory shall be placed on the lab entrance door. Some general safety precautions are as follows:

- Keep protective plugs and caps in place on cylinders at all times when they are not plumbed for use.
- Do not expose cylinders to temperatures higher than 50 degrees C. Some rupture devices on cylinders will release at about 65 degrees C. Some small cylinders, such as lecture bottles, are not fitted with rupture devices and may explode if exposed to high temperatures.
- Never lubricate, modify, force or tamper with cylinder valves.
- Never direct high-pressure gases at anyone, serious injury could result.
- Be aware that the rapid release of a compressed gas will cause an unsecured cylinder gas hose to whip dangerously and may also build up a static charge that could ignite a combustible gas.
- Do not put oil or grease on the high-pressure side of an oxygen, chlorine or other oxidizing agent cylinder. An explosion could result.
- Never bleed cylinders completely empty. Leave a slight pressure to keep contaminants out.
- Always use safety glasses when handling and using compressed gases.

Transport of Cylinders. Use approved handcarts to move cylinders. Cylinders must be secured to the cart during transport, with the protective cap in place.

5.2 Corrosives

A corrosive is a chemical that attacks human tissue and causes irritation, chemical burns and in severe cases, tissue destruction. In case of skin or eye contact with corrosives, promptly flush the area with water for at least 15 minutes. Some examples of corrosives are:

Acids. Inorganic or mineral acids such as sulfuric, nitric, hydrochloric, phosphoric and hydrofluoric are strong corrosives. Organic acids with a carboxyl group are generally less corrosive than the inorganic acids. Examples of organic acids are acetic, benzoic, citric and oxalic. A list of some inorganic acids and their synonyms is included in Appendix B.

Bases. Bases are also strong corrosives. Some common bases include ammonium hydroxide, calcium hydroxide, potassium hydroxide, sodium carbonate and sodium hydroxide. Contact with bases causes a "slippery" or "soapy" feeling. The eye is especially susceptible to bases, or alkalis, and splash goggles or a faceshield is required whenever there is a possibility of eye contact. A list of some inorganic bases and their synonyms is included in Appendix C.

Halogens. The elemental halogens are all extremely corrosive, especially to the respiratory system. They include bromine, chlorine, fluorine and iodine.

Organic Compounds. Organic compounds may be as corrosive as the inorganic acids and bases. Many organics can be absorbed through the intact skin and produce toxic effects. Examples are phenols, amines and some unsaturated ketones.

5.3 Cryogenic Liquids

Cryogenic liquids are liquefied gases having boiling points of less than -73.3 degrees Centigrade (-100 degrees F). The primary hazards of cryogenic liquids are physical hazards such as fire, explosion and pressure buildup and health hazards such as severe frostbite and asphyxiation. Potential fire or explosion hazards exist because cryogenic liquids are capable, under the right conditions, of condensing oxygen from the atmosphere. This oxygen-rich environment in combination with flammable/combustible materials, and an ignition source are particularly hazardous. Pressure is also a hazard because of the large volume expansion ratio from liquid to gas that a cryogen exhibits as it warms and the liquid evaporates. This expansion ratio also makes cryogenic liquids more prone to splash and therefore skin and eye contact is more likely to occur. Contact with living tissue can cause frostbite or thermal burns. Prolonged contact can cause blood clots. All laboratory personnel shall follow the following prudent safety practices when handling, moving and storing cryogenic liquids:

- Ensure containers are properly labeled. Do not remove or destroy identification tags or labels.
- Push wheeled containers. Move other containers with a suitable hand truck.
- When transporting containers on an elevator, do not allow passengers on the elevator. Use freight elevators only.
- Store containers in the upright position in a well ventilated secure location. Do not use or store in a confined space or areas where an oxygen deficient or hazardous atmosphere could develop.
- Do not expose a liquefied gas container to elevated temperature.
- Do not alter, obstruct, defeat or tamper with relief valves, rupture discs or fittings.
- Vent relief valves away from walkways or work areas.

