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## I. List of Department and University Contacts

In case of imminent danger to life and safety, dial 911 from any campus phone, or 423-425-HELP (4357) from any cell phone. Do not dial 911 from a cell phone, as this is routed to the Hamilton County Dispatch, which must then reroute the call to UTC and will result in a delay in response.

Contact Person	Position	Office / Location	Phone Number
<b>Dr. Manuel Santiago</b>	Head, Dept. of Chemistry and Physics	Grote 318A	423-425-5364
<b>Dr. Michael Dabney</b>	Faculty Associate and Lab Coordinator, Dept. Chemical Hygiene Officer	Grote 318C	423-425-4142
<b>Mr. Tim Pridemore</b>	Emergency Management Specialist		423-425-2297
<b>Mr. Robert Mullins</b>	Health and Safety Specialist		
<b>Office of Safety and Risk Management (main number)</b>			423-425-5741
<b>Poison Control Center</b>			800-222-1222

## II. Purpose of Chemical Hygiene Plan

(29 CFR 1910. 1450 9(E)) The development and implementation of a written Chemical Hygiene Plan (CHP) is the foundation of compliance required by the Occupational Safety and Health Administration (OSHA) as stated in the publication Occupational Exposure to Hazardous Chemicals in Laboratories (Federal Register, January 31, 1990, pages 3327-3335, part of CFR 1910). These rules have also been adopted by the Tennessee Occupational Safety and Health Administration (TOSHA). Additionally, The University of Tennessee at Chattanooga shall be subject to any rules on this subject adopted by TOSHA at a subsequent time.

This rule and standard applies to all persons, including University employees, students, and visitors, authorized to be present in laboratories maintained by the Department of Chemistry and Physics. All persons subject to the CHP shall be informed of the locations of the CHP, the availability of Safety Data Sheets (SDS; *formerly known as Material Safety Data Sheets, MSDS*), and other pertinent reference materials relating to their health and safety while in the laboratory. Application of the CHP is in compliance with University of Tennessee Policies on Safety and Health, Subject H, Laboratory Safety.

The CHP shall be reviewed and evaluated for its effectiveness annually by the Department Chemical Hygiene Officer (CHO) and the Chief Chemical Hygiene Officer for UT Chattanooga.

The University of Tennessee at Chattanooga is committed to providing a safe working environment and believes employees have a right to know about health hazards associated with their work. All employees have access to pertinent safety information through their supervisory staff. When safety concerns arise, employees are encouraged to contact their supervisor.

It is important that employees assume responsibility for laboratory safety. The people who work in a given laboratory are best able to detect potential hazards. So that employees may make knowledgeable decisions about the personal risks of employment, this CHP includes policies, procedures, and responsibilities designed to encourage an awareness of potential hazards in the workplace and to train employees in the development of appropriate, safe working conditions. A training program has been designed for the benefit and protection of all laboratory employees.

### III. Standard Operating Procedures

General precautions for handling all laboratory chemicals should include minimizing exposure because few laboratory chemicals are without hazard. Any mixture of hazardous chemicals is assumed to be more toxic than the most toxic component.

#### A. Procedures for Working with Chemicals

##### 1. Accidents and spills

**In all cases, consult the SDS for the respective chemicals. The SDS may be found either in the lab or in the master SDS file, located in Grote 318C**

- **Eye contact:** Promptly flush eyes with water for 15 minutes and seek medical attention.
- **Ingestion:** Consult the SDS or the Poison Control Center. Each chemical will affect the body differently. Seek immediate medical attention.
- **Skin contact:** Promptly flush the affected area with water; in case of a spill over a large portion of the body, use the safety shower. Remove affected clothing. If symptoms persist after washing, seek medical attention.
- **Clean-up:** *The department CHO is to be immediately notified of any large spills.* Promptly clean up all spills using appropriate spill control materials and personal protective equipment. Dispose of clean-up materials properly. If possible, spill containment and remediation should be performed by the laboratory supervisor and/or the laboratory coordinator. If there is any question about how to clean a spill, consult the chemical's SDS and the department CHO. In case of severe health hazards, notify the department CHO, who will then notify the University CHO, as necessary.

