1.0 PURPOSE

To ensure the protection of all laboratory employees from health hazards associated with hazardous chemicals in the laboratory. The precautions and guidelines in this Chemical Hygiene Plan are compatible with current knowledge and regulations.

2.0 SCOPE

This Chemical Hygiene Plan applies to all laboratory employees working on laboratory scale operations involving hazardous chemicals as stated in 29 CFR 1910.1450.

3.0 DEFINITIONS

Action Level - A concentration designated in 29 CFR part 1910 for a specific substance, calculated as an 8-hour time-weighted average, which initiates required activities.

Chemical Hygiene Officer - An employee who is qualified by training or experience, to provide technical guidance in the development and implementation of the provisions of the Chemical Hygiene Plan.

Chemical Hygiene Plan - A written program developed and implemented 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 the laboratory. This plan shall be reviewed and updated at least annually.

Designated Area - An area which may be used for work with select carcinogens, reproductive toxins or substances which have a high degree of acute toxicity. The designated area may be the entire laboratory, an area of the laboratories or a device such as a hood.

Hazardous Chemical - A material where studies conducted in accordance with established scientific principles indicate that acute or chronic health effects may occur in exposed employees. The term "health hazard" includes chemicals which are carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, agents which act on the hematopoietic systems, and agents which damage the lungs, skin, eyes, or mucous membranes.

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

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

Laboratory Use of Hazardous Chemicals - Handling or use of such chemicals in which all of the following conditions are met.

1. Chemical manipulations are carried out on a laboratory scale.
2. Multiple chemical procedures or chemicals are used.
3. The procedures involved are not part of a production process nor in any way simulate a production process, i.e.: pilot plant or manufacturing process.
4. Protective laboratory practices and equipment are available and in common use to minimize the potential for employee exposure to hazardous materials.

Laboratory Worker - An individual employed in a laboratory workplace who may be exposed to hazardous chemicals in the course of his or her assignments.

Medical Consultation - A consultation which takes place between an employee and a licensed physician for the purpose of determining what medical examinations or procedures, if any, are appropriate in cases where a significant exposure to a hazardous chemical may have taken place.

Principal Investigator - Faculty member or designee of department chair.

Reproductive Toxins - Chemicals which affect the reproductive capabilities including chromosomal damage (mutation) and effects on fetuses (teratogeneses).

Select Carcinogen - Any substance which meets one of the following criteria:

1. It is regulated by OSHA as a carcinogen; or
2. It is listed under the category, known to be carcinogens, in the Annual Report on Carcinogens published by the National Toxicology Program (NTP)(latest edition); or
3. It is listed under group 1 (carcinogenic to humans) by the International Agency for Research on Cancer Monographs (IARC)(latest edition) or
4. 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 different tumor incidence in experimental animals in accordance with any of the following criteria:
    a. After inhalation exposure of 6-7 hours per day, 5 days per week, for a significant portion of a lifetime to dosages of less than $10mg/m^3$;
    b. After repeated skin application of less than 300mg/kg of body weight per week; or
    c. After oral dosages of less than 50mg/kg of body weight per day

4.0 RESPONSIBILITIES

The Institutional Biosafety Committee - The Institutional Biosafety Committee (IBC), a University committee appointed by the President, has ultimate responsibility for chemical hygiene and shall provide continuing support to ensure that laboratories are operating in accordance to the Chemical Hygiene Plan. The duties of the IBC are:

1. They shall review grant proposals with regard to select carcinogen or hazardous materials use.
2. They shall assist in the review of the Chemical Hygiene Plan annually to determine that all activities are being conducted safely and in accordance with OSHA regulations.
3. They will define conditions and procedures to ensure safe use of hazardous materials in laboratories.
4. The Committee will review hazardous materials management staffing and support allotted to the Risk Management and Safety Department and make a determination as to whether this staffing and support is sufficient to carry out the duties and responsibilities necessary to meet 29 CFR 1910.1450.
5. The IBC will review reports on non-compliance with these regulations with personnel involved and if necessary administrative action will be taken to ensure the provisions of these regulations are being met.

The Chemical Hygiene Officer - The Chemical Hygiene Officer (CHO) shall be approved by the IBC. The CHO shall be qualified by training and experience in chemical safety and/or industrial hygiene and a member of the Risk Management and Safety Department. The CHO is responsible for the development and implementation of chemical hygiene practices and policies in the laboratories. The responsibilities of the CHO or authorized representative are:

1. To ensure protective equipment is available and in working order.
2. Provide appropriate training.
3. To ensure that facilities and training for use of any material being used is adequate.
4. Conduct inspections of emergency equipment, chemical hygiene, and housekeeping.
5. Provide environmental monitoring where levels may indicate over exposure.
6. Monitor the procurement of select carcinogens and OSHA regulated substances.
7. Monitor use and disposal of chemicals used in the laboratory.
8. See that appropriate audits are maintained.
9. Know the current legal requirements concerning regulated substances.
10. Oversee the management of Material Safety Data Sheets received.
11. Develop and implement the Chemical Hygiene Plan.
12. Seek ways to improve the Chemical Hygiene Plan.

Principal Investigator - the principal investigator is responsible for chemical hygiene in his/her laboratory(s). The principle investigator shall:

1. Monitor the procurement, use and disposal of chemicals used in the laboratory.
2. Ensure that laboratory employees know and follow the chemical hygiene rules.
3. Notify Risk Management and Safety when any renovations or alterations of laboratory use or design take place.
4. Provide Risk Management and Safety with an annual inventory of the hazardous materials in his/her laboratory.
5. Assign the designated area(s) in his/her laboratory.
6. Ensure that monthly inspections of eye washes and fire extinguishers are conducted and that records are maintained. Refer to sections 12.2 and 12.3.

Laboratory Worker - each laboratory worker is responsible for planning and conducting all operations in accordance with the chemical hygiene procedures and developing good personal chemical hygiene habits.

5.0 GENERAL LABORATORY PROCEDURES

5.1 BEHAVIOR IN THE LABORATORY

1. Employees shall act in a professional manner at all times.
2. Horseplay and practical jokes are expressly forbidden.
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.

5.2 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 toxic 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.

5.3 PERSONAL HABITS IN THE LABORATORY

1. Eating, drinking, chewing gum and cosmetic application are not permitted in the laboratory. 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.

5.4 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

5.5 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.

5.6 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.

5.7 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.
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.

5.8 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.

5.9 INSTRUMENT AND EQUIPMENT CARE

1. Never attempt to operate a machine or instrument until you have been properly instructed in its use.
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.

5.10 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.

5.10.1 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 be not easily bumped by passers-by or the hood doors.

5.10.2 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.

5.10.3 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.

6.0 CHEMICAL PROCUREMENT, DISTRIBUTION & STORAGE

6.1 PROCUREMENT

1. All OSHA Standard Specific Chemicals (Appendix 7) must have the approval of the Chemical Hygiene Officer or designee prior to purchase.
   Prior to purchasing approval, the following must be considered:
   a. Proper storage and handling procedures
   b. Are facilities adequate to safely handle the material, and
   c. Is there a designated area for carcinogen use in the laboratory.
2. A material safety data sheet (MSDS) shall be requested for all hazardous chemicals if the MSDS is not already on file.
3. No container should be accepted without an adequate identifying label. The label should include as a minimum the substance name, appropriate hazard warning, and precautionary measures.
4. Bulk quantity chemicals that are subdivided must be placed in containers that are labeled with the minimum information as stated above.
5. For procurement of radioactive materials consult pages 14-21 of the Radiation Safety Manual.

6.2 INVENTORY

1. Each Principal Investigator must provide a yearly inventory of all chemicals in his/her laboratory(s) to the Risk Management and Safety Department.
2. A copy of the chemical inventory for the laboratory shall be located in Appendix 1.

6.3 DISTRIBUTION

1. When chemicals are hand carried, the container should be placed in a secondary container to protect from breakage and spillage.
2. Freight elevators should be used when possible to prevent exposure to people on passenger elevators.
3. If a wheeled cart is used, it should be stable under the load and have wheels that are large enough to handle uneven surfaces without tipping over or stopping suddenly. The "tote" part of the cart should have sides to prevent roll or drop offs.

6.4 STORAGE

1. Both the storage and working amounts of hazardous chemicals shall be as small as practical.
2. All chemical containers must have a legible firmly attached label.
3. Chemical reagents shall be kept in closed containers when not in use.
4. Periodic inventories (at least annually) shall be conducted by laboratory personnel with unneeded items being discarded properly.
5. All flammables must be stored in a safety container, flammable materials cabinet, hood or refrigerator designed for that type of storage.
6. Compressed gas cylinders must be secured at all times. Safety caps should be in place when the cylinder is not in use.
7. Incompatible chemicals should be segregated.

7.0 HAZARD IDENTIFICATION, SIGNS AND LABELS

1. Labels on incoming containers of hazardous chemicals shall not be removed or defaced.
2. Material safety data sheets received with incoming shipments of hazardous chemicals shall be maintained by Risk Management and Safety Department. Material safety data sheets that are received by laboratory personnel or purchasing agent shall be forwarded to Risk Management and Safety. Material safety data sheets shall be made readily accessible to laboratory employees.
3. A hazard review of materials not previously used in the laboratory shall be completed before actual handling occurs. This review will be conducted by the Principal Investigator with the assistance of the Chemical Hygiene Officer. Carcinogen and Extremely Hazardous Substance use will be reviewed by the Institutional Biosafety Committee.
4. Chemical substances developed in the laboratory shall be assumed to be hazardous in the absence of other information.
5. Storage containers of stock or prepared solutions shall be labeled with the proper chemical name.
6. Laboratory areas that have special or unusual hazards should be posted with warning signs. These hazards may by radiation, x-ray, laser operations, flammable materials, biological hazards or other special situations.
7. Telephone numbers for Principal Investigator and laboratory personnel to be contacted in case of an emergency, shall be posted on the door entering the lab, "Emergency Laboratory Safety Information" signs shall be provided by Risk Management and Safety Department for this purpose.
8. Telephone numbers of emergency personnel shall be posted in the laboratory.
9. Location of fire extinguisher(s), safety showers, eyewash stations shall be clearly marked.

8.0 ENVIRONMENTAL MONITORING

1. Employee's exposure to OSHA regulated substances shall not exceed the permissible exposure limits (PEL) specified in 29 CFR Part 1910, Subpart Z.
2. Employee exposures to any substance regulated by an OSHA standard shall be measured when there is reason to believe that exposure levels routinely exceed the action levels. Regular monitoring of airborne concentrations should not be necessary as long as care is taken to ensure that:
   a. The ventilation system (including hoods) is performing and is being used properly;
   b. Laboratory personnel are using the proper protective equipment; and
   c. Laboratory workers are following good hygiene and laboratory safety practices.
3. If monitoring indicates exposure over the action level or PEL, then compliance with the monitoring provision of the relevant standard is required.
4. Employees will be notified of any monitoring results in writing by Risk Management and Safety Department. This notification will take place within 15 days of the receipt of the monitoring.
5. Chemical Hygiene Officer (or designee) shall be responsible for determining when exposure monitoring is necessary or appropriate.

9.0 MAINTENANCE AND INSPECTIONS

9.1 MAINTENANCE

1. All local exhaust ventilation hoods and other engineering controls shall be functioning.
2. Improperly functioning equipment, out of service equipment, and equipment under repair shall be locked out and tagged out and not restarted without the approval of Risk Management and Safety.
3. Improperly functioning equipment shall be reported immediately to maintenance.

9.2 INSPECTIONS

1. Laboratory employees shall conduct the following inspections as indicated.
    a. Personal protective equipment will be inspected before each use. (Detailed procedure is outlined in Section 11, Personal Protective Equipment.)
        1. Eye and Face Protection
        2. Gloves
        3. Respirator
        4. Clothes
    b. Local exhaust hoods will be checked before each use.
    c. Eye washes and fire extinguishers shall be inspected once a month.

2. Chemical Hygiene Officer (or designee) will conduct the following inspections annually.
    a. Fire Extinguishers
    b. Safety Showers
    c. Eye washes
    d. Emergency lighting, illuminated exit signs
    e. Local exhaust ventilation hoods
    f. Compliance with the Chemical Hygiene Plan

10.0 MEDICAL PROGRAM

1. Medical surveillance, including medical consultation and follow-up shall be provided under the following conditions;
   a. Where exposure monitoring is over the action level for an OSHA regulated substance which has medical surveillance requirements.
   b. Whenever a laboratory employee develops signs or symptoms that may be associated with a hazardous chemical to which the employee may have been exposed to in the laboratory.
   c. Whenever a spill, leak or explosion results in the likelihood of a hazardous exposure, as determined by the Chemical Hygiene Officer.
   d. All respirator wearers.
   e. All emergency responders above the awareness level.
2. All medical examinations and consultations shall be performed by, or under the direct supervision of, a licensed physician, at no cost to the employee, without loss of pay and at a reasonable time and place.
3. Medical examinations and consultations shall be performed by the University Physicians.
4. Where medical consultations or examinations are provided, the examining physician shall be provided with the following, information:
   a. The identity of the hazardous chemical(s).
   b. A description of the conditions under which the exposure occurred, including quantitative exposure data if available.
   c. A description of the signs and symptoms of exposure that the employee is experiencing, if any.
5. When examinations or consultations are provided to employees, a written opinion from the examining physician shall be obtained by Risk Management & Safety Department. It shall include:
   a. Results of the medical examination and any associated tests.
   b. Recommendations for further medical follow-up.
   c. Any medical condition revealed that places the employee at an increased risk of exposure to a hazardous chemical found in the work place.
   d. A statement that the employee has been informed by the physician of the results of the examination or consultation.

10.1 ACCIDENTS

Accidents or injuries which occur in the laboratory and require medical treatment should be treated immediately. Medical treatment for injuries incurred at work will be administered by University Health Services professionals on campus. Necessary referrals to other physicians specialists, or facilities will be determined by Health Services.

University Health Services is staffed 24 hours a day, seven days a week when classes are in session. Hours are reduced during spring, fall, Christmas and summer breaks.

Medical treatment that cannot be provided by University Health Services will be administered by professionals at St. Joseph's Medical Center.

For locations, see maps in Appendix 6.

11.0 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.

11.1 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.

11.2 GLOVES

1. Chemical resistant gloves shall be worn whenever the potential for skin contact with hazardous materials exists. A "Chemical Resistance Chart for Gloves" is found in Appendix 11.
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.

11.3 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.

11.4 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.

11.5 RESPIRATORS

Employees issued a respirator must follow all the requirements set forth in the Respiratory Protection Program, Appendix 2.

11.6 EMPLOYEE TRAINING

Employees should not use any personal protective equipment until they have received instruction on the proper selection, use, and limitations of the equipment.

12.0 EMERGENCY EQUIPMENT

12.1 GENERAL

Each laboratory employee shall be familiar with the location, application, and the correct way to operate the following equipment:

1. Fire extinguishers
2. Fire Alarms
3. Smoke or heat detectors
4. Fire suppression systems
5. Safety Showers
6. Eyewash stations
7. Emergency response cart (Stepan & Nieuwland)

12.2 SAFETY SHOWERS AND EYE WASHES

1. Safety showers and eye washes should be within 25 feet of the work area for immediate emergency use.
2. Safety showers and eye washes should be plumbed and provide at least 15 minutes of flushing.
3. Inspections
   a. Monthly by laboratory employees
      1. Safety showers shall be checked for accessibility.
      2. Eye washes shall be checked for accessibility and operation.
      3. These inspections should be documented by initialing the card by the eye wash.
   b. Periodic
      1. Safety showers and eye washes will be tested annually by Preventive Maintenance.
      2. Adequate flow will be observed and documented.