- Keep equipment clean and free of contaminating materials.
- Transfer cryogens slowly to prevent thermal shock or excessive pressure buildup.
- Prevent ice buildup and check areas where ice could plug the system, such as cold traps.
- Avoid eye or skin contact with all cryogenic materials. Wear safety glasses and sideshields or goggles and a face shield, an impervious lab coat or apron and insulated gloves.
- Handle objects in contact with cryogenic gases or liquids with tongs or insulated gloves.
- Understand the hazards of working with cryogenic liquids, their containers and the systems you will be using. Read the MSDS prior to starting work.
- Transfers or pouring of cryogenic liquid shall be done very slowly to minimize the potential for boiling or splashing.

5.4 Explosive and Shock-Sensitive Compounds

Shock-sensitive and/or explosive compounds are an obvious safety problem, even for laboratory scale quantities. The first step in safe operations with such substances is recognition of the potential for damage and personal injury. Some examples of these compounds are lead azides, perchloric acid and its salts, picric acid and its salts and benzoyl peroxide. A key to safe operations with explosive or shock-sensitive substances is to use very small quantities at any one time or place and if possible, avoid their use altogether. A more complete list of potential shock-sensitive chemicals is included in **Appendix D**.

5.5 Hydrofluoric Acid

Hydrofluoric acid is one of the strongest and most corrosive acids known. Hydrofluoric acid solutions are clear and colorless with a density similar to that of water. It is highly corrosive and can readily destroy tissue by penetrating human skin, destroying soft tissue and decalcifying bone. Not only is it a contact hazard to the skin but also exposure to the eyes can result in blindness or permanent eye damage.

Always review the Material Safety Data Sheet for the appropriate personal protective equipment to wear but as a minimum wear chemical resistant goggles, face shield, neoprene or nitrile gloves and a rubber apron when handling this chemical. Work in a chemical fume hood with the required personal protective equipment to avoid chemical contact or exposure to vapors.

The CHO and the EHS&EM Office shall be notified prior to ordering these types of chemicals.

5.6 Incompatible Materials

Some materials can react violently and/or liberate toxic gases when mixed together. Groups of material that do so are referred to as incompatible. The classic examples of materials that are incompatible are cyanides or sulfides and acid. Mixture of the two generates hydrogen cyanide or hydrogen sulfide, respectively. Both are very deadly gases. Laboratory personnel should be aware of groups of material in their lab that could be incompatible. These materials should be physically isolated from their incompatible counterparts. Emergency procedures must also be in place to guide

the laboratory personnel in the event that materials are inadvertently mixed together. A partial list of incompatible materials is given in **Appendix A.**

5.7 Oxidizers

Oxidizers are compounds (solid, liquid, gas) that evolve oxygen or are electron acceptors either at room temperature or upon slight heating. This group includes peroxides, chlorates, perchlorates, nitrates, permanganates and the elemental halogens. Oxidizers can react vigorously at ambient temperatures when they contact organic material or reducing substances.

5.8 Oxygen and Moisture Sensitive Compounds

Many chemical compounds deteriorate when exposed to air. For most of these, oxidation only causes a decrease in purity. For a few others, extreme reactivity with oxygen can lead to other effects. Another group of compounds reacts with atmospheric moisture and causes the release of toxic or flammable gases or vapors or the generation of enough heat to cause fires and explosions. Some examples are as follows:

- Aluminum alkyls react with moisture to generate extremely flammable hydrocarbon vapor.
- Dichlorosilane forms silicon dioxide and hydrogen chloride on contact with air. This will detonate spontaneously under the right conditions.
- Phosphides react with moisture to form highly toxic phosphine.
- Selenides react with moisture to cause the release of highly toxic hydrogen selenide.
- Sodium reacts with moisture to release hydrogen. The heat generated may cause a fire.

5.9 Perchloric Acid

ATTENTION! MUST HAVE A PERCHLORIC ACID HOOD TO WORK WITH THIS SUBSTANCE.