##### 2. Avoid unnecessary exposure to chemicals

- Ensure that appropriate eye protection is worn by all persons, including students and visitors, in areas where chemicals are stored or used.
- Wear appropriate gloves when the potential for contact with toxic chemicals exists. Inspect the gloves before each use, wash before removal (where appropriate), and replace as needed.
- Use properly fitted respiratory equipment when air contaminant concentrations are not sufficiently restricted by fume hoods. Inspect the respirator before use.
- Do not smell or taste chemicals.
- Use only those chemicals for which an adequate ventilation system is available. Apparatus that discharge toxic chemicals (vacuum pumps, distillation columns, etc.) should be vented into local exhaust devices.
- Never eat, drink, smoke, or apply cosmetics in areas where laboratory chemicals are present.
- Storing, handling, or consuming food or beverages in a laboratory or chemical storage area is prohibited. The use of laboratory glassware, utensils, or refrigerators for foodstuff that will be consumed is also prohibited.
- Do not use mouth suction for pipetting or to start a siphon.
- Use protective and emergency apparel and equipment when appropriate.
- If contact lenses are worn in the laboratory, inform the supervisor so that special precautions can be taken in the event of an eye injury.
- Remove laboratory coats immediately upon contamination and dispose of properly.
- Wash areas of exposed skin before leaving the laboratory.

##### 3. Follow standard laboratory safety protocols

- All chemicals must be properly labeled and stored.
- Keep all oxidizing agents at least 10 feet away from solvents. All chemicals should be stored in secure containers within enclosed cabinets, if possible.

- Flammables and acids should be stored in authorized, appropriate storage cabinets.
- Store flammable solvents and acids separately.
- Keep all large quantity containers within appropriate storage cabinets. After removing the needed amount from a large container, return the container to the appropriate storage cabinet.
- All chemicals should be monitored monthly to ensure effective status and continued safety measures. For example, picric acid crystals should be kept moist. Immediately request disposal of expired chemicals.
- Keep the work area clean and uncluttered; clean up the work area on completion of an operation or at the end of each day.
- Do not use damaged glassware. Handle and store laboratory glassware with care to avoid damage.
- Dispose of broken or damaged glassware properly. Broken glassware must be placed into a designated container and may not be discarded in the regular trash.
- Use a hood for operations that might result in the release of toxic chemical vapors or dust. Use a hood or other local ventilation device when working with any moderately volatile substance with a TLV of less than 50 ppm.
- Keep materials stored in the hood to a minimum; do not allow materials to block vents or airflow. Leave the hood on if toxic substances are stored in it or if needed to augment laboratory ventilation.
- Wear close-toed shoes at all times in the laboratory.
- Confine long hair or loose clothing.
- Horseplay, disorderly conduct, or use of abusive language in the laboratory is prohibited.
- Seek information about hazards and plan appropriate protective procedures before beginning a new operation. Consult the SDS or laboratory manual if in doubt about appropriate procedures for a specific chemical.
- In the event of a failure of a utility service, leave lights on, place an appropriate sign on the door, and notify the department CHO.
- If questionable hazardous conditions are found, immediately notify your supervisor and/or the department CHO to remedy the situation.
- Properly label all chemicals before disposal, including a list of all chemicals in the container. Do not mix incompatible agents (e.g. organics with nitric acid or oxidizers).
- A Department Order Request Form should be submitted to the department CHO when requesting a chemical order. The department CHO must be aware of all chemicals entering the department so that proper handling, monitoring, record keeping, and training can be accomplished in a timely manner.
- A current SDS manual is maintained in Grote 318C. Review the appropriate SDS in regard to any question regarding handling, storage, or disposal of a specific substance.
- Be aware of unsafe conditions and see that they are corrected.
- Unauthorized persons, children, and pets are prohibited in the laboratories.

## **B. Housekeeping**

Floors are cleaned regularly by UTC Building Services. All employees of the housekeeping department are trained in the risks associated with working in the laboratory. Information concerning specific risks in individual laboratories will be relayed by the department CHO to the Superintendent of Building Services (400 Palmetto Street, phone 425-4521). The Superintendent is responsible for conveying this information to the Custodial staff.

The housekeeping supervisor conducts a quarterly inspection to assess if:

1. Trash is deposited in appropriate receptacles and properly removed from the laboratory. Broken glass must be placed in a separate labeled receptacle.
2. Chemical spills are promptly reported to the Department CHO.
3. Proper storage is maintained to minimize clutter.

Housekeeping personnel are not to clean counter tops. It is the responsibility of the assigned technical personnel to clean all counter tops and upper surfaces in the laboratory area.

Housekeeping personnel are not to clean up any type of spill until approval and instructions are obtained from the assigned technical staff. If technical personnel are not available, contact the Department CHO for instructions.

### **C. Chemical Inventory**

A current chemical inventory for each laboratory should be maintained and a copy of the inventory provided to the department CHO on a quarterly basis. The department CHO will provide a complete department chemical inventory to the UTC Chief CHO on an annual basis. The annual inventory will be submitted to the Office of Safety and Risk Management (OSRM) no later than June 1<sup>st</sup> of each year.

