

University of Notre Dame Radiation Laboratory

Laboratory Safety Standard Operating Procedures

## 1.0 PURPOSE

To protect all laboratory personnel from the health and safety hazards associated with hazardous chemicals and equipment in the laboratory and to outline operating procedures relative to equipment usage and conduct within the laboratory. This manual should serve as a guide to standard procedures observed in the Radiation Laboratory, and the University of Notre Dame Office of Risk Management *Chemical Hygiene Plan* was used as a basis for its creation. The manual is only a **subset** of the *Chemical Hygiene Plan*, which **must** be read in addition for a comprehensive understanding of what the University expects from laboratory employees as well as what the University provides to laboratory employees in the form of worker protections and emergency procedures.

## 2.0 GENERAL LABORATORY PROCEDURES

### 2.1 BEHAVIOR IN THE LABORATORY

1. Employees shall act in a professional manner at all times.
2. Horseplay and practical jokes using chemicals or any laboratory equipment are expressly forbidden. An enjoyable atmosphere is desirable; use common sense.
3. Never work alone at a potentially dangerous activity.
4. Visitors to the laboratory must observe all safety regulations, including, but not limited, to the wearing of eye protection.
5. Employees shall be aware of the location and proper operation of laboratory safety equipment.

### 2.2 AVOIDANCE OF ROUTINE EXPOSURE

1. Always avoid skin contact with chemicals.
2. Do not smell or taste chemicals.
3. Never pipet by mouth. Use a vacuum or a pipette bulb.
4. Apparatus which may discharge chemical vapors or dusts that might produce adverse environmental effects must be vented into local exhaust devices.
5. Choose only those chemicals for which the quality of the available ventilation is appropriate.
6. Never underestimate the risk. Chemical reactions involving two or more substances may form reaction products that are significantly more toxic than the starting reactions.  
**Always assume that all substances of unknown toxicity are toxic.**

7. Always use common sense, good judgement, professional expertise and safety awareness when it comes to hazardous chemicals.

### **2.3 PERSONAL HABITS IN THE LABORATORY**

1. Eating, drinking, chewing gum and cosmetic application are not permitted in the working laboratories. Wash hands before doing any of these activities.
2. Smoking is allowed only in designated smoking areas outside the laboratory.
3. Food must not be stored in a refrigerator with chemicals. Do not use glassware or utensils which are used in laboratory operations.
4. Hands should be washed before using the restrooms and before eating, drinking or smoking. Wash well before leaving the laboratory area.
5. Confine long hair and loose clothing. Do not wear skimpy clothing (shorts, halter tops). Do not wear sandals and avoid the use of canvas shoes.
6. Be alert to unsafe conditions and see that they are corrected when detected.
7. No one should work alone in a lab when working with hazardous materials. (chemical, biological or radioactive materials)

### **2.4 UNATTENDED OPERATIONS**

1. Only well understood reactions shall be permitted to run unattended. Lights should be left on and an appropriate sign should be placed outside the lab. Emergency provisions should be established to contain toxic substances in the event of a utility failure (such as cooling water) to an unattended operation.

2. The sign shall include:

Researcher Name

Office Phone

After Hours Phone

Research Advisor Name & Phone Number

Hazardous Materials involved

Potential hazards if any equipment or utilities (water, electric, gas, etc) are shut off

## 2.5 LIFTING HEAVY OBJECTS

1. Lift heavy objects by bending at the knees - use your legs, not your back.
2. Hold heavy objects close to your body.
3. Get help in handling objects too heavy or bulky for one person.

## 2.6 HOUSEKEEPING

1. Lab areas (bench tops, hoods, etc.) are to be kept clean and uncluttered. This will help prevent spillage, breakage, personal injuries and unnecessary contact with chemicals.
2. Any spills or accumulations of chemicals on work surfaces shall be removed as soon as possible with techniques that minimize residual surface contamination.
3. Floors and walkways should be maintained dry at all times.
4. Doorways and walkways shall not be blocked or used for storage.
5. Access to exits, emergency equipment, and utility controls shall never be blocked.