Perchloric acid is a strong acid used for complete digestions of organic material. It is normally supplied in bottles up to one gallon in capacity at 70-72% strength. In many respects, its hazards are similar to those of nitric acid, as both are strong oxidants. Perchloric acid presents an additional hazard in that perchloric acid mist and vapor can condense in ventilation systems to form metallic perchlorates, which can be explosive. It is a highly corrosive substance and causes severe burns on contact with the eyes, skin and mucous membranes. Always use impact-resistant chemical goggles, a face shield, neoprene glove and a rubber apron when handling perchloric acid. The quantities of perchloric acid stored should be kept to a minimum, and stored in its original container.

Depending on concentrations, perchloric acid should only be used in a specially designed fume hood. Any questions about this should be referred to the EHS&EM Office for review prior to ordering and using this chemical.

5.10 Peroxide Forming Compounds

Some organic compounds are unusually susceptible to atmospheric oxidation. Peroxidizable substances slowly react under ambient conditions with atmospheric oxygen to form peroxides that may create an explosion hazard. They require special storage and handling procedures to minimize the formation of peroxides. Once formed, peroxides are thermally unstable and may also be shock-sensitive. The types of compounds that is most apt to form peroxides are aldehydes and ketones, ethers, allylic or benzylic structures and vinyl and vinylidine compounds. Peroxide forming compounds must be dated upon receipt. Inhibited ethers can be stored for a maximum of one year. Uninhibited ethers may only be stored for six months. After these dates, peroxide formation may increase, thereby increasing the instability of the material. Disposal of dated peroxide-forming materials is quite difficult and must be accomplished by specially trained and outfitted personnel. Ethers have the greatest ability to form peroxides, but the other classes of compounds should also be routinely evaluated by need and age for proper disposal. A list of potential peroxide forming compounds is included in **Appendix E.**

5.11 Pyrophoric Compounds

Pyrophoric chemicals are those substances that react so rapidly with air and its moisture that the ensuing oxidation and/or hydrolysis leads to ignition. Ignition may be instantaneous, delayed, or occur only if the material is finely divided or spread in a diffuse layer. Some examples are:

- Finely divided metals such as magnesium and zirconium.
- Metal and non-metal hydrides such as germane and diborane.
- Partially or fully alkylated derivatives of metal or non-metal hydrides such as diethylaluminum hydride and trimethylphosphine.
- Alkylated metal alkoxides or non-metal halides such as diethylethoxyaluminum and dichloromethylsilane.
- Carbonyl metals such as pentacarbonyl iron and octacarbonyl dicobalt.

5.12 Water Reactive Substances

Water sensitive compounds react exothermically and violently with water, particularly if it is present in limited quantities, since no significant cooling effect will occur. The following are examples of water reactive substances:

- Alkali and alkaline earth metals such as potassium and calcium.
- Anhydrous metal halides such as aluminum bromide and germanium chloride.
- Non-metal halides such as boron tribromide and phosphorous pentachloride.
- Anhydrous metal oxides such as calcium oxide and cesium trioxide.
- Non-metal oxides such as sulfur trioxide.
- Non-metal halide oxides such as phosphoryl chloride.

6.0 Other Special Precautions

6.1 Biosafety

A biohazard is an agent of biological origin that has the capacity to produce deleterious effects on humans.

Biosafety Levels (BSL)

BSL1 – agents not known to cause disease.
BSL2 – agents associated with human disease.
BSL3 – indigenous/exotic agents associated with human disease and with the potential for aerosol transmission.
BSL4 – dangerous/exotic agents of life threatening nature.

The Longwood University laboratories are only designed for BSL 1 and BSL 2 work. No BSL 3 or BSL 4 work is allowed at our university. Scientists and technicians working with biological agents shall be trained according to the Biosafety Procedures. All work with biological materials shall be conducted according to the safe work practices found in the Biosafety Plan. **See Appendix**

6.2 Laser Safety

A laser is a device which produces an intense, coherent, directional beam of light by stimulating electronic or molecular transitions to lower energy levels.