A chemical inventory is performed annually, listing all the hazardous chemicals in the laboratory. Chemicals listed are those classified as hazardous by the Department of Transportation (DOT), the Environmental Protection Agency (EPA), or displaying a 2 or greater in any section of the National Fire Protection Association (NFPA) diamond. DOT and EPA classifications are in Appendices C and D.

Chemicals are listed alphabetically along with the average quantity, and the manufacturer's name and product number (if applicable). A chemical inventory form is provided on the OSRM's webpage.

Inventories are computerized whenever possible to provide improved sorting capability. A complete chemical inventory is located in the office of the responsible CHO, the UTC Chief CHO, as well as the local fire department and the State Department of Labor (TOSHA).

When chemical inventories are kept current it serves the purpose of keeping tighter control over chemicals within laboratory areas, prevents excessive stock-piling of chemicals, thereby reducing the hazards involved, as well as saving money by purchasing only needed chemicals.

### **D. Safety Data Sheets**

A master department SDS file is provided in Grote 318C. The SDSs are kept in alphabetical order. The department CHO is responsible for updating the SDS file as new materials are procured.

Whenever a new chemical is introduced into the laboratory, immediately notify the department CHO so that proper training may be completed prior to the use of the chemical. In most cases, this will only involve the review of the SDS to determine the proper handling of the chemical. At this time, the department CHO will determine if any special protective devices or procedures are required.

### **E. Chemical Storage**

Chemical Storerooms are located in Grote 307, Grote 405B, Grote 408, Grote 416 and 416A, and Grote 417.

Chemicals can be stored in alphabetical order only if they are in compatible chemical categories. Special attention must be paid to ensure that oxidizing agents and other reactive chemicals are not stored close to incompatible agents.

Chemical storage areas should be minimized. Storage on bench tops and hoods is not desirable. Ventilated cabinets and designated refrigerators are to be used for chemical storage only. No food is permitted in refrigerators where chemicals are stored.

Highly toxic chemicals, including carcinogens, are stored in ventilated storage areas in unbreakable, chemical-resistant secondary containment. The containers should be labeled: Caution: High Chronic Toxicity or Cancer Suspect Agent. A separate inventory list of carcinogens and suspected carcinogens is maintained by the CHO in order to comply with federal and state regulations.

Cylinders of compressed gases are to be strapped or chained to a wall or bench top and are to be capped when not in use. An acceptable, temporary method of securing compressed gas cylinders is to store them on a cylinder dolly and secure them using a chain.

## IV. Labeling

Specific labeling requirements are defined in the OSHA Hazard Communication Standard. Every hazardous chemical used in the laboratory that is not in its original container must be labeled. At a minimum, these labels must contain the following information:

1. Chemical name
2. Hazard statement and precautionary statement (or reference to the SDS in case of limited room)
3. Applicable GHS pictograms

## V. Engineering Controls

- All biohazard hoods and fume hoods are inspected annually and certified by the OSRM. Any hood not passing inspection is taken out of service immediately and may not be used until the hood has passed inspection. It is the responsibility of the employer to purchase the parts and replace the unit in a timely fashion so that the risk to employees is minimized.
- Eyewash fountains are weekly by the department CHO, tested annually, and records maintained by the OSRM.
- Safety showers are inspected and tested annually and records are maintained by the OSRM. Additionally, safety showers are flushed on a weekly basis.
- Fire extinguishers are inspected monthly by the OSRM.
- Chemical hygiene related equipment is monitored by the department CHO.

## VI. Hazardous Waste Disposal

To assure that the impact to people and the environment resulting from the disposal of waste laboratory chemicals is kept to a minimum, a waste disposal program specifying how waste is to be collected, stored and transported has been created. A copy of this waste disposal plan is on file in the OSRM, located at 400 Palmetto Street.

All disposal is done in accordance with regulations from the Tennessee Department of Environment and Conservation (TDEC).