12.3 FIRE EXTINGUISHERS

1. Fire extinguishers should be provided within 30 feet of travel and located along normal paths of travel.
2. Access must be maintained and the location should be conspicuously marked in an appropriate manner.
3. The fire extinguisher type and size must be selected for the appropriate hazards.
4. Inspections and servicing.
    a. Monthly inspections by laboratory employee
        1. The extinguisher is in its designated location.
        2. Access is maintained.
        3. The pin is in place and attached by an unbroken wire.
        4. No indication of physical damage.
        5. These inspections should be documented by initialing the inspection card by the extinguisher.
        6. If any problems are noted, the Notre Dame Fire Department should be notified immediately.
    b. Semiannual inspections by Notre Dame Fire Department or its authorized representatives.
        1. The extinguisher is in its designated location.
        2. Access is maintained.
        3. The pin is in place and attached by an unbroken wire.
        4. No indication of physical damage.
        5. These inspections should be documented.
    c. Annual servicing and maintenance by Notre Dame Fire Department or its authorized representative will involve a complete and thorough examination, including the mechanical parts, the amount and condition of the extinguishing agent, and the agent's expelling device. These activities will be documented.

12.4 FIRE ALARMS

1. Fire alarms must be provided along normal paths of travel, along exit routes.
2. Inspections occur every six months by the Notre Dame Fire Department or its authorized representative.

12.5 SMOKE OR HEAT DETECTORS

Smoke or heat detectors are inspected semiannually by the Notre Dame Fire Department or its authorized representative.

12.6 FIRE SUPPRESSION SYSTEMS

1. The fire suppression system must be selected based on the hazards.
2. Inspections will take place semiannually by the Notre Dame Fire Department or its authorized representative.

12.7 EMERGENCY RESPONSE CARTS

1. Emergency response carts are located in or near teaching laboratories in Stepan Chemistry and Nieuwland Science Halls and contain the following items.
   a. Respirator (organic vapor-acid gas)
   b. Gloves, goggles
   c. Spill kits for acids, caustics and solvents
   d. ABC fire extinguisher
   e. Metal fire extinguisher
   f. First aid kit: band-aids, alcohol rubs, kling gauze, adhesive tape
   g. Hand broom
   h. Plastic trash bags
2. The emergency response carts shall be inspected for missing or damaged items by the Chemical Hygiene Officer (or designee) before each semester and during semester breaks. These inspections shall be documented.

13.0 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.

13.1 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 STUDENT ROOMS
DIAL 911

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 (APPENDIX 3) must be followed.

13.2 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 (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. For more detailed information see Appendix A - "Procedures to follow in case of an Emergency".

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 Office, 636 Grace Hall. A Supervisor's Accident Investigation Report form should also be completed and forwarded to the Insurance Office within 5 days of the accident. Copies of these forms are available through your departmental office.

13.3 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 1-5555.
3. If it is suspected or known that the spill is extremely dangerous:
    a. Call Security (911) who will alert the Fire Department and Risk Management Safety.
    b. Evacuate the building.

13.4 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 RMS 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 Risk Management and Safety (1-5037) for disposal procedure or pickup. If in doubt about the proper spill cleanup procedures, call Risk Management and Safety.

14.0 ACCIDENT REPORTING

1. All near accidents and all accidents, whether resulting in injury or damage, should be carefully analyzed and the results reported to all who might benefit.
2. Injuries requiring medical attention must be reported immediately and appropriate medical treatment provided.
3. STEP-BY-STEP REPORTING PROCEDURE
    a. Employee reports occupational injury or illness to immediate supervisor. Supervisor's primary responsibility is the welfare of the injured employee.
    b. Supervisor, or other qualified person, evaluates the severity of the occupational injury or illness.
        1. Extremely minor: (slight cut, scratch, etc.) minor first aid (i.e. band aid) may be given at the job site. An employee who desires additional treatment must be immediately sent to University Health Services.
        2. Serious injuries and illnesses: Security and/or ambulance must be summoned to transport the employee to an emergency facility.
        3. All others: Employee is referred to University Health Services for diagnosis, treatment or referral.

You should note that in any case where you are not sure of the severity of the injury or where the employee should be referred to, they should be immediately sent to University Health Services. Also, an injured employee desiring treatment from his family physician or a specialist must be sent to University Health Services-not to their own physician.

All work related illnesses (rash, etc.) require evaluation by physicians at the University Health Services.

    c. When the occupational injury results in referral to the University Health Services (including all occupational illnesses), the following requirements must be met:
        1. Supervisor completes the Supervisor's Report of an Injury to the University Health Services.
        2. The Supervisor's Report of an Injury Form must accompany the injured or ill employee to Health Services in order to be treated.
        3. The Supervisor's Report of an Injury Form is used as verification that the injury or illness occurred, or allegedly occurred, at work.
        4. The employee is treated and/or referred by a University Health Services' physician.

5. University Health Services will complete its Employee Injury/Treatment Report and provide a white copy to the employee's department that indicates the disposition of the employee (i.e. referred to hospital, sent home, returned to work, etc.).
6. Should an injury be such that the employee is unable to return to work, the University Health Services will telephone this status to the employee's Supervisor.

d. As soon as possible (but within 48 hours), the Supervisor, or other designated department official, must submit the following:

1. State of Indiana, Worker's Compensation Board Form #34401. This is the First Report of Injury Form.

   It must be forwarded to Carla Beadles, Risk Management and Safety Department, 636 Grace Hall, within 48 hours. It is important to note that insurance claims cannot be filed or paid until the report is processed by Ms. Beadles.

2. Notre Dame Supervisor's Accident Investigation Form. This form is available from Carla Beadles Risk Management and Safety Department.

   This is an in-house form to insure that accidents are investigated by the supervisor, and any necessary actions are taken to prevent a recurrence.

   The completed form is forwarded to Mike McCauslin, Risk Management and Safety Department, as soon as possible.
   All injury or worker compensation forms can be obtained from Risk Management and Safety Department

15.0 RECORD KEEPING

1. Accident/incident records and OSHA 200 forms shall be retained for 5 years by the Risk Management and Safety Department.
2. Medical records shall be retained for employment for 30 years.
3. Inventories of hazardous chemicals used/stored in the laboratory shall be kept by the Chemical Hygiene Officer for 5 years.
4. Industrial hygiene monitoring records shall be maintained for 30 years.

16.0 EMPLOYEE TRAINING

16.1 TRAINING

1. All laboratory employees shall be trained on the hazards of chemicals present in their work area.
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 associated with exposure associated to hazardous chemicals used in the laboratory.

16.2 REFERENCE MATERIALS

1. Material Safety Data Sheets shall be maintained by the Chemical Hygiene Officer for all hazardous chemicals used in the laboratory. These will be located at 636 Grace Hall. Additional locations are listed below:
   a. Radiation Laboratory MSDS- Rad Lab Stockroom
   b. Chem/Physics Library
   c. On the internet
2. The following references are available in the Risk Management and Safety Department Library:
   a. National Research Council. Prudent Practices for Handling Hazardous Chemicals in Laboratories (National Academy Press, 2101 Constitution Ave., Washington, D.C. 10418).
   b. National Research Council. Prudent Practices for Disposal of Chemicals from Laboratories (National Academy Press, 2101 Constitution Ave., Washington, D.C. 10418).
   c. Irving Saz. Dangerous Properties of Industrial Materials, 6th Edition, Von Nostrand Reinhold Co., New York, New York, 1984.
   d. NIOSH Registry of Toxic Effects of Chemical Substances, 1978. (Superintendent of Documents, U.S. Govt. Printing Office, Washington, D.C. 20402).
   e. Patty's Industrial Hygiene and Toxicology, 3rd Edition, 1981. (Wiley-Interscience Publication, New York).
   f. SAFETY - The Sigma-Aldrich Library of Chemical SafetyData., 1st Edition, 1985 (Sigma-Aldrich Corp., P.O. Box 355, Milwaukee, WI 53201).
   g. L. Bretherick. Handbook of Reactive Chemical Hazards, 2nd Edition, 1981. (Billing & Sons LTD), London, England).

17.0 ENGINEERING CONTROLS

17.1 GENERAL VENTILATION SYSTEM

1. General laboratory ventilation shall provide air flow into the laboratory from non-laboratory areas and exhausted to the exterior of the building.
2. The system should ensure that laboratory air is continually replaced, preventing increase of air concentrations of toxic substances during the working day.
3. Air intakes for a laboratory building should be located in such a way that reduces the possibility that the input air will be contaminated by exhaust air.

17.2 LOCAL VENTILATION DEVICES

1. The fume hood is the primary local ventilation device in a laboratory.
2. Other local ventilation devices include ventilated storage cabinets, glove boxes, canopy hoods, snorkels, etc.
3. Local exhaust ventilation should not be located near doors, windows, air diffusers, fans and other sources of cross drafts.
4. All reactions that produce unpleasant odors and/or potentially hazardous fumes, vapors, or gases must be run with or in a local ventilation device.
5. The sash of the hood is to be lowered to within 6" of the floor of the hood when the hood is in use to maintain effectiveness of the ventilation system and personal protection.
6. Hoods are not intended primarily for storage of chemicals. Materials stored in hoods should be kept to a minimum and they should not block vents or alter airflow patterns.
7. Some hoods are designed for specific hazards such as perchloric acid. Be sure to use the proper hood.

17.3 MAINTENANCE AND INSPECTIONS

The quality and quantity of ventilation shall be evaluated upon installation, annually and whenever a change in local ventilation devices is made. These inspections should be documented.

1. Capture velocity should be measured with a velocity meter. The minimum capture velocity at the face of the hood should be 100 fpm at 12" sash opening..
2. Exhaust fan maintenance (penthouse fans/blowers) are checked yearly by Preventive Maintenance.

17.4 VENTILATION FAILURE

In case of hood failure and there is a hazardous chemical release, notify Securityat 911 and evacuate the area.

18.0 CHEMICAL HANDLING PROCEDURES

18.1 GENERAL

Know as much as possible about the chemical you are handling. Read the container label, material safety data sheets, literature in the library and consult with your supervisor or the Chemical Hygiene Officer.

18.2 FLAMMABLE LIQUIDS

A flammable liquid means any liquid with a flash point below 100°F (37.8°C).
A combustible liquid means any liquid with a flashpoint at or above 100°F (37.8°C) but below 200°F (93.3°C).

18.2.1 HAZARDS

1. Vapors can form an ignitable mixture in air.
2. Many flammable liquids are solvents and are potentially hazardous by inhalation.
3. Skin contact should be avoided, irritation or skin absorption are possible with some flammable chemicals.
4. Damage to the eyes ranges from irritation to severe damage.

18.2.2 STORAGE

Storage of Flammable Liquids

The OSHA standard for the maximum storage of flammable liquids is as follows.
For more information, refer to the OSHA General Industry Standards.

The maximum capacity to be stored in a storage cabinet is 60 gallons of flammable or 120 gallons of combustible liquids. Of these volumes, the following table lists the minimum allowable capacity of containers to be stored within the storage cabinet.

	FLAMMABLE LIQUIDS				COMBUSTIBLE LIQUIDS
Classification	IA	IB	IC	II	IIIA
Flash Point	<73°F	<73°F	>73°F	>100°F	>140°F
		<100°F	<140°F		
Boiling Point	<100°F	>100°F			

MAXIMUM QUANTITY PER CONTAINER

Container Type					
Glass or plastic	1 pt	1 qt	1 gal	1 gal	1 gal
metal (sealed from mfg)	1 gal	5 gal	5 gal	5 gal	5 gal
safety cans	2 gal	5 gal	5 gal	5 gal	5 gal
metal drums (DOT spec)	60 gal	60 gal	60 gal	60 gal	60 gal

The maximum amount to be stored outside of a storage cabinet in any one fire area is 25 gallons for the other four classes. They all must be stored in safety containers.

Each storage cabinet must be located in a minimum of three feet away from any other solvent storage cabinet.

It is recommended that each laboratory within a section (room, bay, etc.) not possess, outside of a solvent storage cabinet, more than 6 gallons of class IA liquid in an appropriate safety container and not more than 30 gallons of class IB, IC, or IIIA liquids in the appropriate safety containers.

As a general rule, once metal cans are opened the contents should be transferred immediately into safety containers. Since static charge can build up while pouring liquids, **proper grounding and bonding is essential!** If using alligator clips, make sure the contact surface is metal - not paint. For a paint surface, carefully scrape, remove with a solvent or use a screw-type clamp to get a metal-to-metal contact. Adequate ventilation is also necessary. Don't forget eye protection.

Solvents are a necessary part of every laboratory and have the potential for causing a lot of trouble, but with common sense they can be handled safely.

Definitions

A) Flammable Liquids

Flammable Liquids shall be divided into two classes of liquids as follows:

1) Class I liquid shall include those having flash points below 100° F and may be subdivided as follows:
   a) Class IA shall include those having flash points (closed cup) below 73° F and having a boiling point at or below 100°F.

   b) Class IB shall include those having flash points (closed cup) below 73° F and having a boiling point at or above 100° F.

   c) Class IC shall include those having flash points (closed cup) at or above 73° F and below 100° F.

2) Class II liquids shall include those having flash points (closed cup) at or above 100° F and below 140° F.

B) Combustible Liquids

Combustible liquids shall mean any liquid having a flash point (closed cup) at or above 140° F and shall be known as Class III liquids. Class IIIA shall include those having flash points (closed cup) at or above 140° F and below 200° F. Class IIIB shall include those having flash points (closed cup) at or above 200° F.

C) Aerosols

Aerosols labeled "Flammable" shall be considered Class IA liquids for the purposes of storage.

D) Flash Point

Flash point is the temperature at which a liquid has a vapor pressure sufficient to for an ignitable mixture in the air near the surface of the liquid. Open cup flash points vary several degrees higher than close cup flash point.

E) Fire Area

An area of a building separated from the remainder of the building by construction having a fire resistance of at least 1 hour and having all communication openings properly protected by an assembly having a fire resistance rating of at least 1 hour.

F) Safety Can

Safety can shall mean an approved container, of not more than 5 gallons capacity, having a spring-closing lid and spout cover and so designed that it will safely relieve pressure when subjected to fire exposure. It shall be painted red.

G) Safety Storage Cabinet

Storage cabinets shall be designed and constructed to limit the internal temperature to not more than 325° F when subjected to a 10-minute fire test using standard temperaturere set forth in standard methods of fire tests of building construction material NFPA-251-1969. All joints and seams shall remain
tight and the door shall remain securely closed during the fire test. Cabinets shall be labeled with conspicuous lettering, "Flammable, Keep Fire Away."

18.2.3 CONTROLS

1. Work in the hood as much as possible.
2. All spills must be cleaned up immediately and the spill area must be properly decontaminated.
3. Transfer from drums only when both drum and safety can are grounded and bonded.
4. Emergency showers and eye washes shall be used when skin or eye contact occur. Get first aid attention immediately.
5. Care should be taken when using hotplates to heat flammable liquids. Many models of hotplates are not intrinsically safe. (The heating element is not sealed). Vapors can travel under the plate and ignite. Use heating mantles whenever possible.

18.3 CORROSIVE CHEMICALS

A corrosive chemical is a chemical that causes visible destruction of, or irreversible alterations in, living tissue by chemical action at the site of contact.

18.3.1 HAZARDS

Contact with skin, eyes, respiratory or digestive tract causes severe irritation or burns.

18.3.2 STORAGE

1. Always store concentrated acids and bases in an appropriate cabinet or drip trays.
2. Always store oxidizing acids (nitric, sulfuric, perchloric) away from organic chemicals, paper, wood, or other flammables.
3. Drip tray residues should be cleaned regularly.

18.3.3 CONTROLS

1. Wear protective clothing.
2. Wear splash goggles.
3. When pouring or transferring corrosives, never add water to concentrated mineral acids or bases.
4. In case of splash:
    a. Flush affected area with large amounts of water for at least 15 minutes.
    b. Remove contaminated clothing.
    c. Seek medical attention.

18.4 REACTIVES

A reactive (unstable) chemical is one which in the pure state, or as produced or transported, will vigorously polymerize, decompose, condense or will become self reactive under conditions of shock, pressure or temperature.