There are four classes of lasers:

Class 1 – Low Power – Exempt Lasers and Laser Systems: No special warnings or control measures are required.
Class 2 – Low Power Visible Lasers and Laser Systems: The power output is sufficiently low enough to prevent injury (acute exposures), but may produce retinal injury when stared at for a long period of time.
Class 3A – Medium Power Visible Lasers and Laser Systems: Injury may result when the energy is collected and put into the eye, as with optical components.
Class 3B – Medium Power Lasers and Laser Systems: Biological damage is possible from acute direct or secularly reflective exposure. Special precautions are required as outlined in the PM USA Laser Safety Policy.
Class 4 – High Power Lasers and Laser Systems: Biological damage is possible from acute direct, diffuse or secularly reflective exposure. Special precautions are required as outlined in Longwood University Safety Policy.

At this time no lasers are used in the research for this institution. See Appendix K.

Personal protective equipment, when required, shall be specified based on the type of laser and associated hazards.

All work with lasers shall be conducted according to the safe work practices found in the Laser Safety Procedures.

6.3 Radiation Safety

Sources of ionizing radiation (for example, X-ray, gamma rays, alpha particles and beta particles) are regulated by federal and state agencies. A Radiation Officer must be assigned to administer radiation

safety issues in the within the laboratories. In order to ensure compliance with these regulations, it is imperative that the RSO be informed of all ionizing radiation sources. The procedures to be used during radiation use shall contain the following requirements for using and possessing radioactive materials:

- Personnel shall obtain permission from their facility RSO prior to purchasing radioactive materials, licensed devices or x-ray generating equipment.
- Personnel shall obtain permission from their facility RSO prior to allowing radioactive materials, licensed devices or x-ray generating equipment into Longwood University facilities or on Longwood property.
- Personnel shall obtain permission from their facility RSO prior to contracting services for which a contractor will bring radioactive materials, licensed devices or x-ray generating equipment into Longwood facilities or on Longwood property.
- Facilities having regulated amounts of radioactive material must maintain a current inventory. See Appendix L.

Radioactive materials and licensed devices may not be disposed of by normal non-hazardous or hazardous waste vendors. Typically, licensed devices must be returned to the manufacturer. The return or disposal of radioactive materials and licensed devices shall be coordinated by the RSO.

All work with radioisotopes and radioactive sources shall be conducted according to the safe work practices developed by the RSO.

7.0 Criteria for the Implementation of Control Measures

7.1 Signs and Symptoms Associated with Chemical Exposure

The ability to recognize the signs and symptoms of chemical exposure is important. Then, if adverse effects do arise despite all precautions taken to avoid exposure, those effects can be recognized at an early stage and appropriate action taken. Such action would include seeking medical attention and contacting the CHO. For signs and symptoms of exposure to specific chemicals, consult the appropriate MSDS. The acute and chronic effects of exposure are generally found under "health hazard information" or a similar section. Chemical exposures to the skin may cause the skin to become dry, whitened, reddened, swelled, blistered, itchy or exhibit a rash.

- If you smell a chemical, you are inhaling it. However, some chemicals can be smelled at concentrations well below harmful levels. On the other hand, a chemical might be present even if you cannot smell it. Some chemicals cannot be smelled, even at harmful levels.
- Inhaling or ingesting a chemical may also leave a taste in your mouth. Some chemicals have characteristic tastes.
- Other symptoms associated with chemical exposures include tearing of the eyes, burning sensation of the skin, nose or throat, a cough, dizziness or a headache.

7.2 Criteria for Control Measures

Hazardous chemicals can cause harm when they enter the body in sufficient amounts via inhalation, ingestion, skin absorption or injection. Harmful effects can also occur by eye or skin contact alone. The nature of the hazardous chemical and the routes by which it enters or is absorbed into the body determines the types of exposure control needed.