## VII. Administrative Controls

The Laboratory Manager, in conjunction with the Laboratory Coordinator, is responsible for the safe operation of the laboratories. All activities and procedures require approval by the Department CHO before implementation. Environmental monitoring is required in all laboratories that use any of the following chemicals (as listed in 29 CFR 1910 Sub-part Z) three or more times per week:

- 1910.1001 asbestos, tremolite, anthophyllite, and actinolite
- 1910.1002 coal tar pitch
- 1910.1003 4-Nitrobiphenyl
- 1910.1004 alpha-Naphthylamine
- 1910.1006 Methyl chloromethyl ether
- 1910.1007 3,3'-dichlorobenzidine (and its salts)
- 1910.1008 bis-Chloromethyl ether
- 1910.1009 beta-Naphthylamine
- 1910.1010 Benzidine
- 1910.1011 4-Aminodiphenyl
- 1910.1012 Ethyleneimine
- 1910.1013 beta-Propiolactone

- 1910.1014 2-Acetylaminofluorene
- 1910.1015 4-Dimethylaminoazobenzene
- 1910.1016 N-Nitrosodimethylamine
- 1910.1017 Vinyl chloride
- 1910.1018 Inorganic arsenic
- 1910.1025 Lead
- 1910.1028 Benzene
- 1910.1029 Coke oven emissions
- 1910.1043 Cotton dust
- 1910.1044 1,2-dibromo-3-chloropropane
- 1910.1045 Acrylonitrile
- 1910.1047 Ethylene oxide
- 1910.1048 Formaldehyde
- 1910.1101 Asbestos

All spills are contained according to OSHA guidelines, and appropriate spill kits are used. Spill kits are stored in the chemical storerooms and in laboratories, where appropriate. Assessment of significant risk of all operations is made by the Laboratory Coordinator or the person responsible for the CHP. Chemical hygiene and safety policies will be established for each task performed and engineering controls for personal protective equipment assigned.

## **VIII. Record Keeping**

Records of environmental monitoring, medical consultations and examinations (including tests and written opinions) for each employee are required.

- Accident investigations: Records written and retained by the OSRM.
- Chemical inventory: Each faculty member is responsible for keeping an accurate inventory of chemicals in his or her laboratory. This inventory is to be added to the department master inventory, maintained by the department CHO. A duplicate copy is sent to the OSRM annually.
- Environmental monitoring: Records written and maintained by the department CHO and the OSRM.
- Medical consultation: Records maintained by the OSRM and a copy placed in the employee's personnel file.
- Training: Records maintained by the department CHO and an annual report is provided to the UTC Chief CHO.

In the Department of Chemistry, the Laboratory Coordinator and Faculty Associate shall serve as the designated department CHO and the Custodian of Record. In the Department of Physics, the Laboratory Specialist shall serve as the Custodian of Record and shall consult with the Chemistry Department CHO or the UTC Chief CHO for matters of chemical hygiene.

Full responsibility for training and requisite record keeping lies with the department CHO or the Custodian of Record.

All records are kept, transferred, and made available in accordance with 29 CFR 1910.20.

## **IX. Personal Protective Equipment**

### **A. Eye Protection**

#### **1. Safety Glasses / Safety Goggles**

Eye protection meeting ANSI Standard Z87.1-2003 is required in all laboratory areas. Students may purchase this type of eye protection in the University Bookstore.

## 2. **Contact Lenses**

The Department does not prohibit the wearing of contact lenses in the laboratory. However, employees should notify their supervisor that they wear contacts. In any case, employees should be made aware of the risks of wearing contacts in areas where hazardous chemicals are used, so that they may make their own educated decision about continuing to wear them.

### **B. Skin Protection**

#### 1. **Hand Protection**

Employees and students are required to wear impervious gloves when the potential for contact with blood, bloodborne pathogens, infectious materials, and/or hazardous chemicals exists. These gloves must be compatible with the type of hazard present.

#### 2. **Bodily Protection**

Where the potential for splashes from hazardous chemicals exists, an impervious apron appropriate for the task must be worn.

#### 3. **Clothing and Footwear**

In general, flat close-toed shoes with rubber soles and leather uppers should be worn in the laboratory. Open-toe shoes, flip flops, canvas shoes, and sandals should be avoided. Long pants are preferable to shorts and skirts as these garments provide no protection to the legs from spills.

## **X. Training**

### **A. Training Requirements**

Training is a necessary and important part of the CHP. All employees are trained at the time of their initial assignment to work in an area where hazardous chemicals are present. Additional training is required if new assignments involve exposure to different risks. All training is documented in writing by attendance records.

### **B. Lesson Plans**

Before training begins, a lesson plan should be developed that outlines the expectations of the program. At a minimum, this lesson plan should include the following:

#### 1. **Objectives**

Upon completion of the CHP training program, the employee should be able to:

- Identify and locate potentially hazardous chemicals in the workplace.
- Recognize chemical labeling and its meaning.
- Locate the SDS in the workplace.
- Locate the hazard identification, first-aid measures, exposure controls / personal protection, and disposal considerations sections of the relevant SDS.
- Identify the person responsible for the CHP by name and title.
- Discuss the major components of the facility's standard labeling system.
- Identify the appropriate personal protective equipment for the area and demonstrate its proper use.
- Demonstrate emergency procedures in the event of a hazardous spill.