18.4.1 HAZARDS

1. Water sensitive chemicals react violently in the presence of water.
2. Pyrophoric materials ignite in air at or below room temperature in the absence of added heat, shock or friction.

18.4.2 STORAGE

1. Store water reactives according to label directions.
2. Pyrophorics should be stored in an atmosphere or inert gas or under kerosene; exclude air.

18.4.3 CONTROLS

1. Wear proper safety equipment.
2. Read precautionary label.
3. Use only in a hood/glove box.

18.5 COMPRESSED GASES

Compressed gas means:

1. A gas or mixture of gases having in a container, an absolute pressure exceeding 40 psi at 70°F (21.1°C); or
2. A gas or mixture of gases having, in a container, an absolute pressure exceeding 104 psi at 130°F (54.4°C) regardless of the pressures at 70°F (21.1°C); or
3. A liquid having a vapor pressure exceeding 40 psi at 100°F (37.8°C) as determined by ASTM D-323-72.

18.5.1 HAZARDS

1. Compressed gases may be flammable, toxic or corrosive.
2. Compressed gases which are heated may result in an explosion.
3. Gas cylinders with a broken valve head becomes a missile capable of penetrating walls.

18.5.2 STORAGE AND USE

1. General Standards
   a. All compressed gas cylinders must be secured to wall or lab bench. Cylinder stands or supports for smaller bench size gas cylinders.
   b. Leave valve safety caps in place except when the cylinder is in use.
   c. Cylinders shall be clearly marked with the content name. Do not remove or deface labels, decals, etc., provided by the supplier for identification.
   d. Cylinders shall be clearly marked with the content name. Do not remove or deface labels, decals, etc., provided by the supplier for identification.
   e. Leave valve safety caps in place except when the cylinder is in use.
   f. Valve adapters should not be used.
   g. A pressure-regulated device shall be used at all times to control the flow of gas from a cylinder.
   h. Never attempt to repair or alter cylinder valves or safety relief devices.

2. Liquid Nitrogen

   Individuals working with liquid nitrogen should wear eye protection and gloves or use protective thermal pads to avoid “burns”.

3. Pressure Regulators and Needle Valves

Needle valves and regulators are designed specifically for different families of gases. Use only the properly designed fittings.

a. Threads and surfaces must be clean and tightly fitted. Do not lubricate.
b. Tighten regulators and valves firmly with the proper size wrench (Avoid using adjustable wrenches or pliers as they can damage nuts). Do not force tight fits.
c. Open valves slowly. Do not stand direct in front of the gauges. (Gauge face may blow out). Do not force frozen valves.
d. Shut off cylinders when not in use.
e. Use new or good tubing (Tygon, ideally, not old cracked rubber tubing) to transfer toxic gases from pressurized cylinders.
f. Seal the regulator or needle valve to the cylinder over the threads with Teflon tape to insure a good seal.
g. Lecture bottles should have a lead washer present when using a needle valve. With the needle valve open and the cylinder valve closed, there should be a good vacuum on the hose and valve. If not, you have a leak. Don't take chances - - fix it.

4. Leak Testing

Cylinders and connections should be tested by "Snoop" or a soapy water solution.

18.5.3 CONTROLS

1. Always open valves cautiously and slowly.
2. Return empty.
3. For standard operation procedure or regulators and needle valves.

18.6 RADIOACTIVE MATERIALS

Refer to pages 31-46 in the Radiation Safety Manual for hazard identification, storage and control measures.

18.7 TOXIC METALS

18.7.1 HAZARDS

These materials are toxic by inhalation, ingestion and possible skin absorption.

18.7.2 STORAGE

1. Store only the minimum quantity necessary.
2. Make sure lids are replaced securely.

18.7.3 CONTROLS

1. Work in the hood as much as possible.
2. Spills should be cleaned up immediately.

18.8 CARCINOGENS, MUTAGENS, TERATOGENS AND REPRODUCTIVE TOXINS

18.8.1 HAZARDS

Exposures can potentially induce carcinogenesis, mutagenesis, or adverse reproductive outcomes.

18.8.2 STORAGE

1. Maintain the minimum quantity necessary.
2. Store these chemicals in the hood, glove box or vented cabinet.

18.8.3 CONTROLS

1. Wear disposable protective clothing.
2. Work only with adequate engineering controls, such as hoods, glove boxes, etc.
3. Work in designated area ONLY (See Section 19.0).

19.0 WORK WITH SUBSTANCES OF MODERATE TO HIGH CHRONIC TOXICITY OR HIGH ACUTE TOXICITY

1. A designated area must be established for work with "select carcinogens", reproductive toxins and substances which have a high degree of acute toxicity. This area will be assigned by the Principal Investigator. It will be conspicuously marked by a warning sign.
2. Access to designated areas will be restricted to personnel who are trained about the hazards and safe handling of the materials.
3. Work with these materials should take place in a fume hood, glove box or similar equipment.
4. No food, beverages or tobacco products should be permitted in the designated areas.
5. Workers should wash their hands before leaving the area.

6. Protective clothing worn in designated areas should not be worn outside of that area.
7. Maintain records of the amounts of these materials used and stored and the names of workers involved.
8. Pre-emergency planning must take place before working with these materials.
9. Assure that emergency equipment and materials to minimize exposure to people and property are available in case of emergency.
10. All containers of these substances must be labeled with identity and warning.

Certain toxic materials require additional handling procedures. See below.

19.1 ALLERGENS (Examples: diazomethane, isocyanates, bichromates)

A wide variety of substances can produce skin and lung hypersensitivity. Because of this variety and the varying response of individuals, suitable gloves should be used to prevent hand contact with allergens.

19.2 EMBRYO TOXINS (Examples: organomercurial, lead compounds, formamide)

1. Women of child bearing potential should take care to avoid contact with these materials.
2. Hoods, glove boxes or other essential engineering controls should be known to be operating at required efficiency before work with EMBRYO TOXINS is started.
3. Store these substances, properly labeled, in an adequately ventilated area in a secondary container.
4. Notify supervisor of all incidents of exposure or spills.
5. Disposable protective clothing should be worn when working with these substances.
6. Conduct all work and transfers in the designated area.

20.0 OPERATIONS REQUIRING PRIOR APPROVAL

1. Lab personnel must obtain prior approval from the Institutional Biosafety Committee before commencing operations involving recombinant DNA. This is to assure that safeguards are in place and that personnel are adequately trained.
2. Prior approval must be obtained from the Institutional Animal Care and Use committee before purchasing animals. Contact Richard Hilliard, Director of Research Compliance, Graduate School Research Division.
3. Prior approval is required when procuring radioactive materials and select carcinogens (See Section 6.1).
4. Lab personnel must obtain prior approval from the Institutional Biosafety Committee before commencing operations involving extremely toxic, environmentally harmful or reactive materials, including but not limited to PCBs, TNT, RDX, HMX, Dioxin, and Silane.

21.0 WASTE DISPOSAL PROCEDURES

21.1 BROKEN GLASS

Broken beakers, pipettes, etc., should be promptly swept up and disposed of in puncture proof resistant containers (such as a card board box) . The box must be taped shut and marked " BROKEN GLASS".

21.2 INFECTIOUS WASTE

Infectious waste disposal procedures are outlined in "Guidelines for the collection, handling and disposal of infectious waste. (Appendix 4)

21.3 RADIOACTIVE WASTE

Radioactive waste storage and disposal procedures are outlined in the Radiation Safety Manual pages 46-50.

21.4 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 12.

21.5 USED FLUORESCENT LIGHT BULBS

Fluorescent light bulbs cannot go into the regular trash. They must be boxed. The box must be taped shut and labeled: USED LAMPS CONTAINING MERCURY. Building Services will pickup the boxes for recycling.

22.0 REFERENCES

1. Code of Federal Regulations, 29 CFR Part 1910, Subpart Z. U.S. Government Printing Office, Washington, DC 20402 (latest edition). (Toxic and Hazardous Substances).
2. Code of Federal Regulations, 29 CFR Part 1910.1450, "Occupational Exposure to Hazardous Chemicals in Laboratories".
3. Code of Federal Regulations, 29 CFR Part 1910.134, "Respiratory Protection".
4. Code of Federal Regulations, 29 CFR Part 1910.95, "Occupational Noise Exposure".
5. Code of Federal Regulations, 29 CFR Part 1910.120, "Hazardous Waste Operations and Emergency Response".
6. Code of Federal Regulations, 29 CFR Part 1910.147, "The Control of Hazardous Energy (Lock Out/Tag Out)".
7. University of Notre Dame Radiation Safety Manual.
8. University of Notre Dame Chemical Safety Manual.
9. University of Notre Dame Emergency Response Plan.
10. University of Notre Dame Respiratory Protection Program.

Appendix 1 CHEMICAL INVENTORY

This plan is prepared in accordance with 20CFR 1910.120 paragraph (q)

I. Introduction

This emergency response plan is designed to minimize hazards to human health or the environment from fires, explosions and hazardous materials incidents. It is also designed to provide procedures to be implemented to handle hazardous materials incidents in the event an incident occurs.

II. Pre-Emergency Planning

Meetings with personnel from Risk Management and Safety Dept. and the primary Police and Fire Dept. Directors have resulted in a coordination of responsibilities and the designation of an Incident Command System.

Personnel involved are familiar with the layout of the campus and the properties of the hazardous materials involved in the various buildings on campus.

Secondary Fire/Hazardous Materials Response Team (South Bend Fire Dept.'s Haz Mat Team) has been contacted and a list of its resources has been made available. It has agreed to provide support to the primary emergency authority when requested.

Inspections of the various facilities on campus have been conducted by Risk Management and Safety Dept. personnel to identify the types and quantities of hazardous materials present.

III. Personnel Roles, lines of Authority and Communication

In the event of an emergency hazardous materials incident, personnel roles and lines of authority are established as follows:

Security personnel who discover or are made aware that an emergency materials release has occurred are to:

1. Alert all persons in the area of the emergency
2. Notify Fire Department
3. Notify Risk Management & Safety
4. Secure the area

When the Fire Department personnel arrive, the senior officer becomes the "Senior Official on Scene" and is responsible for:

1. Establishing an Incident Command post (site)
2. Evaluating site to determine necessity of South Bend Haz Mat
3. Calling South Bend Haz Mat if deemed necessary
4. Evacuating personnel to safe zones
5. Identifying materials to the extent safely possible
6. Controlling area with assistance of Security Dept. personnel

The position of the "Senior Official on Scene" gets passed to Risk Management and Safety personnel or South Bend Haz Mat as they arrive on the scene.

IV. Emergency Recognition & Prevention

Each emergency responder is trained/retrained according to his respective role in an emergency compliance to this standard.

The initial training includes emergency recognition and identification.

Persons in work areas with hazardous materials have been trained in compliance with the OSHA Hazard Communication Standard. Prevention of hazardous materials incidents is included in the training on how to handle the material.

V. Evacuation Routes

In some buildings on campus, there are "Emergency Evacuation Routes" posted on the walls. All Exits are clearly marked with lighted signs and these signs are inspected three times per year.

Key routes for evacuation from campus are Juniper Road to the east, State Road 933 west, Douglas to the north, Angela/Edison to the south.
Determination of which route to take will be on a case by case basis.

VI. Emergency Alerting

During a hazardous materials incident emergency alerting and/or evacuation of the necessary buildings could be handled by a couple of different methods. Depending on the building and the scope of evacuation necessary, a pull station might be used to sound the fire alarm. In other circumstances, a door-to-door alert may be used. The door-to-door alert may be handled by security and/or fire personnel or faculty members present on the scene. The method used is left to the discretion of the Officer in charge.

VII. Decontamination

After the emergency operations have been terminated, the individual in charge of the Incident Command shall implement appropriate decontamination procedures. Because of the nature and varying properties of hazardous materials that may be involved it requires a case by case assessment.

VIII. Emergency Medical Treatment

In the event of human exposure, University Health Services and local medical facilities would be utilized.

If the assessment of the release indicates that evacuation of the local area may be advisable, appropriate local officials must be notified immediately. Officials from the Department's below may need to be contacted.

- Notre Dame Security Department Emergency
  #911

- St. Joseph County Emergency Management
  #235-9234

- St. Joseph County Police
  #235-9611

- IDEM
  #317-233-7745 or Toll free 888-233-7745

If evacuation is advisable, Risk Management and Safety personnel shall immediately report to the:

Emergency Response Team 1-317-633-0144
Indiana State Board of Health

All communications regarding site operations must go through the incident command.

IX. Critique of Response and Follow-Up

After an emergency situation has taken place, all personnel involved are to meet and discuss problem areas where personnel or the plan fell short of its intent and to assess the areas that went smoothly. If the cause was identifiable, follow up measures must be taken to assure that it would not occur again.

X. PPE and Emergency Equipment

1. One 10-pound CO_2 Fire Extinguishers, Type Bc, Amerex Corp. Model 330. This is wall-mounted inside the Risk Management and Safety vehicle and is serviced annually and following discharge.
2. Self-contained breathing apparatus available from the University Fire Department and Risk Management and Safety vehicle. Accessible in five minutes. Fire Department equipment: six 30-minute air tanks, two 15-minute air tanks, three 15-minute air tanks. Risk Management & Safety equipment: two 15-minutes air tanks.
3. Face shields, gloves, safety goggles, protective coats, and aprons are available in the Risk Management and Safety vehicle.

4. Organic solvent and acid respirators are available on Risk Management and Safety vehicle. These should not be used in solvent or acid environments, which exceed 1000 ppm.

5. Spill Control Material:
   2 - Salvage Drums
   20 - 250 ml Spill Absorbent Pillows
   10 - 1 Liter Spill Absorbent Pillows
   15 - Cubic Feet of Absorbent Material
   (i.e.: vermiculite or dry clay material)
   200 Absorbent Pads
   These items are located in the Spill Response Supply Room in the Risk Management & Safety Services Building (RMS Services) and some are stored in the Risk Management and Safety vehicle

6. Neutralizing material for small acid or base spills available at RMS Services and on emergency carts in Nieuwland and Stepan Chemistry Hall.

7. Assorted cleaning agents to decontaminate equipment or areas available at RMS Services and accessible in 5 minutes.

8. 2 Haz Mat suits that totally encapsulate over SCBA's are stored in Risk Management and Safety vehicle.

9. 2 Bunker outfits at HWPB.

APPENDIX 4 GUIDELINES FOR THE COLLECTION, HANDLING, AND DISPOSAL OF INFECTIOUS WASTE

The University of Notre Dame, in its continual efforts to protect the health and safety of its employees, students, and guests, has instituted an infectious waste disposal program. The program is required under Indiana State Board of Health regulations, Title 410.

The University recognizes that the various researchers and departments involved with infectious material and waste go to great extremes to insure that the material is handled as safety as possible and protection is afforded at all times. The University also recognizes that the disposal of infectious waste has become a national problem and it is with this understanding adopts these following guidelines. The following guidelines are instituted in order to additionally safeguard the employees and students who handle infectious waste products, and includes the responsibilities of individuals, researchers, and departments in the safe handling of disposal of infectious waste.

Infectious waste, while a very broad term, is generally accepted in include waste that epidemiological evidence indicates is capable of transmitting dangerous communicable diseases. This definition includes but is not limited to:

Cultures and stocks of infectious agents and associated biologicals. Including cultures from medical and pathological laboratories; cultures and stocks of infectious agents from research and industrial laboratories, waste from the production of biologicals; discarded live and attenuated vaccines and culture dishes and devices used to transfer, inoculate, and mix cultures.

1. Pathological wastes.

   Body tissues and their containers.

2. Human or animal blood and blood products.

   Liquid waste, human and animal blood, products of blood, items saturated or dripping with human or animal blood; items that were saturated and dripping that are now caked with dried human or animal blood; including serum, plasma, and other blood components and their containers which were used or intended for use either in patient care, testing, laboratory analysis, research, or the development of pharmaceuticals. Intravenous bags are also included in this category.