Control measures must be implemented whenever exposures may be detrimental to an individual's health. Deciding when exposures may be detrimental is not always easy. However, certain circumstances will always dictate a need for control measures. These circumstances may include an exposure above an acceptable level such as OSHA's permissible exposure limit (PEL), when an individual experiences exposure-related health effects or when low level, long-term exposures (chronic exposures), may be detrimental. It is very important that lab personnel be aware of possible symptoms of overexposure, since some individuals may be more sensitive to a particular chemical exposure, even at levels generally held as acceptable.

The best approach for implementing control measures is a proactive approach. Reasonable control measures should always be implemented when working with laboratory chemicals. If the work involves particularly hazardous or toxic chemicals such as the OSHA listed hazardous chemicals, chemicals covered by the OSHA substance-specific regulations or
OSHA listed carcinogens, the specific control measures discussed in Section 8 must also be implemented.

7.3 Direct Methods of Control

Direct methods of control are those which involve a change in practice concerning the use of the toxic chemical. A change may involve the use of a smaller amount of the chemical, alternating personnel using the chemical, substitution with a less toxic agent or a change in the procedure that eliminates the need for the toxicant.

7.4 Engineering Methods of Control

Engineering control methods generally do not affect the potential for exposure; rather they direct the toxicant away from the personnel by some method. They are usually considered to be indirect methods of control. For this reason, they are not the first choice for control. Engineering methods of control include general laboratory ventilation, local ventilation such as fume hoods, glove boxes and canopies and equipment and work area modifications. Used in conjunction with good laboratory work procedures, properly designed and operated exhaust ventilation is effective in minimizing employee air contaminant exposures.

7.5 Personal Protective Equipment

Personal protective equipment (PPE) is the least preferable method of control. However, unless methods 7.3 and 7.4 totally eliminate the possibility of exposure to chemicals, then PPE is required. Section 4.9 discusses the PPE requirements in our laboratories.

7.6 Administrative Controls

Administrative controls for minimizing inhalation and physical contact exposures include:

- General laboratory safety and health procedures.
- Self-audits and walk-throughs conducted by laboratory personnel to identify and evaluate potential health hazards.
- Health and safety orientation and training sessions to inform employees about the ways they can minimize their exposure to hazards.
- Chemical use authorization controls to assure that prospective chemical users have the knowledge and protective equipment available to them for adequate control of their chemical exposures.

8.0 Control Measures for OSHA Listed Hazardous / Toxic Chemicals

8.1 Handling OSHA Listed Hazardous / Toxic Chemicals

OSHA's lists of hazardous chemicals and carcinogens are discussed in Sections 8.4, 8.5 and 8.6. The complete lists can be found in Appendices G (OSHA Hazardous and Toxic Substances), Appendix H (Listed Carcinogens) and Appendix I (OSHA Substance Specific Regulated Chemicals).

The systems in place to assure employee protection and compliance with the applicable regulations are as follows:

- All chemicals received shall be entered into the Cis-Pro System with and MSDS. .

On an annual basis, the chemical handling procedure is reviewed for potential employee exposure. Based on this review, personal exposure monitoring may be required.

- The CHO shall be notified of new procedures involving hazardous substances. This is not meant to be a way to control what procedures may be implemented or to restrict the capabilities of our labs, but simply a method by which we can assure employee protection and compliance with all the applicable regulations.

8.2 Designated Areas

A "Designated Area" is an area that may be used for work with carcinogens, reproductive toxins or substances which have a high degree of acute toxicity. A designated area may be an entire laboratory, an area of a laboratory or a device such as a fume hood. OSHA's Laboratory Standard requires these areas shall be labeled or have the appropriate signage. The following sign shall be posted in all appropriate locations approved by the CHO:

DANGER – DESIGNATED AREA
Select Carcinogens, Reproductive Toxins
and Acute Toxicity Chemicals in Use.
Authorized Personnel Only

8.3 General Safety Precautions for Working with Hazardous/Toxic Chemicals

The following safety precautions shall be followed when working with hazardous, toxic or carcinogenic chemicals:

- The quantity of the chemical stored in the laboratory should be minimized.