## 2.7 PERSONAL PROTECTION

1. Personnel must know the types of protective equipment available and use the proper type for each job. Everyone, including visitors, must wear the appropriate eye protection where chemicals are stored or handled.
2. Wear **appropriate** gloves when handling **hazardous** chemicals. Wear at least basic gloves when handling any chemicals or glassware.
3. Do not use contact lenses in the laboratory unless absolutely necessary. Vapors and chemicals can get trapped under the lens and make it impossible to remove the lens to rinse the eye. Severe eye damage can occur. If they are worn, the supervisor must be informed so that special precautions can be taken.
4. The University has made arrangements with C&B Optical to obtain prescription safety glasses at a reduced cost. Contact Risk Management and Safety for details.
5. Personal Protective Equipment forms must be completed for each lab worker. PPE Forms are to be returned to Risk Management & Safety Department, 636 Grace Hall.

## 2.8 GLASSWARE

1. Inspect all glassware for defects and cracks. Weak glass can cause severe accidents through cuts, leaking hazardous chemicals, or imploding under vacuum.

2. Always use lubricant when inserting glass tubing or glass thermometers into rubber stoppers.
3. Fire-polish all cut glass tubing and rods.
4. Vacuum distillations or evaporations should be shielded in case of implosion. Only round-bottom flasks should be used for vacuum distillations. Erlenmeyer flasks may implode.
5. Exercise care in removing frozen glass stoppers. First try soaking glass stopper in hot water to expand the glass. If this technique doesn't work, try soaking the frozen joints in Coca-Cola for a couple of hours. If it is necessary to remove the stopper by tapping, wrap the stopper in a cloth or paper towel and protect your hands with gloves in case of breakage.

## **2.9 INSTRUMENT AND EQUIPMENT CARE AND USE**

1. Never attempt to operate a machine or instrument until you have been properly instructed in its use. See the laboratory instrument manual for obtaining training for a specific instrument in the laboratory.
2. Keep the area around instruments and equipment clear of obstructing materials.
3. All belt driven equipment should have a belt guard to prevent hands and clothing from being pulled between belt and pulley (i.e. vacuum pumps).
4. Equipment with frayed electrical cords should be repaired before use.
5. Do not leave oil and boiling water baths unattended. Take precautions to contain any hot oil and water spills.

## **2.10 WORKING WITH VACUUM**

In an evacuating system, the higher pressure is on the outside, rather than on the inside, so that a break can cause an implosion rather than an explosion. The resulting hazards consist of flying glass, spattered chemicals and possibly fire. Special precautions including eye protection are required. Equipment at reduced pressure is especially prone to rapid changes in pressure. This can create large pressure differences within the apparatus that can push liquids into unwanted locations, sometimes with very undesirable consequences. Mechanical vacuum pumps should be protected by using cold traps, and vented to an exhaust hood or to the outside of the building. If solvents or corrosive substances are inadvertently drawn into the pump, the oil should be changed before any further use. The belts and pulleys on such pumps must be covered with guards.

### **2.10.1 Assembly of Vacuum Apparatus**

Vacuum apparatus should be assembled so as to avoid strain. Joints should be assembled in a way that allows various sections of the apparatus to be moved if necessary without placing strain on the necks of the flasks. Heavy apparatus should be supported from below as well as by the neck. Vacuum apparatus should be placed well onto the bench or into the hood where it will not be easily bumped by passers-by or the hood doors.

### **2.10.2 Glass Vessels**

Glass vessels at reduced pressure are capable of collapsing violently either spontaneously (if cracked or weakened in some other way) or from an accidental blow. Adequate shielding should be in place. It is advisable to check for flaws in the glassware each time the vacuum apparatus is used. Only round-bottomed or thick walled flat-bottomed flasks specifically designed for operation at reduced pressure should be used as reaction vessels. Repaired glassware is subject to thermal shock and therefore should not be used in reduced pressure procedures.