3 Used and unused sharps

   Sharps that have been used in animal or human patient care, treatment or medical research, or industrial laboratories; including hypodermic needles, syringes (with or without the attached needle), Pasteur pipettes, scalpel blades, blood vials, needles with attached tubing, and culture dishes (regardless of presence of infectious agents). Also included are other types of broken or unbroken glassware that were in contact with infectious agents such as used slides and cover slips.

4. Contaminated Animal Carcasses

Contaminated animal carcasses, body parts, and bedding of animals that wereknow to have been exposed to infectious agents during research (including research in veterinary hospitals), production of biologicals or testing of pharmaceuticals.

5. Other waste that has been intermingled with infectious waste. Any material (i.e. : paper products, plastic products, disposables), that has at any time been in contact with or believed to have been in contact with any infectious agent.

INFECTIOUS WASTE GENERATORS

It shall be the responsibility of the infectious waste generator (i.e.: individual, researcher, department) to adhere to the following guidelines and procedures as listed:

The individual generator (researcher, department) shall be required to render innocuous all infectious waste (except sharps and sharps containers, animal carcasses and contaminated bedding) through autoclaving prior to discard as solid waste.

1. The individual generator (researcher, department) upon autoclaving shall be required to separate the infectious waste as follows:
   a. Used and unused sharps should be placed in the container identified as SHARPS.
   b Infectious cultures and stocks, pathological waste, and human blood products should be placed in the container labeled as CULTURES, PATHOLOGICALS, BLOOD, (after autoclaving).
   c. Contaminated animal bedding be placed in the container labeleld ANIMAL BEDDING.
   d. Contaminated animal carcasses should be properly protected and frozen.
2. It shall be the individual department's responsibility to provide protective garments as necessary to persons involved in infectious agent research or infectious waste handling.
3. The individual generator (researcher, department) has the responsibility to ensure that the infectious wastes are located in the appropriate container, that the container lids are kept on, and that the general area is maintained in a clean and sanitary condition.
4. Keep infectious waste storage area secured or otherwise protected from unauthorized entry.

RISK MANAGEMENT AND SAFETY RESPONSIBILITIES

It is the responsibility of Risk Management and Safety Department to collect, treat (if necessary) and dispose of infectious waste generated a the University of Notre Dame. Representatives of Risk Management and Safety shall collect the various containers of infectious waste and animal carcasses on a scheduled basis and transport these materials to the department's waste processing facility.

It is also the responsibility of Risk Management and Safety to maintain records indication amount (in pounds) of each class of waste material and notation of researcher or department prior to final disposal. Risk Management and Safety shall maintain in the responsibility for final disposal of infectious waste of the following means:

1. The Department may contract with a licensed infectious waste disposer to dispose of infectious waste
2. The Department may utilize other technologically possible and approved means available.

Risk Management and Safety will provide, at cost to the individual department, adequate containers with appropriate labeling to be located in secured building or department areas (as selected upon mutual agreement between Risk Management and Safety and the researcher or department). The biohazard symbol will be displayed at all storage areas. The containers will, as required, be as follows:

1. Sharp Containers
    a. Leakproof, rigid and puncture resistant
    b. Labeled with the biohazard symbol
2. Other infectious waste:
    1. impervious to moisture
    2. of sufficient strength
    3. secured
    4. labeled with the biohazards symbol

At all times prior to disposal, infectious waste will be stored in a secure area, protected from adverse environmental conditions and identified with the biohazard label.

It shall be the responsibility of Risk Management and Safety to provide necessary instruction and training in Universal precaution procedures and all other applicable guidelines regarding the handling or transportation of infectious waste. Records of instruction including an attendance record shall be maintained by Risk Management and Safety.

All records, including waste shipments, weights, departments, disposal, instruction, training attendance and any other pertinent or necessary records shall be maintained by the Department of Risk Management.

Violations of any of the above guidelines will be handles as any violation of University guidelines by the University's Department of Human Resources in conjunction with the individual's department, supervisor, etc. and also Risk Management and Safety.

APPENDIX 5 OSHA STANDARD SPECIFIC CHEMICAL LIST

Asbestos
4- Nitrobiphenyl
alpha-Naphthylamine
Methyl-chloromethyl ether
3,3'- Dichlorobenzidine and it’s salts
bis-Chloromethyl ether
beta-Naphthylamine
Benzidine
4-Aminodiphenyl
Ethyleneimine
beta-Propiolactone
2-Acetylaminofluorene
4-Dimethylaminoazobenzene
N-Nitrosodimethylamine
Vinyl chloride
Inorganic Arsenic
Inorganic Lead
Benzene
1,2- Dibromo-3-chloropropane
Acrylonitrjle
Ethylene Oxide
Formaldehyde

DRUGS AND ENVIRONMENTAL CHEMICALS
aminopterin
androgenic hormones
busulfan
chlorobiphenyls
coumarin anticoagulants
cyclophosphamide
diethylstilbestrol
diphenylhydantoin
etretinate
lithium
methylaminopterin
mercury, organic
methimazole and scalp defects
penicillamine
13-cis-retinoic acid
tetracyclines
thalidomide
trimethadione
valproic acid

RADIATION
ionizing radiation

INFECTIONS
cytomegalovirus
herpes virus hominis
parvovirus B-19
rubella virus
syphilis
toxoplasmosis
venezuelan equine
encephalitis virus

Reference : "Catalog of Teratogenic Agents", T.H. Shepard, 6th ed., Johns Hopkins Press, 1989

LIST OF PROVEN TERATOGENS AND MUTAGENS
calcium arsenate
benzene
dimethylmercury
5-fluorouracil
methotrexate
methylmercury
dinitrogen pentoxide

APPENDIX 7 INCOMPATIBILITY CHART

CHEMICAL	**KEEP OUT OF CONTACT WITH:**
Acetic Acid	Chromic Acid, nitric acid, hydroxyl compounds, ethylene glycol, perchloric acid, peroxides, permanganates.
Ammonium Nitrate	Acids, metal powders, flammable liquids, chlorates, nitrates, sulfur, powdered organic or combustible materials.
Bromine	Ammonia, acetylene, butadiene, butane, methane, propane, petroleum gases, hydrogen, sodium carbide, turpentine, benzene, powdered metals.
Chlorates	Ammonium salts, acids, metal powders, sulfur, finely divided organic or combustible materials.
Chlorine	Ammonia, acetylene, butadiene, butane, methane, propane, petroleum, gases, hydrogen, sodium carbide, turpentine, benzene, powdered metals.
Flammable Liquids	Ammonium nitrate, chromic acid, hydrogen peroxide, nitric acid, sodium peroxide, all of the halogens.
Hydrocarbons: (Butane, Propane, Benzene, gasoline, turpentine, etc.)	Chlorine, bromine.
Hydrogen peroxide	Copper, chromium, iron, most metals or their salts, alcohols, acetone, organic materials, aniline, nitromethane, flammable liquids, combustible materials.
Hydrogen sulfide	Fuming nitric acid, oxidizing gases.
Iodine	Acetylene, ammonia (aqueous or anhydrous), hydrogen.
Nitric Acid (conc.)	Acetic acid, aniline, chromic acid, hydrocyanic acid, hydrogen sulfide, flammable liquids or gases.
Sulfuric Acid (conc.)	Potassium chlorate, potassium perchlorate, potassium permanganate (or compounds with similar light metals, such as sodium or lithium), acetone.

APPENDIX 8 INHERENT PROPERTIES

Examples of chemicals which may preclude long term storage

Property	Examples
Deliquescent	Acid chlorides, acetamide, ammonium and potassium acetate, aluminum chloride, cupric chloride
	Hygroscopic Ammonium bromide, cyclohexanol, ethylene glycol, ferric chloride and nitrate, perchloric acid
Absorb CO2	Barium hydroxide, ethylene diamine, lead acetate, lithium hydroxide
Auto oxidation	Benzaldehyde
Light Sensitive	Styrene, mercury oxide, chloroform
Corrosive Fumes	Bromine, hydrochloric acid
Decomposition	Calcium hypochlorite, Hydrogen peroxide
Efflorescent	Ferric ammonium sulfate, chromic potassium sulfate, citric acid, copper sulfate
Extremely volatile	Collodion
Sublimes	p-dichlorobenzene, iodine
Peroxidizes	1, 4-dioxane, isopropyl and ethyl ether, cyclohexene, tetrahydrofuran
Dry out	Picric acid, benzoyl peroxide

GENERAL REFERENCES

1. Journal of Chemical Education, continuing series on "Safety in the Chemical Laboratory" and "Safety Tips".

2. Bretherick, Handbook of Reactive Chemical Hazards, 3rd ED, 1985.

3. Flinn Scientific, Inc. Chemical Catalog/Reference Manual, P.O. Box 219, Batavia IL 60510 (send for free catalog).

4. Sax, Dangerous Properties of Industrial Materials, sixth edition.

5. National Fire Prevention Association, National Fire Codes - 30, 45, 325M, 49, 491M.

APPENDIX 9 GLOVE SELECTION CHART

The following guide was developed from information in several sources. The information presented here is believed to be accurate; however, we cannot guarantee its accuracy. Many factors affect the breakthrough times of glove materials including, but not limited to:

1. Thickness of glove material
2. Concentration of the chemical worked with
3. Amount of chemical the glove comes in contact with
4. Length of time which the glove is exposed to the chemical
5. Temperature at which the work is done
6. Possibility of abrasion or puncture.

This information is provided as a guide to proper glove material selection. Glove performance varies between manufactures, so always consult the manufacturer to make sure you will have the right glove for your application.

Selection Key:

4	Excellent, breakthrough times generally greater than 8 hours.
3	Good, breakthrough times generally greater than 4 hours.
2	Fair, breakthrough times generally greater than 1 hour.
1	Not Recommended, breakthrough times generally less than 1 hour.
?	Not Tested or No Information, check other references.

GLOVE SELECTION GUIDE

	Natural Rubber	Neoprene	Butyl	PVC	Nitrile	Viton®
Chemical						
Organic Acids						
Acetic acid	2	3	4	2	1	4
Formic acid	2	3	4	3	2	2
Lactic Acid	4	4	4	3	4	4
Maleic acid	3	3	2	3	3	4
Oxalic acid	4	4	4	4	4	4

	Natural Rubber	Neoprene	Butyl	PVC	Nitrile	Viton®
Inorganic acids						
Chromic acid up to 70%	1	1	4	3	3	4
Hydrochloric acid up to 37%	3	3	4	3	3	3
Hydrofluoric acid up to 70%	2	2	3	1	1	?
Nitric acid 70+ %	?	1	2	?	1	4
Perchloric acid up to 70%	4	4	3	4	4	4
Phosphoric acid 70+ %	4	4	4	4	4	4
Sulfuric acid 70+ %	1	2	4	2	1	2

	Natural Rubber	Neoprene	Butyl	PVC	Nitrile	Viton®
Alkalis						
Ammonium hydroxide up to 70%	1	3	4	2	3	?
Potassium hydroxide up to 70%	4	4	4	4	4	4
Sodium hydroxide 70+ %	4	4	4	4	3	3

	Natural Rubber	Neorene	Butyl	PVC	Nitrile	Viton®
Salt Solutions						
Ammonium nitrate	4	4	4	4	4	4
Calcium hypochlorite	1	3	4	4	3	4
Ferric chloride	4	4	4	4	4	4
Mercuric chloride	3	3	4	3	3	4
Potassium cyanide	4	4	4	4	4	4
Potassium dichromate	4	4	4	4	4	4
Potassium permanganate	4	4	?	4	4	?
Sodium cyanide	4	4	4	4	4	4
Sodium thiosulfate	4	4	4	4	4	4

	Natural Rubber	Neoprene	Butyl	PVC	Nitrile	Viton®
A**romatic hydrocarbons**						
Benzene	1	1	1	1	1	3
Gasoline	1	1	1	1	4	4
Naphthalene	1	1	1	1	4	4
Toluene	1	1	1	1	1	4
Xylene	1	1	1	1	1	4

	Natural Rubber	Neoprene	Butyl	PVC	Nitrile	Viton®
Aliphatic hydrocarbons						
Diesel fuel	1	2	1	2	3	4
Hexanes	1	1	1	1	4	4
Kerosene	1	3	1	3	4	4
Naphtha	1	2	1	3	4	4
Pentane	1	1	1	1	3	4
Petroleum ether	1	1	1	2	3	4
Turpentine	1	1	1	1	2	4

	Natural Rubber	Neoprene	Butyl	PVC	Nitrile	Viton®
Halogenated hydrocarbons						
Carbon tetrachloride	1	1	1	1	1	4
Chloroform	1	1	1	1	1	4
Methylene chloride	1	1	1	1	2	3
Polychlorinated biphenyls (PCB's)	1	4	4	?	2	4
Perchloroethylene	1	1	1	1	2	4
Trichloroethylene	1	1	1	1	1	4

	Natural Rubber	Neoprene	Butyl	PVC	Nitrile	Viton®
Esters						
Ethyl acetate	1	1	3	1	1	1
Butyl acetate	1	1	2	1	1	1
Methyl acetate	1	1	4	1	1	1
Isobutyl acrylate	1	1	4	1	1	1

	Natural Rubber	Neoprene	Butyl	PVC	Nitrile	Viton®
Ethers/Glycols						
Diethyl ether	1	2	1	1	2	1
Ethylene glycol	1	2	4	1	2	4
Isopropyl ether	1	2	1	1	3	1
Propylene glycol	?	3	3	2	2	?
Tetrahydrofuran	1	1	2	1	1	1

	Natural Rubber	Neoprene	Butyl	PVC	Nitrile	Viton®
Aldehydes						
Acetaldehyde	1	1	4	1	1	1
Acrolein	1	1	4	1	1	1
Benzaldehyde	1	1	4	1	1	3
Butyraldehyde	1	1	4	1	1	1
Formaldehyde	1	2	4	2	4	4
Glutaraldehyde	?	4	4	2	?	4

	Natural Rubber	Neoprene	Butyl	PVC	Nitrile	Viton®
Ketones						
Acetone	1	1	4	1	1	1
Diisobutyl ketone	1	1	2	1	1	2
Methyl ethyl ketone	1	1	4	1	1	1

	Natural Rubber	Neoprene	Butyl	PVC	Nitrile	Viton®
Alcohols						
Allyl alcohol	1	1	4	1	4	3
Butyl alcohol	1	3	4	2	3	4
Ethyl alcohol	1	2	4	1	3	4
Isopropyl alcohol	1	3	4	2	4	4
Methyl alcohol	1	1	4	1	1	4

	Natural Rubber	Neoprene	Butyl	PVC	Nitrile	Viton®
Amines						
Aniline	1	1	4	1	1	2
Ethanolamine	2	4	4	3	4	4
Ethylamine	1	2	4	1	1	1
Methylamine	1	3	4	2	4	4
Triethanolamine	1	1	4	1	4	1

	Natural Rubber	Neoprene	Butyl	PVC	Nitrile	Viton®
Elements						
Bromine	1	2	1	?	1	4
Chlorine aqueous	?	1	2	?	1	4
Iodine	?	1	3	?	3	4
Mercury	?	4	4	?	4	4

	Natural Rubber	Neoprene	Butyl	PVC	Nitrile	Viton®
Miscellaneous						
Acetic anhydride	1	2	4	1	1	1
Acetonitrile	1	1	4	1	1	1
Acrylamide	1	1	3	1	2	3
Carbon disulfide	1	1	1	1	1	4
Cresols	1	3	4	?	2	4
Cutting fluid	?	2	?	2	3	?
Dimethyl sulfoxide	1	4	4	1	1	1
Hydraulic oil	?	?	1	2	3	?
Hydrazine	2	4	4	4	4	1
Hydrogen Peroxide	4	2	4	3	4	4
Lubricating oil	3	3	?	?	4	3
Malathion	?	3	1	?	3	?
Nitrobenzene	1	1	4	1	1	4
Phenol	1	3	2	1	1	4
Photo solutions	3	4	?	3	4	?
Picric acid	1	2	3	1	2	4
Pyridine	1	1	4	1	1	1

Viton® is a registered trademark of DuPont Dow Elastomers.