## 2. **Protocols**

The lesson plan should include a description of the applicable environmental monitoring protocol(s).

## 3. **Activity Plan**

The activity plan should describe the following:

- Audiovisuals that will be used (e.g. videotape, presentations, equipment instructions, handouts)
- An outline of topics to be discussed with approximate time limits.

## 4. **Covered Topics**

The list of topics to be covered should include:

- Content of lab standard
- Location of the CHP
- Identification of chemical hazards
- Location of a chemical
- Location of the SDS
- Labeling information
- Procedures for handling hazardous chemicals
- Work practices
- Proper moving, storage, and use of hazardous materials
- PEL for specific chemicals used by the employee
- Visual appearance of chemicals used
- Environmental monitoring requirements
- Signs and symptoms of exposure
- Protective equipment used to prevent overexposure
- Conditions to avoid
- Environmental protection
- Emergency procedures
- Spill containment
- Medical consultation procedures

## 5. **Summary**

Finally, the lesson plan should include a summary of the above points. Restate the objectives and main points. Answer any questions that may arise.

# **XI. Chemicals Requiring Approval for Use**

There are several potentially hazardous chemicals used in the Department of Chemistry and Physics that require an evaluation of proposed protective procedures before any activity involving the handling of the chemical is commenced. If you plan to work with any of the chemicals in the listing below, you must contact the department CHO. The department CHO will then review the available information, including the SDS, and determine what special procedures, if any, are required. The CHO will then submit a recommendation for approval or rejection to the Department Head, who makes the final decision. Approval must be obtained in advance before purchase or

usage of any chemical listed below. It is the responsibility of the department CHO to determine through inventory which chemicals are to be placed on the Acutely Hazardous Chemicals List.

The person responsible for the CHP should review the chemical inventory listing and designate the acutely hazardous materials actually present. The listing should be reviewed and updated as necessary. Examples for each category of acutely hazardous chemicals are listed below and should not be construed as an exact list.

**A. Toxic Gases**

- Carbon monoxide
- Arsine
- Fluorine
- Hydrogen cyanide
- Hydrogen selenite
- Phosphine

**B. Acutely Toxic Compounds**

- 1,4-dioxane
- Ricin
- Plutonium
- Cyanide compounds
- Pesticides

**C. Shock Sensitive Compounds**

- Picramide
- Picric acid
- Nitroglycerine (and other nitro- compounds)
- Benzoyl peroxide
- Acetyl peroxide

**D. Highly Corrosive Compounds**

- Benzenesulfonic acid
- Hydrofluoric acid
- Formic acid
- Ethanoyl chloride
- Benzotrichloride (aka trichlorotoluene)

**E. Extremely Flammable Compounds**

- Carbonyl sulfide
- Arsine
- Dipropylamine

**XII. MEDICAL CONSULTATIONS AND EXAMINATIONS**

All employees needing medical attention must use the University Workers Compensation procedures defined by the University Human Resources Office.

The employee is sent for medical evaluation under the following circumstances:

1. There are signs and/or symptoms associated with exposure to a hazardous chemical.

2. Environmental monitoring reveals and exposure level above the action level.
3. An event, such as a spill, leak, or explosion, results in a hazardous chemical exposure.

The laboratory shall provide the following information to the examining physician:

1. Identity of the hazardous chemical(s) to which the employee has been exposed.
2. A description of the conditions under which the exposure occurred, including quantitative exposure data if available.
3. A description of the signs and/or symptoms of exposure.
4. A copy of the SDS for the chemical(s) involved.

Non-University employees and students shall bear the expense for medical surveillance and treatment in the event of an accidental exposure to a hazardous chemical. These individuals may contact the University OSRM to request information about filing appropriate claims for compensation pursuant to the guidelines set forth by the Tennessee Claims Commission.