### **2.10.3 Dewar Flasks**

Dewar flasks are capable of collapsing as a result of thermal shock or a slight scratch by a stirring rod. They should be shielded, either by a layer of friction tape or enclosed in wooden or metal container. This reduces the hazard of flying glass in case of collapse.

## **3.0 PERSONAL PROTECTIVE EQUIPMENT**

The Chemical Hygiene Officer (or authorized representative) will be responsible for the selection of personal protective equipment, acquiring approved equipment, maintaining availability, and establishing cleaning and disposal procedures.

Chemical protective clothing must be removed before leaving the work area.

### **3.1 EYE PROTECTION**

1. Safety glasses with side shields must meet the requirements of ANSI Z87.1
2. Face shields with safety glasses underneath or chemical splash goggles are required when transferring or pouring acid or caustic materials, or where a potential splash exists.
3. Employees are not permitted to wear contact lenses in the laboratory. Exceptions may be made if contact lenses are recommended by an ophthalmologist or optometrist and vision deficiency cannot be corrected with glasses. The physician must be informed of the nature of the employee's job. Chemical splash goggles must be worn over the contact lenses.

4. Before each use, eye and face protection is to be inspected for damage, i.e. cracks, debris, scratches. If deficiencies are noted, the equipment should be cleaned, repaired, or replaced before use.

### **3.2 GLOVES**

1. Chemical resistant gloves shall be worn whenever the potential for skin contact with hazardous materials exists.
2. Gloves shall be removed before touching other surfaces (door knobs, telephone receivers, faucet handles).
3. Heat resistant gloves shall be used for handling hot objects. Asbestos gloves should **not** be used.
4. Low temperature gloves specifically designed for cryogenic use shall be worn when handling materials like dry ice or liquid nitrogen.
5. Before each use, gloves are to be inspected for damage and contamination, i.e. tears, punctures, discoloration. If deficiencies are noted, the gloves should be cleaned, repaired, or replaced before use.

### **3.3 CLOTHING**

1. No sandals or open-toed shoes are to be worn by laboratory employees. Canvas shoes should be avoided. The shoe should have a non-skid sole and should have a reasonable heel height.
2. Laboratory coats shall be worn by laboratory employees whenever in the work area.
3. Disposable clothing should be worn if working with highly toxic materials, such as carcinogens, mutagens or teratogens.
4. Halter tops and shorts should not be worn in the laboratory (unless completely covered with a lab coat as they provide little protection from a potential splash or chemical spill).

### **3.4 HEARING PROTECTION**

1. Hearing protection (ear muffs or plugs) are required whenever employees are exposed to 85 dBA or greater as an 8 hour time weighted average (TWA).
2. Hearing protection is to be inspected before each use for tears and contamination. If deficiencies are noted, the hearing protector should be cleaned, repaired or replaced before use.

#### **4.0 GENERAL TRAINING**

1. All laboratory employees shall be trained on the hazards of chemicals present in their work area and the PPE required.
2. The aim of the training program is to assure that all individuals working in a laboratory are adequately informed about safe laboratory practices, risks involved and procedures to follow in case of an emergency.
3. This training will be provided at the time of the employee's initial assignment to the work area where hazardous chemicals are present. The training shall also be conducted when there is a change in work assignments involving new exposure situations.
4. The training shall be provided by the Chemical Hygiene Officer or designee.
5. The training shall include:
  - a. Methods and observations that may be used to detect the presence or release of a hazardous chemical
  - b. Physical and health hazards of chemicals in the work area
  - c. Handling of hazardous materials - acquisition to disposal
  - d. Fire extinguisher training
  - e. Personal protective equipment
  - f. Interpretation of a MSDS
  - g. Engineering controls
  - h. Emergency procedures
  - i. Personal hygiene
  - j. Location, availability and contents of the written Chemical Hygiene Plan.
  - k. Signs and symptoms of exposures associated to hazardous chemicals used in the laboratory.