APPENDIX 10 CHEMICAL WASTE DISPOSAL

1.0 HAZARDOUS WASTE DISPOSAL AT THE UNIVERSITY OF NOTRE DAME

HOW IT WORKS: HAZARDOUS WASTE MANAGEMENT

The several hundred kilograms of hazardous wastes generated at the University each month present a serious and complex problem for the University. Unless you understand that chemical wastes are your problem and responsibility, our teaching and research efforts may be compromised. The key to solving this problem lies in recognizing your responsibility, understanding our management system, and reducing the volume of surplus chemicals.

1. Your Problems and Responsibilities

   Surplus chemicals are your problem. When hazardous chemicals are mismanaged, they have the potential to pollute the environment and threaten human health. Whether your surplus chemicals are generated inorganic synthesis or in creating ceramics, understanding your responsibility for those wastes or unwanted chemicals is the most important first step in sound hazardous waste management.

2. Our Management System

   The success of the management system depends on cooperation between you and the Risk Management & Safety Department staff. You should use this Disposal Guide to identify hazardous wastes and determine their appropriate route of disposal. There are three routes of disposal for your surplus chemicals.

   a. Disposal (of certain materials) to the normal trash or sanitary sewer system.

   b. Chemical treatment (such as neutralization), followed by disposal to the sanitary sewer system.

   c. Risk Management & Safety (RM&S) Department pickup for recycling, incineration, or land filling.

Please note that the campus pathological incinerator is not to be used for the disposal of chemicals. Pathological incinerators are designed and licensed only for the incineration of pathological waste and not for chemical waste.

When your surplus chemicals are given to RM&S, we first determine whether the chemical is a waste or can be redistributed. If the chemical is waste, we then determine the degree of hazard and the appropriate route of disposal.

Waste solvent are commingled in 55 gallon drums and incinerated commercially in an EPA licensed incinerator. Potential explosives are detonated and burned by a commercial facility. Non-hazardous wastes are disposed of in the sanitary sewer or a local sanitary landfill. Finally, the remainder is packaged into 55 gallon drums and sent to an EPA approved hazardous waste landfill, or incinerated.

Throughout this process, the University is required to keep records that account for hazardous wastes “from the cradle to the grave”.

3. Your Job in Waste Reduction

The Resource Conservation and Recovery Act of 1976 makes it illegal to improperly manage hazardous wastes. The Act and its subsequent regulations provide for a maximum $25,000 fine for each day of violation and criminal penalties for willful and fraudulent violations. The Act's emphasis is on waste reduction and recycling. Of the disposal methods listed in the previous section, a hazardous waste landfill is clearly the lease desirable. Hazardous waste landfills are costly, use our land resources and should be used only as a method of last resort when other disposal methods are not available. We have designed our management system around waste reduction methods. It makes sense because the handling, treatment and disposal of surplus chemicals is expensive. You can help ease the problem of chemical waste disposal. Please:

a. Order Only What You Need

Don't buy a kilogram of material when you plan to use only a few grams. The savings made by an economy size purchase, may be used up and exceeded in the disposal costs of the excess. Be sure to check your current stock before ordering chemicals. It may also be possible to borrow small amounts of chemicals from other labs. Please take the time to check.

b. Substitute Non-Hazardous Or Less Hazardous Materials For Hazardous Ones

For example, there are many nonhazardous substitutes for chromic acids. Also, dichloromethane is less toxic than carbon tetrachloride or chloroform and can be substituted satisfactorily in most cases.

c. Dispose of Nonhazardous Materials Yourself

Chemicals that can safely be disposed of in the normal trash or in the sanitary sewer system should not be given to RM&S or mixed with hazardous chemicals.

d.. Use Recycled Chemicals Whenever Possible

We have an ongoing program of redistributing your usable but unwanted chemicals. The RM&S Department has established criteria for deciding which chemicals are suitable for recycling. All recycled chemicals are in their original container and may still have their factory seals. Periodically, RM&S distributes a list of recyclable chemicals in the Department newsletter, FlashPoint.

f. Treat Chemicals In Your Laboratory

When you order a chemical, you have the responsibility for its disposal. Don't give RM&S a chemical you can treat in your lab. Acids and bases should be neutralized and put into the sewer system. Procedures are given in this guide. Other treatments that you can carry out in you lab are metal precipitations and safe reductions of strong oxidizers. Please call RM&S for procedures for carrying out these and other chemical treatments.

g. Date Opening

Many chemicals have limited shelf life. After which they decompose, give off fumes, absorb water or CO2, or form peroxides. Watching the storage time can minimize disposal of "reactive" materials by disposing of them when they are stable. See below for a chart of chemicals not designed for long term storage.

1.1 What is Hazardous?

This section will help you identify hazardous chemicals. The Indiana Department of Environmental Management (IDEM) and the U.S. Environmental Protection Agency (EPA) considers chemical waste hazardous if it:

- exhibits certain hazardous characteristics (See 1.2.1, below), or

- is a listed hazardous chemical (Section 1.2.2, below).

Some chemicals are included in both Sections 1.2.1 and 1.2.2, because they fit the criteria of each section. Chemicals that you can dispose of in the normal trash or the sewer system, are listed in Sections 1.3 and 1.4. If a chemical isn't in these sections or you'd like more information, call RM&S.

1.1.1 Hazardous Characteristics

Chemicals which have the following four characteristics are considered to be hazardous by the EPA:

a. IGNITABILITY

A liquid which has a flash point of less than 60 deg C is considered ignitable by the EPA. This includes almost all organic solvents. Some examples are:

Ethyl ether	Methanol	Ethanol
Acetone	Toluene	Benzene
Pentane	Hexane	Skelly B
Xylene	Formaldehyde	Heptane
Ethyl Acetate	Petroleum Ether	

Instructions for the disposal of organic solvents are given in Section 1.6.

b. CORROSIVITY

An aqueous solution having a pH of less than or equal to 2, or greater than or equal to 12.5 is considered corrosive by the EPA. Instructions for the disposal of concentrated solutions of acids or bases are given in Section 1.5. Corrosive materials also include thionyl chloride, solid, sodium hydroxide and other nonaqueous acids or bases.

c. REACTIVITY

Chemicals that react violently with air or water are considered reactive by the EPA. An example is sodium metal. Reactive materials also include strong oxidizers, such as perchloric acids, and chemicals capable of detonation when subjected to an initiating source, such as old picric acid and phosphorous.

Solutions of cyanide or sulfide that could generate toxic gases are also classified as a reactive by EPA.

d. TCLP TOXICITY

TCLP is a laboratory test to determine leaching. Chemicals characterized as toxic by the EPA may leach into the groundwater if improperly managed. EP toxic wastes include concentrated toxic metal solutions and the following list of pesticides:

Endrin	Lindane	2,4-D
Methoxychlor	Toxaphene	2,4,5-TP Silvex

Any chemical with an LD50 less than 500 mg/kg or is a carcinogen, mutagen or teratogen eg. Furadan Oral LD50 (human) 11 mg/kg or Osium tetraoxide Oral LD50 (rat) 14 mg/kg.

1.1.3 Other Hazardous Wastes

. 1. Aqueous Solutions of Toxic Metals

a. Disposal in General

The concentrations of the following toxic metals are regulated for disposal to the sanitary sewer.

Aluminum	Chromium	Selenium
Arsenic	Copper	Silver
Barium	Lead	Zinc
Cadmium	Mercury	

You can treat concentrated aqueous solutions of these metals to precipitate the metal and then filter prior to discharge to the sewer system. Call us if you want advice on the procedure.

b. Special Precautions for Lead, Mercury and Silver

Lead, mercury and silver require special precautions for disposal. If you discharge any of these metals, their compounds or aqueous solutions of their compounds into the sewer system, make sure you meet these concentrations.

Lead	2.0 mg/l
Mercury	0.02 mg/l
Silver	0.4 mg/l

Lead, mercury and silver are especially important pollutants. Filtering, precipitation for some other type of collection must be routine procedure for your lab if you use them. Even when silver recovery units are being employed, we've found several instances of high discharges resulting from poor maintenance. For treatment procedures, testing or more information, please call us. RM&S will collect solutions and/or filtrated solids for disposal.

2. Solutions of Nonmetallic Pesticides

You should put solutions of nonmetallic pesticides in plastic or glass bottles for pickup by RM&S.

3. Free-Flowing Metallic Mercury

Package free-flowing mercury (broken thermometers, mercury from manometers, etc in tightly sealed containers. Label with a chemical discard tag and call RM&S for pickup.

A mercury vacuum is available for spill cleanup. Contact RM&S to find out location.

4. Solutions of Cyanide or Sulfide

Solutions containing cyanide or sulfide compounds release toxic gases under acidic conditions. For safety, you should package these solutions separately from acids and give them to us.

1.2.2 Hazardous Chemicals

This section presents a list of chemicals which the EPA considers hazardous because of their carcinogenicity, mutagenicity, teratogenicity, or other toxicity. The list, which will be updated to keep up with current scientific information, is not meant to be complete and generally does not include substances which have hazardous characteristics, as defined previously. The omission of a chemical from this list does not mean it is not toxic or otherwise hazardous. Call RM&S if you want additional hazard information.

Disposal instructions for these chemicals are given in Sections depending on their classification and physical form.

Auramine

Azaserine (L-Serine, diazoacetate (ester))

Aziridine

Azirinopyrrola indole-4,7-dione

Barium and compunds, N.O.S.* Flammable solid & oxidizer ORMB

Barium Cyanide - Poison B

Benz(c) acridine (3,4-Benzacridine)

Benzenamine, 4-chloro-2-methyl-

Benz(a) anthracene (1,2-Benzanthracene)

Benzene (Cyclohexatriene) (Benzol)

Benzenearsonic acid (Arsonic acid, phenyl-)

Benzene, dichloromethyl-(Benzal chloride)

Benzene, hexahydro- Flammable liquid

Benzene, (1-methylethyl) - Flammable liquid

Benzenesulfonic acid chloride (Benzenesulfonyl chloride)

Benzenethiol (Thiophenol)

Benzidine ((1,1'-Biphenyl)-4,4'diamine) -Poison B

Benzo (b) fluoranthene (2,3-Benzofluoranthene)

Benzo (j) fluoranthene (7,8-Benzofluoranthene)

Benzo (a) pyrene (3,4-Benzpyrene)

*Not Otherwise Specified; includes related species

EPA HAZARDOUS CHEMICALS LIST (CONTINUED)

p-Benzoquinone (1,4-Cyclohexadienedione)

Benzotrichloride (Benzene, trichloromethyl-)

Benzyl chloride (Benzene, (chloromethyl-) Corrosive material

Beryllium and compounds, N.O.S* .-Poison B

Beryllium Dust

2,2'-Bioxirane (1,2:3,4-Diepoxybutane)

Bis (2-chloroethyl) ether (Ethane, 1,1'-oxybis (2-chloro)) bis (2-chloro-))

Bis (2-chloroethyl) ether (Ethane, 1,1'-oxybis (2-chloro-))

Bis (2-chloroisopropyl) ether (Propane, 2,2'-oxybis (2-chloro-))

Bis (chloromethyl) ether (Methane, oxybis (chloro-))

Bis (2-ethylhexyl) phthalate (1,2-Benzenedicarboxylic acid,
bis (2-ethyl-hexyl) ester)

Bromoacetone (2-Propanone, 1-bromo-)-Poison A

Bromomethane (Methyl bromide)-Toxic

4-Bromophenyl phenyl ether (Benzene, 1-bromo-4-phenoxy-)

Brucine (Strychnidin-10-one, 2,3-dimethoxy-)-Poison B

1-Butanol (n-Butyl alcohol)

2-Butanone peroxide (Methyl ethyl ketone peroxide)-Toxic

Butyl benzyl phthalate (1,2-Benzenedicarboxylic acid, butyl phenylmethyl ester)

2-sec-Butyl-4,5-dinitrophenol (DNBP) (Phenol, 2,4-dinitro-6-(1-methylpropyl)-)

DDE (Ethylene, 1,1-dichloro-2,2-bis (4-chlorophenyl)-)

*Not Otherwise Specified; includes related species

EPA HAZARDOUS CHEMICALS LIST (CONTINUED)

DDT (Dichlorodipehnyltrichloroethane)-ORMA

Diallate (S-2,3-Dichloroally)diisopropylthiocarbamate)

Dibenz (a,H) acridine (1,2,5,6-Dibenzacridine)

Dibenz (a,j) acridine (1,2,7,8-Dibenzanthracene)

7H-Dibenzo (c,g) carbazole (3,4,5,6-Dibenzcarbazole)

Dibenzo (a,e) pyrene (1,2,4,5-Dibenzpyrene)

Dibenzo (a,h) pyrene (1,2,5,6-Dibenzpyrene)

Dibenzo (a,i) pyrene (1,2,7,8-Dibenzpyrene)

1,2-Dibromo-3-chloropropane

1,2-Dibromoethane (Ethylene dibromide)

Dibromomethane (Methylene bromide)

Di-n-butyl phthalate (1,2-Benzenedicarboxylic acid, dibutyl ester)

o-Dichlorobenzene (Benzene, 1,2-dichloro-)

m-Dichlorobenzene (Benzene, 1,3-dichloro-)

p-Dichlorobenzene (Benzene, 1,4-dichloro-) ORM-A

Dichlorobenzene, N.O.S.* ORM-A

3,3'-Dichlorobenzidine

1,4-Dichloro-2-butene Flammable liquid, corrosive material

Dichlorodifluoromethane

1,1-Dichloroethane (Ethylidene dichloride) Toxic

1,2-Dichloroethane (Ethylene dichloride) Toxic

*Not Otherwise Specified; includes related species

EPA HAZARDOUS CHEMICALS LIST (CONTINUED)

trans-1,2-Dichloroethene (1,2-Dichloroethylene)

Dichloroethylene, N.O.S.* (Ethene, dichloro-, N.O.S.*)

1,1-Dichloroethylene (Ethene, 1,1-dichloro-)

Dichloroethyl ether

Dichloromethane (Methylene chloride)-ORM A

2,4-Dichlorophenol

2,6-Dichlorophenol

2,4-Dichlorophenoxyacetic acid (2,4-D), salts and esters

Dichlorophenylarsine (Phenyl dichloroarsine)

Dichloropropane, N.O.S.*

1,2-Dichloropropane (propylene dichloride)

Dichloropropanol, N.O.S.*

Dichloropropene, N.O.S.*

1,3-Dichloropropene

Dieldrin - ORM A

Diethylarsine

N,N-Diethylhydrazine (Hyrazine,1,2-diethyl)

O,O-Diethyl S-methyl ester of phophorodithioic acid

O,O-Diethylphosphoric acid, O-p-nitrophenyl ester (Phosporic acid, diethyl p-nitrophenyl ester)

*Not Otherwise Specified; includes related species

EPA HAZARDOUS CHEMICALS LIST (CONTINUED)

Diethyl phthalate (1,2-Benzenedicarboxylic acid, diethyl ester)

O,O-Diethyl-O-2-pyrazinyl phosphorothioate

(phosphororthioic acid, O,O- diethyl-O-pyrazinyl ester)

Diethylstilbesterol

Dihydrosafrole (Benzene, 1,2-methylenedioxy-4-propyl-)

Diisoproplyfluorphosphate (DFP)

Dimethoate

3,3'-Dimethoxybenzidine

Dimethylamine (N-Methylmethanamine)

N,N-Dimethylaniline

7,12-Dimethylbenz(a)anthracene (1,2-Benzanthracene,. 7,12-dimethyl-)