### **XIII. RESPONSIBILITIES**

#### **A. University CHO**

The University CHO for UTC coordinates the Campus Chemical Hygiene Program within University guidelines and has the responsibility to:

- Develop a written hygiene plan to be submitted to the University Safety Office for approval.
- Perform periodic reviews, at least annually, of department plans and prepare revisions to keep the campus plan current relative to changes in regulations and University safety policy.
- Coordinate the necessary activities required to ensure that an adequate emergency reaction response capability exists within each department.
- Coordinate a program to ensure that all hazardous materials information resources required by regulations are available to department employees and that the contents of these materials are current.
- Oversee training of department employees to ensure compliance with safety regulations. Laboratory employees should have adequate job orientation so that they may protect themselves against the potential adverse effects of exposure to hazardous chemicals.
- Coordinate necessary medical consultations to satisfy the requirements of the medical consultation and medical examination sections of the standard.
- Coordinate the arrangements of all required employee monitoring to satisfy the requirements of the employee exposure determination section of the standard.
- Coordinate the implementation of the approval procedure for those substances that are designated as requiring prior approval before use.
- Coordinate all other activities that are shown to be necessary to ensure compliance with all aspects of the standard.

In order to assure compliance with the University of Tennessee Safety Policies, the University CHO has the authority to initiate actions closing down a laboratory if the safety requirements of the UTC CHP are not met.

#### **B. Laboratory Safety Officers**

Safety responsibilities for a specific laboratory rest with the faculty or staff member designated by the department CHO and approved by the Department Head. The designated person must:

- Work with administrators and other employees to develop and implement appropriate chemical hygiene policies and practices.
- Monitor the procurement, use, and disposal of chemicals in the laboratory.
- See that appropriate audits are maintained.

- Help project directors develop precautions and adequate facilities.
- Know the current legal requirements concerning regulated substances.
- Seek ways to improve the CHP.
- Certify the performance of protective equipment.

### **C. Laboratory Supervisors**

The immediate supervisor has the overall responsibility to:

- Ensure that students and workers understand and follow the chemical hygiene rules.
- Make working personal protective equipment available.
- Ensure proper training of all employees and students under their purview.
- Provide regular chemical hygiene and housekeeping inspections including routine inspections of emergency equipment.
- Know the current legal requirements concerning regulated chemicals and determine the need for protective equipment.

### **D. Laboratory Employees and Students**

The laboratory employee is responsible for:

- Planning and conducting each laboratory operation in accordance with the institutional chemical hygiene procedures.
- Developing good personal chemical hygiene habits.
- Following exactly his or her supervisor's instructions, provided it does not conflict with established safety guidelines.

## **XIV. Additional Safety Requirements Other Than Those for Hazardous Materials**

- Dispose of glass and sharp objects in designated disposal containers.
- Non-contaminated waste is to be disposed of in regular trash.
- Never obstruct exits, fire extinguishers, fire hoses, gas valves, etc.
- Doors into laboratory areas are to remain closed at all times when not in use. Never prop doors open.
- Make sure that all equipment is properly grounded and that the wiring of all equipment is in good condition. If cracks in insulation or exposure of the wiring is noticed, immediately unplug the equipment and notify your supervisor and the department CHO.
- In the case of exhaust failure, immediately notify your supervisor and the department CHO. If personnel are in danger of contamination by toxic or infectious agents, immediately remove all personnel from the area, and close off the area until the problem has been properly resolved.
- Chemical storage cabinets are to be placed at least six (6) feet away from laboratory exits.

## **XV. Radiation Safety**

The purpose of this section of the CHP is to present regulations and recommended procedures for working with radiation sources at the University of Tennessee at Chattanooga in order to protect the individual, prevent the spread of contamination, and to assist in fulfilling the responsibilities of the University to its students, staff, and neighbors.

Radiation is an invaluable tool in teaching and research and, when properly employed, can provide great benefits to mankind with little or no attendant risk. However, improper use can bring risk of radiation exposure resulting in chronic illness, injury, or even death. The known hazards, in order of their importance, are the deposition of radioactive materials in the body; external exposure to neutrons, gamma, and x-rays; and exposure to beta radiation.

Use of radiation sources implies acceptance by the user of some increased exposure above the natural background radiation to which man is always exposed. Common sense dictates that such increase in personnel exposures and contamination levels should be kept to the minimum, consistent with reasonable effort and expense. Minimums considerably lower than the so-called "Maximum Permissible Levels" can be maintained provided the user has adequate knowledge and equipment, along with the skill and disposition to use them. Proper disposition means a balanced perspective towards radiation entailing a healthy respect, free of both the blind fear of the novice and the familiar contempt one sometimes encounters in the "old hand."

This section is designed to help University staff in performing teaching and research with radiation sources in a safe, legal, and efficient manner without imposing unnecessary restrictions on anyone's work. Some of the rules come from Federal and State Regulations which, having the force of law, permit no modifications unless specifically permitted by law.