#### **5.0 EMERGENCY PROCEDURES**

No universal emergency plan will do all things for all emergency situations. The most important component of emergency planning is prevention. Prevention measures range from employee training to facility inspections.

## **5.1 EMERGENCY REPORTING PROCEDURES**

Call the Security Department for all emergencies. They will dispatch the Police, Fire Department, medical aid, or Risk Management and Safety.

### **FOR ALL EMERGENCIES**

**DIAL 911 from campus phones**

**DIAL 574-631-5555 from a Cellular phone**

When reporting an emergency, give:

1. Location of victim or emergency
2. Name of victim
3. Name of caller
4. Extension number of caller
5. Facts concerning the emergency

In the event that a hazardous materials release cannot be not controlled by the laboratory employee, the University Emergency Response Plan must be followed.

## **5.2 FIRST AID**

First aid is helpful for treating minor injuries or as an interim measure until trained medical personnel can take over. For accident victims who need medical care beyond first aid, call Security (631-5555) for transportation to the proper medical facility. Minor medical care will be provided by professionals at the University Health Services on campus. Emergency care will be provided by professionals at St. Joseph's Medical Center. Use procedures on the following page if you become involved in an emergency situation requiring first aid. Please report all undergraduate injuries, no matter how minor, to the professor responsible for the laboratory.

### **FIRST AID PROCEDURES**

#### **1. CHEMICAL BURNS:**

Flush the affected area with cold water for at least 15 minutes. Flush eye for at least 15 minutes at an eye wash station or sink.

#### **2. THERMAL BURNS:**

Immerse the burned area in cold water or apply ice until the pain stops. Cover with a sterile dressing.

### 3. POISONS:

Call the Poison Center (1-800-382-9097) for assistance in administering poison antidotes.

### 4. BLEEDING:

Hold a clean cloth pad directly on the wound and apply hand pressure. Apply a tourniquet only as a last resort.

### 5. FIRES:

Put out burning clothing or hair with a cotton lab coat, fire blanket or water. If these resources are not available, make the victim roll on the ground to put out the flames.

### 6. INJURY FORMS TO BE COMPLETED

All employee injuries must be reported to your departmental office so the appropriate forms can be completed. If treatment will be performed at the University Health Services, a completed Supervisor's Report of an Injury form should accompany the injured employee. The State of Indiana Worker's Compensation Board, Form 33401 (previously form 24), must be completed within 5 days of the injury and submitted to the Risk Management and Safety RM&S Department, 636 Grace Hall. A Supervisor's Accident Investigation Report form should also be completed and forwarded to RM&S within 5 days of the accident. Copies of these forms are available through your departmental office. Questions should be referred to Carla Gruse at 631-7532 or gruse.1@nd.edu.

### **5.3 CHEMICAL SPILLS**

When lab spills occur, it is necessary to take prompt and appropriate action. Appropriate action will depend on the severity of the hazards associated with the particular chemical.

1. If the spill is minor and of known limited danger, begin the cleanup operation immediately.
2. If the spill is unknown in chemical composition or potentially dangerous (explosive, toxic fumes), evacuate the room and call Risk Management and Safety at 1-5037 or after hours to Security at 911 or 631-5555.
3. If it is suspected or known that the spill is extremely dangerous:
  - a. Call Security (911) from a campus phone who will alert the Fire Department and Risk Management Safety.
  - b. Evacuate the building.

## **5.4 CHEMICAL SPILL CLEANUP**

Spill control begins by spreading an absorbent material, like vermiculite, on the spill. Spill cleanup kits are superior alternatives to vermiculite. Kits are made specifically for acids, alkalies, organic solvents and mercury and are available through RM&S or lab supply companies. These kits have many times the absorbent capacity of vermiculite. Kitty litter may also be used as a substitute for vermiculite. Each laboratory shall have appropriate spill absorbents available in the lab for the types of chemicals that are stored or used in the laboratory. After allowing the chemical to absorb, scoop up the vermiculite and deposit it into a plastic disposal bag. Wipe up the contaminated surface with soap and water and a sponge and place in the disposal bag. Tie the bag and label it with a chemical discard tag. Call RM&S (1-5037) for disposal procedure or pickup. If in doubt about the proper spill cleanup procedures, call RM&S.