3,3'-Dimethylbenzidine (o-Tolidine)

alpha, alpha-Dimethylbenzylhydroperoxide

Dimethylcarbamoyl chloride

1,1-Dimethylhydrazine

1,2-Dimethylhydrazine

alpha, alpha-Dimethylphenethylamine (Ethanamine, 1,1-dimethyl-2-phenyl)

2,4-Dimethylphenol

Dimethyl phthalate (1,2-Benzenedicarboxylic acid, dimethyl ester)

Dimethyl sulfate (Sulfuric acid, dimethyl ester)

Dinitrobenzene, N.O.S.*

*Not Otherwise Specified; includes related species

EPA HAZARDOUS CHEMICALS LIST (CONTINUED)

4,6-Dinitro-o-cresol and salts (Phenol, 2,4-dinitro-6-methyl-, and salts)

2,4-Dinitrophenol

2,4-Dinitrotoluene (Benzene, 1-methyl-2,4-dinitro-)

2,6-Dinitrotoluene (Benzene, 1-methyl-2,6-dinitro-)

Di-n-octyl phthalate (1,2-Benzenedicarboxylic acid, dioctyl ester)

1,4-Dioxane (1,4-Diethylene oxide)

Diphenylamine (Benzenamine, N-phenyl-)

1,2-Diphenylhydrazine

Dipropylamine

Di-n-propylnitrosamine (N-Nitroso-di-n-propylamine)

Disulfoton

2,4-Dithiobiuret (Thiomidodicarbonic diamide)

Endosulfan

Endothall

Endrin nd metabolites

Epineprine

Ethane, 1,1'-oxybis- (Ethyl Ether)

Ethidium Bromide

Ethyl acetate

Ethyl acrylate

Ethyl carbamate (Urethan) (Carbamic acid, ethyl ester)

*Not Otherwise Specified; includes related species

EPA HAZARDOUS CHEMICALS LIST (CONTINUED)

Ethyl cyanide (Propanenitrile)

Ethylenebisdithiocarbamic acid, salts and esters

Ethyleneimine (Azirdine)

Ethylene oxide (Oxirane)

Ethylenethiourea (2-Imidazolidinethione)

Ethyl methacrylate (2-Propenoic acid, 2-methyl-, ethyl ester)

Ethyl methanesulfonate (Methanesulfonic acid, ethyl ester)

Famphur (Famophos)

Fluoranthene (Benzo (j,k) fluorene)

Flourine

2-Flouroacetamide

Flouroacetic acid, sodium salt

Formaldehyde (Methylene oxide)

Formic acid (Methanoic acid)

Furan (Furfuran)

2-Furancarboxaldehyde (Furfural)

Furan, tetrahydro-

Glycidylaldehyde (1-Propanol,2,3,-epoxy)

Hamolethane, N.O.S.*

Heptachlor

*Not Otherwise Specified; includes related species

EPA HAZARDOUS CHEMICALS LIST (CONTINUED)

Heptachlor epoxide (alpha, beta, and gamma isomers)

Hexachlorobenzene

Hexachlorobutadiene (1,3-Butadiene, 1,1,2,3,4,4-Hexachloro-)

Hexachlorocyclopentadiene (1,3-cyclopentadiene, 1,2,3,4,5,5-hexachloro-)

Hexachloroethane (Ethane, 1,1,1,2,2,2-hexachloro-)

Hexachlorophene (2,2'-Methylene (3,4,6-trichlorophenol))

Hexachloropropene (1-Propene, 1,1,2,3,3,3-hexachloro-)

Hexaethyl tetraphosphate (Tetraphophoric acid, hexaethyl ester)

Hydrazine (Diamine)

Hydrofluoric acid (Hydrogen fluoride)

Hydrogen cyanide (Hyrdocyanic acid)

Hydrogen sulfide (Sulfur hydride)

Hydroperoxide, 1-methyl-1-pheylethyl

Hydroxydimethylarsine oxide (Cacodylic acid)

Ineno (1,2,3-cd) pyrene (1,10- (1,2-phenylene) pyrene)

Indomethacin

Iodomethane (Methyl iodid)

Iron Dextran (Ferric dextran)

Isocyanic acid, methyl ester (Methyl isocyante)

Isobutyl alcohol (1-Propanol, 2-methyl-)

Isosafrole Benzene, 1,2-methylenedioxy-4-allyl-)

*Not Otherwise Specified; includes related species

EPA HAZARDOUS CHEMICALS LIST (CONTINUED)

Keptone (Chlordecone)

Lasiocarpine

Lead and compounds, N.O.S.*

Lead acetate (Acetic acid, lead salt)

Lead subacetate (Lead, bis (acetato-O) tetrahydroxyti-)

Lindane (all isomers)

Maleic anhydride (2,5-Furandione)

Maleic hydrazide (1,2-Dihydro-3,6-pyridazinedione)

Malononitrile (Propanedinitrile)

Melphalan (Alanine, 3-(p-bis(2-chloroethyl) amino) phenyl-, L)

Mercury fulminate (Fulminic acid, mercury salt)

Mercury and compounds, N.O.S.*

Methacrylonitrile (2-Propenenitrile, 2-methyl-)

Methanamine, N-methyl

Methanethiol (Thiomethanol)

Methanol

Methapyrilene (Pyridien, 2-((2-dimethylamino)ethyl)-2-thenylamino-)

Metholmyl

Methoxychlor (Ethane, 1,1,1-trichloro-2,2-bis(p-methoxyphenyl)-)

2-Methylaziridine (1,2-Propylenimine)

*Not Otherwise Specified; includes related species

EPA HAZARDOUS CHEMICALS LIST (CONTINUED)

1-Methylbutadiene

Methyl chlorocarbonate (Carbonochloridic acid, methyl ester)

3-Methylcholanthrene (Benz(j)aceanthrylene, 1,2-dihydro-3-methyl-)

4,4'-Methylenebis(2-chloroaniline) (Benzeneamine, 4,4'-methylenebis- (2-chloro-)

Methylethylketone (MEK) (2-Butanone)

Methyl hydrazine

2-Methyllactonitrile (Propanenitrile, 2-hydroxy-2-methyl-)

Methyl isobutyl ketone

Methyl methacrylate (2-Propenoic acid, 2-methyl-,methyl ester)

Methyl methanesulfonate (Methanesulfonic acid, methyl ester)

2-Methyl-2-(methylthio)propionaldehyde-o-(methylcarbonyl)oxime (Propanal,
2-methyl-2-(methylthio-,o-((methylaminocarbonyl)oxime)

N-Methyl-N'-nitro-N'-nitrosoguanidine

Methyl parathion

4-Methyl-2-pentanone

Methylulthiouracil

Mitomycin-C

Mustard gas (Sulfide, bis(2-chloroethyl)-)

Naphthalene

1,4-Naphthoquinone (1,4-Napthalenedione)

1-Naphthylamine (alpha-Naphthylamine)

*Not Otherwise Specified; includes related species

EPA HAZARDOUS CHEMICALS LIST (CONTINUED)

2-Naphthylamine (beta-Naphthylamine)

1-(1-Naphthyl)-2-thiourea (Thiourea, 1-naphthalenyl-)

Nickel and compounds, N.O.S.*

Nickel carbonyl (Nickel tetracarbonyl)

Nickel cyanide (Nickel (II) cyanide)

Nicotine and salts

Nitric oxide (Nitrogen (II) oxide)

p-Nitroaniline (Benzenamine, 4-nitro-)

Nitrogen dioxide (Nitrogen (IV) oxide)

Nitrogen mustard and hydrochloride salt (Ethanamine, 2-chloro-,N-(2-chloroethyl)-N-methyl-, and hydrochloride salt)

Nitrogen mustard N-Oxide and hydrochloride salt (Ethanamine, 2-chloro-,

N-(2 chloroethyl)-N-methyl-, and hydrochloride salt)

Nitroglycerine (1,2,3-Propanetriol, trinitrate)

p-Nitrophenol (4-Nitrophenol) (Phenol, 4-nitro-) Nitrobenzene

2-Nitropropane

4-Nitroquinoline-1-oxide (quinoline, 4-nitro-1-oxide-)

Nitrosamine, N.O.S.*

N-Nitrosodi-n-butylamine (1-Buranamine, N-butyl-N-nitroso-)

N-Nitrosodiethyanolamine (Ethanol, 2,2'-(nitrosoimino)bis-)

N-Nitrosodiethylamine (Ethanamine, N-ethyl-n-nitroso-)

N-Nitrosodimethylamine (Dimethylnitrosamine)

N-Nitroso-N-ethylurea (Carbamide, N-ethyl-N-nitroso-)

*Not Otherwise Specified; includes related species

EPA HAZARDOUS CHEMICALS LIST (CONTINUED)

N-Nitrosomethylethylamine (Ethanamine, N-methyl-N-nitroso-)

N-Nitroso-N-methylurea (Carbamide, N-methyl-N-nitroso-)

N-Nitroso-N-methylurethane (Carbamic acid, methylnitroso-, ethyl ester)

N-Nitrosomethylvinylamine (ethenamine, N-methyl-N-nitroso-)

N-Nitrosomorpholine (Morpholine, N-nitroso-)

N-Nitrosonornicotine (Nornicotine, N-nitroso-)

N-Nitrosopiperidine (Pyridien, hexahydro-, N-nitroso-)

Nitrosopyrrolidine (Pyrrole, tetrahydro-, N-nitroso-)

N-Nitrososarcosine

5-Nitro-o-toluidine (Benzenamine, 2-methyl-5-nitro-)

Octamethylpyrophosphoramide (Diphosphoramide, octamethyl-)

Osmium tetraoxide

Paraldehyde

Parathion

Pentachlorobenzene

Pentachloroethane

Pentachloronitrobenzene (PCNB)

Pentachlorophenol

1,3-Pentadiene

Phenacetine (Acetamide, N-(4-ethoxyphenyl-)

Phenol, (Carbolic acid)

*Not Otherwise Specified; includes related species

EPA HAZARDOUS CHEMICALS LIST (CONTINUED)

Phenol, 2,4-dinitro-

Phenol, 2,4,6,-trinitro-, ammonium salt

Phenylenediamine (Benenediamine)

Phenylmercury acetate (Mercury, (acetato)phenyl-)

N-Phenylthiourea

Phorate

Phosgene (Carbonyl chloride)

Phosphine (Hydrogen phosphine)

Phosphorouse sulfide

Phthalic acid esters, N.O.S.* (Benzene, 1,2-dicarboxylic acid, esters, N.O.S.*)

Phthalic achydride (1,2-Benzenedicarboxylic acid anhydride)

2-Picoline (Pyridien, 2-methyl-)

Polychlorinated biphenyl, N.O.S*

Potassium cyanide

Potassium silver cyanide (Argentate (1-), potassium dicyano-)

Pronamide (3.5-Dichloro-N-(1,1-dimethyl-2-propynyl)benzamide)

Propane, 2-nitro-

1,3-Propane sultone (1,2-Oxathiolane, 2,2-dioxide)

2-Propenoic acid, ethyl ester

n-Propylamine (1-Propanamine)

Propyltiouracil

*Not Otherwise Specified; includes related species

EPA HAZARDOUS CHEMICALS LIST (CONTINUED)

2-Propyn-1-ol (Propargyl alcohol)

Pyridine and salts

Reserpine

Resorcinol (1,2-Benzenediol)

Saccharin and salts

Safrole (Benzene, 4-allyl-1,2-methylenedioxy)

Selenious acid (Selenium dioxide)

Selenium and compounds, N.O.S.*

Selenium sulfide (Sulfur selenide)

Selenourea (Caramimidoselenoic acid)

Silver cyanide

Sodium azide

Sodium cyanide

Streptozotocin (D-Glucopyranose, 2-deoxy-2-(3-methyl-3-nitrosoureido)-)

Strontium sulfide

Strychnine and salts (strychnidin-10-one, and salts)

Sulfur phosphide

1,2,4,5-Tetrachlorobenzene

2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)

Tetrachloroethane, N.O.S.*

1,1,1,2- Tetrachlorethane

*Not Otherwise Specified; includes related species

EPA HAZARDOUS CHEMICALS LIST (CONTINUED)

1,1,2,2-Tetrachlotoethane

Tetrachloroethylene (Ethene, 1,1,2,2-tetrachloro-)

Tetrachloromethane (Carbon tetrachloride)

2,3,4,6-Tetrachlorophenol

Tetraehtyldithiopyrophosphate (Dithiopyrophosphoric acid, tetraethylester)

Tetraethyl lead (Plumbane, tetraethyl-)

Tetraethylpyrophosphate (pytophosphoric acid, tetraethyl ester)

Tetrahydrofuran

Tetranitromethane

Thallium and compounds, N.O.S.*

Thallic oxide (Thallium (III) oxide)

Thallium (I) acetate (Acetic acid, thallium (I) salt)

Thallium (I) carbonate (Carbonic acid dithallium (I) salt)

Thallium (I) chloride

Thallium (I) nitrate (Nitric acid, Thallium (I) salt)

Thallium selenite

Thallium (I) sulfate (Sulfuric acid, thallium (I) salt)

Thioacetamide (Ethanethioamide)

Thiofanox

Thiosemicarbazide (Hydrazinecarbothioamide)

Thiourea (Carbamide, thio-)

*Not Otherwise Specified; includes related species

EPA HAZARDOUS CHEMICALS LIST (CONTINUED)

Thiram (Bis(dimethylthiocarbamoyl)disulfide)

Toluene (Benzene, methyl-)

o-Toluidine hydrochloride (Benzenamine, 2-methyl-,hydrochloride)

Tolylene diisocyanate (Benzene, 1,3-diisocyanatomethyl-)

Toxaphene (Camphen, octachloro-)

Tribromomethane (Bromoform)

1,2,4-Trichlorobenzene

1,1,1-Trichloroethane (Methyl chloroform)

1,1,2-Trichloroethane

Trichloroethene (Trichloroethylene)

Trichloromethanethiol

Trichloromonofluoromethane (Freon)

2,4,5-Trichlorophenol

2,4,6-Trichlorophenol

2,4,5-Trichlorophenoxyacetic acid (2,4,5-T)

2,4,5-Trichlorophenoxypropionic acid (2,4,5-TP) (Silvex)

Trichloropropane, N.O.S.*

1,2,3-Trichloropropane

O,O,O-Triethyl phosphorothioate (Phosphorothioic acid, O,O,O-triethyl ester)

sym-Trinitrobenzene (Benzne, 1,3,5-trinitro-)

Tris(1-azidinyl)phosphine sulfide

*Not Otherwise Specified; includes related species

EPA HAZARDOUS CHEMICALS LIST (CONTINUED)

Tris(2,3-dibromopropyl) phosphate(1-Propanol, 2,3-dibromo-,phosphate)

Trypan blue

Uracil mustard (Uracil 5-(bis(2-chloroethyl)amino)-)

Vanadic acid, ammonium salt (Ammonium vanadate)

Vanadium pentoxide (Vanadium (V) oxide)

Vinyl chloride (Ethene, chloro-)

Warfarin

Xylene (Benzene, dimethyl)

Zinc Chloride

Zinc phosphide

*Not Otherwise Specified; includes related species

1.3 Chemicals For the Normal Trash

You can safely dispose of many solid chemicals in the normal trash if the containers are tightly capped and of good integrity. Examples are given on the following list. These chemicals were selected because they:

a. are sold by Chemistry Stores

b. have oral rat LD50 toxicity values higher than 500 mg/kg and

c. have no positive determination for carcinogenicity according to the National Institute of Occupational Safety and Health (NIOSH) 1979 Registry of Toxic Effects of Chemical Substances.

If you intend to dispose of more than five pounds of any one of these chemicals, call RM&S for further evaluation.