In general, it is the responsibility of the individual radiation user to understand and conduct his operations in an acceptable manner to minimize hazards to himself and others. It is the responsibility of the laboratory supervisor to ensure that all personnel, particularly new personnel, in his area are properly instructed with respect to the nature of the radiation hazards and the necessary radiation safety procedures in his laboratory and that they possess the necessary skills and disposition to cope with radiation safety problems safely. The Radiation Safety staff is responsible for assisting all users and supervisors by providing consultation and certain services in matters of radiation safety.

The Radiation Safety Committee is responsible for establishing policies for the Radiation Safety Program, for reviewing the work of the Radiation Safety staff, and advising both them and the radiation users on particular problems.

#### **A. Radiation Laboratory Procedures**

- The use of radioisotopes is restricted to approved areas.
- Before using any radioisotope in the laboratory, you must be familiar with limitations placed on this institution regarding isotope use.
- To prevent accidental entry of radioactive materials into the body, high standards of cleanliness and good housekeeping must be maintained in all laboratories where radioactive material is present.
- Always use gloves. Remove gloves before leaving the work area. Wear protective clothing (lab coats, masks, shoe covers) as needed.
- Wash hands and arms thoroughly before handling any object which goes to the mouth, nose, or eyes (e.g., cigarettes, cosmetics, foods). Keep fingernails short and clean.
- Smoking and eating in radioisotope laboratories is prohibited. No food or drink may be stored in laboratory refrigerators.
- One or more trial runs with non-radioactive materials are recommended for new procedures and new personnel to test effectiveness of procedures and equipment.
- Use double containers for storage of working solutions of radioisotopes. For example, if the radioisotope solution is in a liquid scintillation vial, place the vial in a small beaker.
- Never pipette by mouth. Use rubber bulbs, syringes, or mechanical devices.
- Clean up minor spills immediately. For major spills follow emergency procedures.
- Whenever possible, operations with radioactive materials should be conducted in a hood, dry box, or other type of closed system. Operations with materials susceptible to atmospheric distribution, such as boiling, evaporating, distilling, or ashing, must be done in a hood with an air flow of approximately 100 linear feet per minute. Work with activities of more than a few hours half-life should be done over a tray. Work with finely divided powder must be done in a hood or closed system.
- Table and bench tops should be of a non-porous, chemical resistant material. Working surfaces shall be covered with absorbent paper regardless of the type of surface.
- When work is completed each person will clean up his own work area and arrange for disposal or proper storage of all radioactive materials and equipment.

- Vacuum pumps used in systems containing radioisotopes must not be permitted to exhaust into room air or out windows. Use a double trap mechanism on any vacuum system.
- Exhaust stacks must not be vented near openable windows or building air intake vents.
- Laboratories shall provide special radioactive waste containers. These shall bear the words "Caution, Radioactive Waste," and a warning to janitors against handling.
- Housekeeping should not touch benches and instruments, etc., and are permitted to clean floors and windows only. Laboratory personnel are responsible for the rest of the housekeeping.
- Repairs such as plumbing, etc., should not be undertaken unless Radiation Safety has been notified.
- When use and storage of radioactive materials is to be terminated at a facility, notify Radiation Safety which must make a terminal survey before an area can be released for other uses.

## **B. Radioactive Waste Management**

Researchers must ensure, prior to the procurement of any radioactive materials, that a method of disposal of the materials either presently exists or can be worked out to the satisfaction of the Radiation Safety Committee.

- Each Radioisotope Laboratory Supervisor must maintain accurate records of the types, quantities, and forms of radioisotopes which are placed in the radioactive waste which is released from his/her radioisotope laboratory. Records kept by the Laboratory Supervisor may be based on either calculations or on measurements.
- Radioactive waste containers should be stored as close to the work area as possible to minimize the probability of spillage during the transfer of the waste to the containers.
- Waste containers shall not be stored in hallways, stairwells or other uncontrolled areas.
- Radioactive waste containers should be covered at all times when not in use.
- Each radioactive waste container shall be labeled with a "Caution Radioactive Materials" label or sticker.
- When handling or transferring radioactive waste, the individual should wear a laboratory coat and disposable gloves.
- Radioactive wastes containing carcinogens, biohazards, or very hazardous chemicals must be inactivated, if possible, and packaged in such a way that they present minimal hazards to people who handle the wastes.

## **C. Radiation Emergency Procedures**

In all emergencies, the UTC Chief CHO should be contacted as soon as possible.

### **1. Extreme hazards**

Defined as: high radiation levels or the possibility of airborne contamination from dry or volatile radioactive materials.

- Evacuate the laboratory immediately. Close and lock the door.
- Summon the University Safety Officer and the Radiation Safety Officer immediately.
- Remove shoes if contamination is suspected. Do not touch anything unnecessarily.