- Use the smallest amount of chemical that is consistent with the requirements of the work to be done.
- Work with these chemicals must be performed within a functioning fume hood, biological safety cabinet, ventilated glove box, sealed system or other system designed to minimize exposure to these chemicals.
- Compressed gas cylinders which contain acutely toxic chemicals should be kept in ventilated gas cabinets.
- Gloves and other appropriate personal protective equipment must be worn.
- Lab workers of child-bearing age should be especially cautious when working with reproductive toxins. Handle these chemicals only in a hood whose satisfactory performance has been confirmed. Wear appropriate PPE to prevent skin contact.
- Minimize exposure to these chemicals by any route using all reasonable precautions.
- Assure that all laboratory personnel in the designated area are aware of the substance being used and take any necessary precautions.
- Decontaminate a designated area when the work is completed.
- When leaving a designated area, remove any protective apparel, clean and decontaminate or dispose of it properly. Thoroughly wash hands, forearms and face.

8.4 OSHA Hazardous Chemicals

The Lab Standard defines "Hazardous Chemicals" as chemicals for which there is statistically significant evidence, based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed employees. This includes chemicals that are carcinogenic, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, neurotoxins, agents that act on the hematopoietic systems, and agents which damage the lungs, skin, eyes or mucous membranes. The OSHA listed hazardous chemicals are included in **Appendix G**. However, this is not intended to be a complete list or an exclusive categorization scheme. If there is available scientific data that supports including other chemicals on this list, the data must be evaluated for applicability.

8.5 Carcinogens

"Select Carcinogens" are defined by the Lab Standard as being any substance that meets one of the following criteria:

- It is regulated by OSHA as a carcinogen.
- It is listed under the category, "known to be carcinogenic" in the Annual Report on Carcinogens published by the National Toxicology Program (NTP) (latest edition).
- It is listed under Group 1 (carcinogenic to humans) by the International Agency for Research on Cancer Monographs (IARC) (latest edition).
- It is listed in either Group 2A or 2B by IARC or under the category, reasonably anticipated to be carcinogenic by NTP, and causes statistically significant tumor incidence in experimental animals in accordance the any of the following criteria: After inhalation exposures of 6-7 hours per day, 5 days a week, for a significant portion of a lifetime to dosages less than 10 mg/m3. After repeated skin application of

less than 300 mg/kg of body weight per week. After oral dosages of less than 50 mg/kg of body weight per day.

A list of chemicals meeting these definitions is included in **Appendix H.**

8.6 OSHA Substance Specific Regulated Chemicals

OSHA has specific regulations for chemicals they consider being especially toxic or carcinogenic. The presence or use of these chemicals requires initial exposure evaluations. Based on the results of the exposure evaluations, other parts of the standards may apply. A list of the OSHA Substance Specific Regulated Chemicals is included in **Appendix I.**

9.0 Employee Information and Training

All employees who work in laboratories and may be exposed to hazardous chemicals must be apprised of the hazards of the chemicals present in their workplace, this includes student awareness. This information and training shall be provided at the time of an employee's initial assignment to a work area where hazardous chemicals are present and prior to assignments involving new exposure situations.
Employees shall be informed of the following:

- The contents of the Lab Standard, its appendices and its location and availability.
- The location and availability of the Longwood University Chemical Hygiene Plan.
- The permissible exposure limits for OSHA regulated substances or recommended exposure limits for other hazardous chemicals where there is no applicable OSHA Standard.
- Signs and symptoms associated with exposures to hazardous chemicals used in the laboratory.
- The location and availability of known reference material on the hazards, safe handling, storage and disposal of hazardous chemicals found in the laboratory including, but not limited to Material Safety Data Sheets (MSDS) received from chemical suppliers.