## **6.0 WASTE DISPOSAL PROCEDURES**

### **6.1 BROKEN GLASS**

Broken beakers, pipettes, etc., should be promptly swept up and disposed of in containers marked "GLASS".

### **6.2 RADIOACTIVE WASTE**

Radioactive waste storage and disposal procedures are outlined in the Radiation Safety Manual.

### **6.3 CHEMICAL WASTE**

Each person working in the laboratory has a responsibility to see that all wastes are disposed of properly. Thorough chemical waste procedures are found in Appendix 10 of the Chemical Hygiene Manual.

## **Golden Rules (Short List)**

1. Each room needs to have at least 4 waste bottles:
  - a. Aqueous, Acid, Chlorinated Organics, Non-chlorinated organics (mark any if heavy metals are present)
  - b. Bottles should be labeled with what is put into them as you put it in. This means putting an official waste label on a waste container before placing any waste into it. Just a sharpie marker designation is not sufficient.
  - c. Store waste bottles in your own space until waste pickup
  - d. Waste bottles should be contained in plastic tubs (one for full bottles ready for pickup, one for partially full bottles which still may be added to)
2. After acids are used, neutralize with sodium carbonate or sodium hydroxide in an ice bath in a hood and wash them down the sink with a copious amount of running water, with the exception of nitric acid, which should be neutralized and stored for pickup. If heavy metals are present in any neutralized acid waste, keep solution in a labeled waste bottle.
3. Clean glassware often
  - a. Use proper cleaning technique. Use below methods, with priority given to the first listed method, i.e., only use aqua regia if no other methods properly clean your glassware
    - i. Rinse, soap and water, dishwasher, base bath, acid bath, aqua regia
  - b. Do not overkill the washing of glassware (dilute acid can be used most times in place of concentrated acid)
  - c. If using aqua regia, recycle it in a designated aqua regia container
  - d. Anything soaking in acid or base for cleaning should be in a contained receptacle like a plastic tub
4. Do not mix organics with acids
5. When in the laser room and the laser is on, proper safety goggles must be worn by everyone.
6. Place all unwanted needles, syringe tips, and razors in the sharps container. Unused needles, syringe tips, and razors to be used should be stored together in an organized container.
7. If you break a piece of equipment, replace it. If you break something that is commonly used by others, inform all users of the situation and when it will be fixed.
8. If someone from outside the lab wishes to take something from the lab they must check it out with the list near the door between rooms 202 and 206. They must also sign it back in when returned.
9. Use gloves when handling chemicals, do not use gloves when typing on a computer or writing with pens/pencils or touching any public item (like doorknobs/elevator buttons).
10. Replace chemicals from the shelf they were obtained, if you empty something replace it or order new material.

11. Do not wear open toed shoes in lab, take conversations to hallway if needed. Changing shoes at your desk first thing in the morning is ok.
12. Do not let any electrical outlets rest on the floor for flooding concerns.
13. Water hoses should be clamped to all fittings.
14. When using another lab put everything back where you found it and replace consumables.
15. When using a hood and are away from it for more than 1h, make a note who is working, what experiment is in progress (this includes acid or base cleaning), and any potential safety hazards.
16. If a power cord is cracked get it replaced (electronics shop).
17. Secure all gas cylinders to a wall or very sturdy table.
18. If there is a log book sign in and out of the piece of equipment and leave it a clean workstation.
19. If there is a spill that you can clean up, do it if you know the proper procedure. However, if a spill involves a dangerous gas cloud, call risk management (1-5037). Emergencies (injuries, immanent risk of injury), dial police/fire (1-5555).

**THE GOLDEN (LABORATORY) RULE:** Use common sense and think about what you are doing, ask questions if you are not sure about something, and ask before borrowing.