### **2. Other hazards**

Examples: spills or suspected spills of radioactive materials where the material is not airborne.

Keep calm. Assume that you are contaminated until a survey proves otherwise.

- Confine contamination.
  - Localize the spill. Right a tipped container, then pour or drop absorbent material on the spill. Dampen down a dry spill.

- Do not track contamination around the laboratory. Call for help if possible.
- Close the door to prevent the spread of airborne contamination.
- Check shoes before leaving the area after a spill has been cleaned up.
- Protect personnel.
  - Remove contaminated clothing and wash contaminated parts of the body with detergent.
  - Warn other workers.
- Decontaminate.
  - If thorough washing does not remove contamination from the body, consult the UTC Chief CHO.
  - Do not spread radioisotopes to clean areas.

### 3. **Emergency Procedures**

In case of electrical power outage:

- Cease work as rapidly as possible. If the hood was in use, close the hood door.
- Evacuate the area immediately. Close and lock the laboratory door. A notice not to enter the room must be placed on the door to prevent entry.
- Remove contaminated clothing and wash contaminated areas of the body with detergent.
- Call the UTC Chief CHO.

## **XVI. GLOSSARY**

The following terms are used as part of the CHP:

### **Acute:**

An adverse effect with symptoms of high severity coming quickly to a crisis.

### **Carcinogen:**

A substance capable of causing cancer.

### **Chemical Hygiene Officer (CHO):**

The person responsible for the chemical hygiene program and the content in the chemical hygiene plan. Also serves as department safety officer, and ensures that the department is operating in accordance to all applicable regulations.

### **Chemical Hygiene Plan (CHP):**

“A written program developed and implemented by the employer which sets forth procedures, equipment, personal protective equipment, and work practices that are capable of protecting employees from the health hazards presented by hazardous chemicals used in that particular workplace.” -29 CFR 1910.1450

### **Chronic:**

An adverse effect with symptoms that develop slowly over a long period of time or that frequently recur.

### **Combustible:**

Able to catch on fire and burn.

**DOT:**

Department of Transportation

**EPA:**

Environmental Protection Agency

**Flammable:**

Capable of being easily ignited and burning with extreme rapidity.

**Infectious:**

Sources that cause infections either by inhalation, ingestion, or direct agents contact with the host material.

**LC50:**

The concentration of a substance in air that causes death in 50% of the animals exposed by inhalation. A measure of acute toxicity.

**LD50:**

The dose that causes death in 50% of the animals exposed to a substance through ingestion. A measure of acute toxicity.

**Mutagen:**

Capable of changing cells in such a way that future cells are affected. Mutagenic substances are usually considered to be suspected carcinogens.

**OSHA:**

Occupational Safety and Health Administration, the regulatory branch of the Department of Labor concerned with employee safety and health.

**PPE:**

Personal protective equipment: Clothing and other equipment used to minimize the risk of an employee coming into bodily contact with a hazardous material

**PEL:**

Permissible Exposure Limit. The legally allowed concentration in the workplace that is considered a safe level of exposure for an 8-hour shift, 40 hours per week.

**pH:**

A measure of how acidic or caustic a substance is on a scale of 1 to 14. A pH of 1 indicates that a substance is strongly acidic; a pH of 14 indicated that a substance is strongly alkaline.

**Physical:**

Workplace sources recognized for their potential effects on the body. Heat exposure or excessive noise levels are examples of this risk group.

**SDS:**

Safety Data Sheet

**Sensitizers:**

Agents that can cause an allergic reaction at some point in time following repeated exposures.

**Sterility:**

Changes made in male or female reproductive systems that result in and inability to reproduce.

**Teratogens:**

A substance that causes a deformity in newborns if a significant exposure exists during pregnancy.

**TLV:**

Threshold Limit Value. The amount of exposure allowable for and employee in an 8-hour day.

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**REFERENCES****THE FOLLOWING SOURCES WERE USED TO PREPARE THIS PLAN:**

1. U.S. Department of Labor, final rule part II. Federal Register 29 CFR Part 1910. Occupational Exposure to Hazardous Chemicals in Laboratories, Wednesday, January 31, 1990.
2. National Research Council. Prudent Practices for Handling Hazardous Chemicals in Laboratories, National Academy Press, 1981.
3. National Research Council. Prudent Practices for Handling Hazardous Chemicals in Laboratories, National Academy Press, 1983.
4. A Model Chemical Hygiene Plan for Laboratories, Terry Jo Gile, MT(ASCP), MA Ed. Clinical Laboratory Management Association, Inc. 1990.