CHEMICALS FOR NORMAL TRASH

Acid, Ascorbic	Acid Benzoic
Acid, Boric	Acid Casamind
Acid, Citric	Acid, Lactic
Acid, Oleic	Acid, Phosphotungstic
Acid, Phthalic	Acid, Salicylic
Acid, Silicic	Acid, Stearic
Acid, Succinic	Agar
Acid, Tartaric	Aluminum Chloride
Albumen	Aluminum Metal
Aluminum Hydroxide	Ammonium Chloride
Ammonium Bicarbonate	Ammonium Sulfate
Ammonium Phosphate	Base, Blood Agar
Ammonium Sulphamate	Brain Heart Infusin
Beef Extract	Broth Nutrient
Brom Phenol Blue	Calcium Carbonate
Buffer Solution	Calcium Lactate
Calcium Chloride	Calcium Sulphate

CHEMICALS FOR NORMAL TRASH CONT'

Calcium Phosphate

Charcoal, Animal

Cerelose, Dextrose

Dextdrose

Crystal Violet

Extract Malt

Drierite

Ferric Chloride

Extract Yeast

Ferric Sulphate

Ferric Nitrate

Galactose

Ferrous Ammonium Sulphate

Graphite

Gelatin

Gum, Guaic

Gum, Arabic

Kaolin

Hematoxylin

Lithium Carbonate

Lactose

Lithium Sulphate

Lithium Chloride

Magnesium Carbonate

Litmus Mild

Magnesium Nitrate

Magnesium Chloride

Magnesium Sulphate

Magnesium Oxide

Magnesium Acetate

Maltose

Manganese Dioxide

Manganese Chloride

Methyl Red

Manganese Sulphate

Methylene Blue

Methyl Salicylate

Naphthol Beta

Naphthalene

Pepsin

Paraffin

Petroleum Jelly

Peptone

Potassium Bicarbonate

Potassium Acetate

Potassium Bitartrate

Potassium Bisulphate

Potassium Bromide

Potassium Bromate

Potassium Citrate

Potassium Carbonate

Potassium Phosphate

CHEMICALS FOR NORMAL TRASH CONT'

Potassium Iodide

Potassium Nitrate

Potassium Sodium Tartrate

Potassium Sulphite

Pumice

Sodium Acetate

Sodium Benzoate

Sodium Bisulphate

Sodium Borate

Sodium Carbonate

Sodium Chloride

Sodium Formate

Sodium Lactate

Sodium Salicylate

Sodium Succinate

Sodium Thioglycollate

Sucrose

Talcum Powder

Tin Metal

Potassium Sulphate

Potassium Sulphocyanate

SDS (Sodium Dodexyl Sulfate)

Sodium Ammonium

Phosphate

Sodium Bicarbonate

Sodium Bisulphite

Sodium Bromide

Sodium Citrate

Sodium Iodide

Sodium Nitrate

Sodium Phosphate

Sodium Silicate

Sodium Tartrate

Sodium Thiosulphate

Stannous Chloride

Thymol

Trypticase

TryptoneWax, Bee's

1.3 Chemicals For the Sanitary Sewer System

You can safely dispose of many chemicals into the sanitary sewer system if they are water soluble, degradable in the sanitary sewer and properly diluted. Examples aregiven in the following list. Chemicals in solid form should be followed by twenty (20) parts of water. If you intend to dispose of more than one pound of any one of these chemicals, call RM&S for further evaluation.

1. AQUEOUS SOLUTIONS OF CHEMICALS LISTED UNDER "CHEMICALS FOR THE NORMAL TRASH" (Section 1.3).

2. VERY DILUTE AQUEOUS SOLUTIONS OF WATER SOLUBLE ORGANIC SOLVENTS. (i.e., <10% solutions). Examples are:

Allyl Alcohol	Propanol
Glycerine	Propylene Glycol

3. CONCENTRATED SOLUTIONS OF ACIDS OR BASES

   This section explains the disposal of concentrated solutions of acids, such as hydrochloric, sulfuric, and nitric and bases such as ammonium hydroxide. These solutions should be neutralized in the laboratory as described in Section 1.5 below. However, the RM&S will pick acids and bases up for disposal.

   You should take special care when neutralizing strongly oxidizing acids such as perchloric acid and fresh chromic acid, so call us for additional instructions.

1.4 General Neutralization Procedures

CAUTION: FUMES AND HEAT ARE GENERATED

1. Do your neutralizations in a well-ventilated hood and behind a safety shield.

2. Keep containers cool while neutralizing.

3. You should be wearing an apron, goggles, and gloves.

4. Perform all steps SLOWLY.

5. Neutralize concentrated solutions of acids and bases to within a pH range of greater than 2 and lower than 12.5 and then flush them into the sanitary sewer with at least twenty (20) parts of water.

1.4.1 Acid Neutralization

While stirring, add acids to large amounts of an ice-water solution of base such as sodium carbonate (soda ash), calcium hydroxide (slaked lime), or 8M sodium hydroxide (for concentrated acids). When a pH above 2 is achieved, dispose of the solution into the sewer system followed by twenty (20) parts of water.

1.4.2 Base Neutralization

Neutralize by first adding the base to a large vessel containing water. Slowly add a 1M solution of HCL. When a pH of 12.5 is achieved, dispose of into the sewer system followed by twenty parts of water.

1.4.3 Chromic Acid

1. Alternatives to Chromic Acid Cleaning Solutions

Chromic acid is a powerful oxidizing agent. It is both toxic and corrosive and can explode on contact with organic materials. Users of chromic acid cleaning solutions on campus have suffered burns to both skin and clothing. We urge you to consider the alternatives listed on the next page that clean satisfactorily and are less toxic.

2. Disposal

You should neutralize spent chromic acid solution to pH 2 by SLOWLY pouring it into a stirred 8M NaOH-ice solution in a large container. CAUTION: fumes and heat are green Cr (III) by the addition of a saturated sodium bisulfite solution. (Hexavalent chromium is highly oxidizing and toxic and is strictly regulated in waste). Put the neutralized, reduced solution into the sewer system, followed by twenty (20) parts of water.

SUGGESTED ALTERNATIVES TO CHROMIC ACID CLEANING SOLUTION

Product	Manufacturer
No Chromix	Godax Laboratories
RBS 35 Concentrate	Pierce Chemical Co.
RBS Solid	Pierce Chemical Co.
S/P Laboratory Detergent	American Scientific Products
S/P Contrad 70	American Scientific Products
Alconox	American Scientific Products
Fisherband Sparkleen	Fisher Scientific Co.
FL-70 Concentrate	Fisher Scientific Co.
Liquinox Liquid Detergent	Fisher Scientific Co.
Isoclean	Lab Safety Supply
Count-Off	New England Nuclear Co.
Lift Away Concentrated Decontaminant	Research Products International Corp.

1.5 Organic Solvents

Place your organic solvents in glass bottles or carboys the solvents originally came in or in ones provided by RM&S. Don't put them in the sewer. Halogenated solvents (e.g., chloroform, carbon tetrachloride and dichloromethane) and their mixtures should be kept separate as they are more difficult to dispose of. Be sure to deface or remove original label and attach Chemical Discard tag to bottle.

Call RM&S and we'll pick up your spent organic solvents and their associated organic solutes. When we pick up the solvents, the contents will then be commingled in 55 gallon drums and shipped off campus for incineration. We have to pump the contents, so they must be fluid and not contain any solids, precipitates or residues.

1. Substances That Should Not Be Put Into Solvent Waste Containers

   The following substances are inappropriate for incineration. Don't put them into your organic waste containers. They should be collected in separate containers.

   Solutions of acids or bases

   Aqueous solutions of toxic organic chemicals

   Metals (e.g., Sb, As, Ba, Cd, Cr, Pb, Hg, Ni, Se, Ag)

   Vacuum pump oil

   Sulfides or inorganic cyanides

   Strong oxidizers or reducers

   Water reactive substances

   Unknowns

   Large amounts of water

2. Waste Analysis

   To comply with EPA regulations, you must complete our chemical discard tag when wanting to dispose of hazardous waste. You'll need to complete a tag for each container. You must list the major components of your waste on the form and particularly note all of the following::

   Halogenated compounds (e.g., CHCl3 , CH2CL2, CCl4, and solutes)

   Metals (e.g., Pb, Hb, Ag, Cr)

   Sulfur compounds (e.g., CS2, DMSO, and solutes)

   Hazardous Chemicals listed in Section 1.2

   Solvents

   Please be sure that you values reflect a reasonable, defendable estimate. We're required to routinely analyze waste to see if here are discrepancies between waste content and information reported on your form..

3. Waste Solvent Storage

To avoid fumes, you may wish to initially collect waste solvents in another vessel such as a beaker with a watch glass on top or a metal can with spring loaded cover (available from Scientific Products or Fisher, called safety can or liquid disposal can). This may be stored conveniently in a fume hood.

1.6 Liquids Other Than Acids, Bases, and Organic Solvents

This section deals with six other types of liquid chemicals. For liquids not covered by these sections, use Section 1.2, "What is Hazardous?" to determine whether the liquid is hazardous. Package hazardous liquids according to Section 1.13 and give to RM&S. Dispose of nonhazardous, water-soluble liquids into the sewer system.

1. Aqueous Solutions of Toxic Organic Chemicals

   For highly toxic chemicals, the decision as to whether an aqueous solution should be incinerated, treated in some way, or put into the sewer system depends on the toxicity and concentration of the solute. This decision is made by RM&S staff after consultation with its desk references as well as the appropriate disposal facility.

   If you think that the sewer system is not an appropriate route of disposal for an aqueous solution (because the organic solute is highly toxic), package it according to Section L and give to RM&S. We will evaluate the solution for its appropriate route of disposal.

   In general, aqueous solutions of organic chemicals should be put into the sewer system if they are neutral, nonreactive, nonignitable and the organic solute is not highly toxic. Call RM&S if you have any questions.

1.7 Solids

Package tightly capped containers of hazardous solid chemicals according to the instructions given in 1.13. To determine whether or not a chemical is hazardous, see Section 1.2. Section 1.3 lists chemicals that may be disposed of in the normal trash.

You can dissolve small amounts of hazardous organic solids in an organic solvent and place them into solvent waste containers.

1.8 Potentially Explosive and Other Reactive Chemicals

1.8.1 Potentially Explosive Chemicals

You should package each container of potentially explosive chemicals separately from other chemicals. Follow the packaging instructions in Section 1.13 and label the box and form clearly as to hazardous characteristics and special handling precautions. In addition, when calling for a pickup, please inform RM&S that you have potentially explosive materials. Potentially explosive chemicals include:

Ammonium nitrate	Diazo compounds
Hydrazine compounds	Nitrocellulose
Peroxide-forming agents	Picric Acid

A. Peroxide Forming Agents

Peroxides are low power explosives and very sensitive to shock and heat. A variety of organic compounds react with oxygen from the air to form unstable peroxides. Well-known peroxide forming compounds include:

Diethyl Ether	Tetrahydrofuran
Isopropyl Ether	Other ethers

Other peroxide forming agents include:

Aldehydes

Compounds with benzylic hydrogens

Compounds with allyl groups

Vinyls

B. Peroxide Formation and Safety Tips

1. Exposure of any of the peroxide-forming agents to light or air increase the rate

of peroxide information. Therefore, store these agents in full, light-tight containers.

2. Refrigeration does not prevent peroxide formation

3. Order small amounts frequently to decrease storagetime.

4. Date new containers when opened.

5. Be particularly cautious with materials of unknown vintage. Do not attempt to remove caps from containers that may cause sparks. Call RM&S for advice or assistance when such containers are found.

6. Never distill peroxide-forming solvents unless they are known to be free of peroxides. Peroxides concentrated in the residue can pose a serious explosion hazard.

C. Peroxide Testing and Disposal

1. Before beginning work with a peroxide-forming agent, determine its peroxide content. Dispose of agents containing greater than 80 ppm peroxide. Easy-to-use quantitative peroxide test strips are available from Scientific Products or Aldrich

2. Materials found to contain peroxides (greater than 80 ppm) should be treated prior to disposal. Methods for removal of peroxides involve the addition of reducing agent such as ferrous sulfate (for diethyl ether peroxides) or sodium metabisulfite (for isopropyl ether peroxides).

3. The treated solvent should be placed in a waste container and the empty container rinsed with water. Most peroxides are water soluble and the rinsate can be put in the sewer system.

1.9.2 Strong Oxidizers and Reducers

The best way to dispose of oxidizers and reducers is to chemically neutralize them. You should treat the chemicals listed below in your laboratory. For information on treatment techniques, please call us. If you choose not to neutralize these chemicals, contact RM&S for pickup and disposal.

STRONG OXIDIZERS

Chromic acid (fresh)	Metallic chlorates
Metallic nitrates	Metallic perchlorates
Metallic permanganates	Perchloric acid

STRONG REDUCERS

n-Butyl lithium	Calcium hydride
Metallic sulfides	Sodium hydride
Stannous chloride	

1.8.3 Other Reactives (Including Water Reactives)

Listed below are a variety of reactive materials that you should give to RM&S for disposal. Package any liquids separately from solids and please note special hazards and/or handling precautions on each box. See 1.13 for additional packaging and labeling instructions.

Acetyl chloride	Bezoyl peroxide
Bromine	Calcium metal
Lithium metal	Phosphorous (yellow)
Potassium metal	Sodium metal
Thionyl chloride	

1.10 Precipitates, Semisolids, Residues, Gels, etc.

Since they can't be pumped, don't put precipitates, semisolids, residues or gels of any kind into solvent waste containers. If separable, the liquid phase should first be removed by decantation, filtration, evaporation or absorption. Use Section 1.2 to determine whether the material is hazardous or call us for assistance. If the material is hazardous, package it in leak-proof containers according to 1.13 and contact RM&S for pick-up.

1.11 Labware Contaminated with Toxic Chemicals

Contaminated labware disposal can be a problem if the contaminant(s) is/are highly toxic. Labware pertains to disposable lab items, such as gloves, bench top coverings, pipets, test tubes, aprons, etc. The decision as to whether contaminated labware should be place in a secure landfill, treated in some way, or put into the normal trash depends upon the toxicity and concentration of the contaminant.

If you feel that the normal trash is not an appropriate route of disposal for your contaminated labware (because the contaminant has a high toxicity), package it according to 1.13 and let RM&S pick it up. We will evaluate the labware for its appropriate route of disposal.

All PCB contaminated labware 50 ppm or greater must be given to RM&S for disposal.

In general, labware contaminated with chemicals should be put into the normal trash if it is nonreactive, nonignitable and the contaminant is not highly toxic. Call RM&S if you have any questions. Procedures for decontaminating nondisposable items are also available.

1.12 Unknown Chemicals

You must make every effort to provide an accurate description of all chemicals you give us. Unknown chemicals present serious problems for the University. Without a description, we can't handle or dispose of a chemical in a safe manner. Disposal companies will not accept chemical waste without an analysis, and an analysis of one sample could easily cost $1,000.

1. Investigation of Unknown Chemicals

   We offer assistance in investigating the identity of unknown chemicals. Any information you can provide about an unknown chemical you wish to dispose of greatly aids identification. For example, even knowing whether or not a chemical is organic or inorganic is helpful.

2. Procedure

Call RM&S if you have an unknown chemical. Don't move it from its location if possible.

3. Reducing the Problem

You can reduce the occurrence of unknown chemicals by being thorough in maintaining labels on chemical containers. Periodic review of chemical stock and careful record keeping lessens the chance of discovering containers with missing labels.

4. Moving? Call Us!!

We often receive unknown an unwanted chemicals when new personnel enter a laboratory. To alleviate this problem, we offer assistance to individuals planning to leave their lab. This assistance includes identification of unknowns, sorting of unwanted chemicals and redistribution for recycling purposes. Before a faculty member leaves the University, she/he or the department should contact RM&S to ensure

that all chemicals have been safely and correctly dealt with. chemicals. Proper identification of the materials you give us is also important. Because of EPA regulations, we must know the identity of each container.

1.13 Packaging and Labeling

Good packaging increases safety when we handle and transport your all material we receive from labs. Please follow these rules when giving material to RM&S:

1. Label each container you package with its identity. Attach a properly, completed Chemical Discard Tag on each waste container.