Employee training shall include:

- Methods and observations that may be used to detect the presence or release of a hazardous chemical (such as monitoring conducted by the employer, continuous monitoring devices, visual appearance or odor of hazardous chemicals when being released, etc.).
- The physical and health hazards associated with chemicals in the workplace.
- The measures employees can take to protect themselves from these hazards, including specific procedures that have been implemented to protect employees from exposure to hazardous chemicals, such as appropriate work practices, emergency procedures and personal protective equipment to be used.
- The location of safety equipment such as showers, eyewash stations, fire extinguishers, fire alarm pull boxes and emergency exits.
- What actions to take in the event of a hazardous material emergency.

- The applicable details of the Longwood University Chemical Hygiene Plan.

10.0 Emergency Reporting and Response

All emergencies, medical, confined space, fire and /or spills shall be reported to LUPD on ext. 911/2091. Provide LUPD with information regarding the exact nature of the emergency, the building and location, chemicals which may be involved and the number of injured. Stay on the line until security has all the information they need and releases you.

Emergency response shall follow the Longwood University Emergency Management Plan and the specific EHS&EM procedures. This may include the use of:

- The emergency phone numbers.
- Emergency eyewashes and safety showers.
- Fire extinguishers.
- Fire pull stations.
- Evacuation procedures.
- Chemical data systems and MSDSs.
- Emergency response supplies and equipment.
- Emergency response team services.

11.0 Medical Consultation and Medical Exams

All employees who work with hazardous chemicals in laboratories shall be provided the opportunity to receive medical consultation and examinations under the workers compensation or a panel physician under the following circumstances:

- Whenever an employee develops signs or symptoms associated with a hazardous chemical to which the employee may have been exposed in the laboratory.
- Where exposure monitoring reveals an exposure level routinely above the action level for an OSHA regulated substance.
- 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.

12.0 Hazardous Wastes

12.1 General Rules

Hazardous waste management is ruled by increasingly stringent and complex regulations. The proper management of chemical and hazardous wastes is the responsibility of the generator of the waste. Indiscriminate disposal by pouring waste chemicals down the drain or adding them to mixed refuse for landfill burial is not allowed. Hoods shall not be used as a means of disposal for volatile chemicals. All wastes shall be collected and stored according to the Hazardous Waste Guidelines. Hazardous waste shall be stored in a safe and secure area with the proper labels attached.

12.2 Chemical Waste Disposal Methods

All chemical laboratories shall be supplied with the following containers to be used for the storage and ultimate disposal of hazardous wastes where applicable:

- 5- gallon waste solvent containers
- Broken glass containers
- Empty chemical containers cabinet
- Tags to mark empty compressed gas cylinders for pickup
- Aerosol can bucket
- Sharps container

13.0 RECORDKEEPING

13.1 Medical Records

Longwood University shall maintain the medical records for each employee with occupational exposure. The records shall be maintained for the duration of employment plus 30 years, in accordance with 29CFR1910.20.

13.2 Exposure Monitoring Records

The EHS&EM shall maintain the records of any measurements taken in order to monitor employee exposures to hazardous chemicals in the laboratory. The records shall be maintained for the duration of employment plus 30 years, in accordance with 29CFR1910.20.

13.3 Training Records

All regulatory safety and health training is documented by employee name, or employee identification number, date, topic of training, length of class and instructor name. This data is maintained by the Laboratory Director and the EHS&EM Office.

13.4 Inspection Records

All laboratory inspection records are available for review from the CHO and are maintained according to the record's retention schedule.

13.5 Access to Records

Per OSHA Standard 29CFR1910.20 "Access to Exposure and Medical Records", employees have the right to receive copies of MSDSs, exposure monitoring records and medical records associated with their jobs. Information shall be provided in accordance with the standard and with the Longwood University "Access to Employee Exposure and/or Medical Records" procedure available on the EHS&EM website. Requests for exposure monitoring records may be made through EHS&EM or the CHO by filling out the proper forms. Requests for medical records may be made through the EHS&EM by filing out the proper form.