2. Consider chemical compatibility when packaging a variety of items.

3. Put chemicals into closed containers that will not leak.

4. Pack liquids separately from solids.

5. If you have multiple containers of the same chemical, pack your chemicals in a strong cardboard box. Do not seal box as RM&S staff will check each container for proper

identification.

6. Call RM&S (1-5037) and let them know you have waste for pickup. Routine pickups are scheduled biweekly for Chemistry, Physics, Radiation Laboratory and Biology. If in another department, every effort will be made to pick up the waste within 72 hours of the call.

1.14 REFERENCES

All Books Available in RM&S Department Library

a. National Research Council. Prudent Practices for Handling Hazardous Chemicals in Laboratories (National Academy Press, 2101 Constitution Ave., Washington D.C. 10418).

b. National Research Council. Prudent Practices for Disposal of Chemicals from Laboratories (National Academy Press, 2101 Constitution Ave., Washington, D.C. 10418).

c. Irving Sax. Dangerous Properties of Industrial Materials, 6th Edition, Von Nostrand Reinhold Co., New York, New York, 1984.

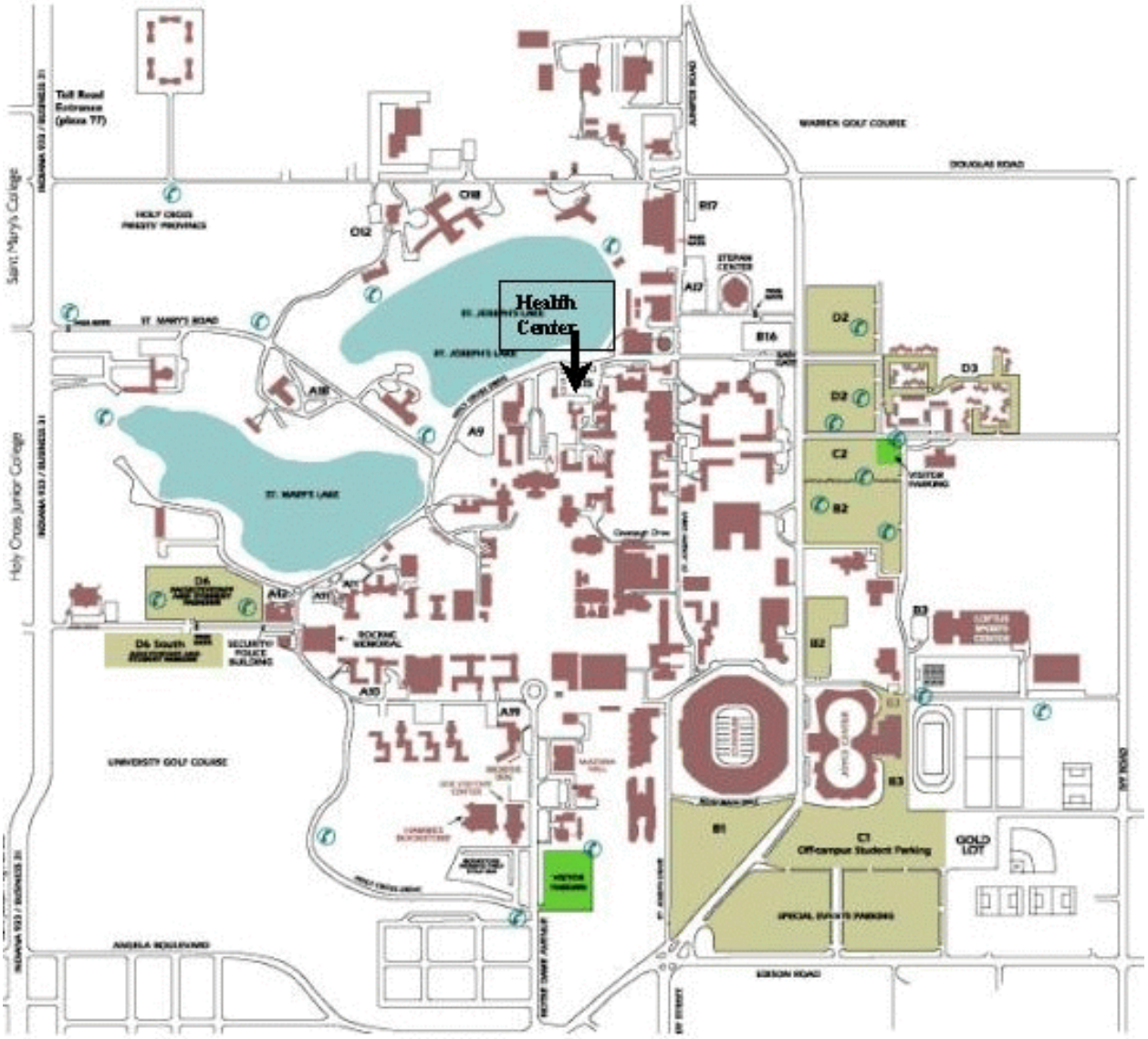
d. NIOSH Registry of Toxic Effects of Chemical Substances, 1978. (Superintendent of Documents, U.S. Govt. Printing Office, Washington, D.C. 20402).

e. Patty's Industrial Hygiene and Toxocology, 3rd Edition, 1981. (Wiley-Interscience Publication, New York).

f. SAFETY - The Sigma-Aldrich Library of Chemical Safety Data., 1st Edition, 1985 (Sigma-Aldrich Corp., P.O. Box 335, Milwaukee, WI 53201).

APPENDIX 11 MAPS TO MEDICAL FACILITIES

CAMPUS MAP


Health Center
Saint Mary's College
Holy Cross Junior College
Toll Road Entrance (plaza 77)
HOLY CROSS PRIESTS' PROVINCE
ST. MARY'S ROAD
ST. MARY'S LAKE
ST. JOSEPH'S LAKE
WARREN GOLF COURSE
DOUGLAS ROAD
ASHFORD ROAD
UNIVERSITY GOLF COURSE
ANGELA BOULEVARD
EDISON ROAD
D6 South
SECURITY/POLICE BUILDING
C1 Off-campus Student Parking
GOLD LOT
SPECIAL EVENTS PARKING
VISITOR PARKING

MAP FROM CAMPUS TO ST. JOSEPH MEDICAL CENTER

Appendix 12

Code of Federal Regulations, 29 CFR 1910.1450

Occupational Exposure to Hazardous Chemicals in Laboratories.

(a)Scope and application.

(a)(1) This section shall apply to all employers engaged in the laboratory use of hazardous chemicals as defined below.

(a)(2) Where this section applies, it shall supersede, for laboratories, the requirements of all

other OSHA health standards in 29 CFR part 1910, subpart Z, except as follows:

(a)(2)(i) For any OSHA health standard, only the requirement to limit employee exposure to the specific permissible exposure limit shall apply for laboratories, unless that particular standard states otherwise or unless the conditions of paragraph (a)(2)(iii) of this section apply.

(a)(2)(ii) Prohibition of eye and skin contact where specified by any OSHA health standard shall be observed.

(a)(2)(iii) Where the action level (or in the absence of an action level, the permissible exposure limit) is routinely exceeded for an OSHA regulated substance with exposure monitoring and medical surveillance requirements paragraphs (d) and(g)(1)(ii) of this section shall apply.

(a)(3) This section shall not apply to: 1910.1450(a)(3)(i)

(a)(3)(i) Uses of hazardous chemicals which do not meet the definition of laboratory use, and in such cases, the employer shall comply with the relevant standard in 29 CFR part 1910, subpart 2, even if such use occurs in a laboratory.

(a)(3)(ii) Laboratory uses of hazardous chemicals which provide no potential for employee exposure. Examples of such conditions might include:

(a)(3)(ii)(A)Procedures using chemically-impregnated test media such as Dip-and-Read tests where a reagent strip is dipped into the specimen to be tested and the results are interpreted by comparing the color reaction to a color chart supplied by the manufacturer of the test strip; and

(a)(3)(ii)(B) Commercially prepared kits such as those used in performing pregnancy tests in which all of

the reagents needed to conduct the test are contained in the kit.

(b)Definitions -

"Action level" means a concentration designated in 29 CFR part 1910 for a specific substance, calculated as an eight (8)-hour time-weighted average, which initiates certain required activities such as exposure monitoring and medical surveillance.

"Assistant Secretary" means the Assistant Secretary of Labor for Occupational Safety and Health, U.S. Department of Labor, or designee.

"Carcinogen" (see "select carcinogen").

"Chemical Hygiene Officer" means an employee who is designated by the employer, and who is qualified by training or experience, to provide technical guidance in the development and implementation of the provisions of the Chemical Hygiene Plan. This definition is not intended to place limitations on the position description or job classification that the designated individual shall hold within the employer's organizational structure.

"Chemical Hygiene Plan" means a written program developed and implemented by the employer which sets forth procedures, equipment, personal protective equipment and work practices that (i) are capable of protecting employees from the health hazards presented by hazardous chemicals used in that particular workplace and (ii) meets the requirements of paragraph (e) of this section.

"Combustible liquid" means any liquid having a flashpoint at or above 100 deg. F (37.8 deg. C), but below 200 deg. F (93.3 deg. C), except any mixture having components with flashpoints of 200 deg. F (93.3 deg. C), or higher, the total volume of which make up 99 percent or more of the total volume of the mixture.

"Compressed gas" means:

(i) A gas or mixture of gases having, in a container, an absolute pressure exceeding 40 psi at 70 deg. F (21.1 deg. C); or

(ii) A gas or mixture of gases having, in a container, an absolute pressure exceeding 104 psi at 130 deg. F (54.4 deg C) regardless of the pressure at 70 deg. F (21.1 deg. C); or

(iii) A liquid having a vapor pressure exceeding 40 psi at 100 deg. F (37.8

C) as determined by ASTM D-323-72.

"Designated area" means an area which may be used for work with "select carcinogens," reproductive toxins or substances which have a high degree of acute toxicity. A designated area may be the entire laboratory, an area of a laboratory or a device such as a laboratory hood.

"Emergency" means any occurrence such as, but not limited to, equipment failure, rupture of containers or failure of control equipment which results in an uncontrolled release of a hazardous chemical into the workplace.

"Employee" means an individual employed in a laboratory workplace who may be exposed to hazardous chemicals in the course of his or her assignments.

"Explosive" means a chemical that causes a sudden, almost instantaneous release of pressure, gas, and heat when subjected to sudden shock, pressure, or high temperature.

"Flammable" means a chemical that falls into one of the following categories:

(i) "Aerosol, flammable" means an aerosol that, when tested by the method described in 16 CFR 1500.45, yields a flame protection exceeding 18 inches at full valve opening, or a flashback (a flame extending back to the valve) at any degree of valve opening;

(ii) "Gas, flammable" means:

(A) A gas that, at ambient temperature and pressure, forms a flammable mixture with air at a concentration of 13 percent by volume or less; or

(B) A gas that, at ambient temperature and pressure, forms a range of flammable mixtures with air wider than 12 percent by volume, regardless of the lower limit.

(iii) "Liquid, flammable" means any liquid having a flashpoint below 100 deg F (37.8 deg. C), except any mixture having components with flashpoints of 100 deg. C) or higher, the total of which make up 99 percent or more of the total volume of the mixture.

(iv) "Solid, flammable" means a solid, other than a blasting agent or explosive as defined in 1910.109(a), that is liable to cause fire through friction, absorption of moisture, spontaneous chemical change, or retained heat from manufacturing or processing, or which can be ignited readily and when ignited burns so vigorously and persistently as to create a serious hazard. A chemical shall be considered to be a flammable solid

if, when tested by the method described in 16 CFR 1500.44, it ignites and burns with a self-sustained flame at a rate greater than one-tenth of an inch per second along its major axis.

"Flashpoint" means the minimum temperature at which a liquid gives off a vapor in sufficient concentration to ignite when tested as follows:

(i) Tagliabue Closed Tester (See American National Standard Method of Test for Flash Point by Tag Closed Tester, Z11.24 - 1979 (ASTM D 56-79)) - for liquids with a viscosity of less than 45 Saybolt Universal Seconds (SUS) at 100 deg. F (37.8 deg. C), that do not contain suspended solids and do not have a tendency to form a surface film under test; or

(ii) Pensky-Martens Closed Tester (See American National Standard Method of Test for Flashpoint by Pensky-Martens Closed Tester, Z11.7 - 1979 (ASTM D 93-79)) - for liquids with a viscosity equal to or greater than 45 SUS at 100 deg. F (37.8 deg. C), or that contain suspended solids, or that have a tendency to form a surface film under test; or

(iii) Setaflash Closed Tester (see American National Standard Method of test for Flash Point by Setaflash Closed Tester (ASTM D 3278-78)).

Organic peroxides, which undergo autoaccelerating thermal decomposition, are excluded from any of the flashpoint determination methods specified above.

"Hazardous chemical" means 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 exposed employees. The term "health hazard" includes chemicals which are carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, neurotoxins, agents which act on the hematopoietic systems, and agents which damage the lungs, skin, eyes, or mucous membranes.

Appendices A and B of the Hazard Communication Standard (29 CFR 1910.1200) provide further guidance in defining the scope of health hazards and determining whether or not a chemical is to be considered hazardous for purposes of this standard.

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

"Laboratory scale" means work with substances in which the containers used for reactions, transfers, and other handling of substances are designed to be easily and safety manipulated by one person. "Laboratory scale" excludes those workplaces whose function is to produce commercial quantities of materials.

"Laboratory-type hood" means a device located in a laboratory, enclosure on five sides with a movable sash or fixed partial enclosed on the remaining side; constructed and maintained to draw air from the laboratory and to prevent or minimize the escape of air contaminants into the laboratory; and allows chemical manipulations to be conducted in the enclosure without insertion of any portion of the employee's body other than hands and arms.

Walk-in hoods with adjustable sashes meet the above definition provided that the sashes are adjusted during use so that the airflow and the exhaust of air contaminants are not compromised and employees do not work inside the enclosure during the release of airborne hazardous chemicals.

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

(i) Chemical manipulations are carried out on a "laboratory scale;"

(ii) Multiple chemical procedures or chemicals are used;

(iii) The procedures involved are not part of a production process, nor in any way simulate a production process; and

(iv) "Protective laboratory practices and equipment" are available and in common use to minimize the potential for employee exposure to hazardous chemicals.

"Medical consultation" means a consultation which takes place between an employee and a licensed physician for the purpose of determining what medical examinations or procedures, if any, are appropriate in cases where a significant exposure to a hazardous chemical may have taken place.

"Organic peroxide" means an organic compound that contains the bivalent -O-O- structure and which may be considered to be a structural derivative of hydrogen peroxide where one or both of the hydrogen atoms has been replaced by an organic radical.

"Oxidizer" means a chemical other than a blasting agent or explosive as defined in 1910.109(a), that initiates or promotes combustion in other materials, thereby causing fire either of itself or through the release of oxygen or other gases.

"Physical hazard" means a chemical for which there is scientifically valid evidence that it is a combustible liquid, a compressed gas, explosive, flammable, an organic peroxide, an oxidizer pyrophoric, unstable (reactive) or water-reactive.

"Protective laboratory practices and equipment" means those laboratory procedures, practices and equipment accepted by laboratory health and safety experts as effective, or that the employer can show to be effective, in minimizing the potential for employee exposure to hazardous chemicals.

"Reproductive toxins" means chemicals which affect the reproductive chemicals which affect the reproductive capabilities including chromosomal damage (mutations) and effects on fetuses (teratogenesis).

"Select carcinogen" means any substance which meets one of the following criteria:

(i) It is regulated by OSHA as a carcinogen; or

(ii) It is listed under the category, "known to be carcinogens," in the Annual Report on Carcinogens published by the National Toxicology Program (NTP)(latest edition); or

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

(iv) It is listed in either Group 2A or 2B by IARC or under the category, "reasonably anticipated to be carcinogens" by NTP, and causes statistically significant tumor incidence in experimental animals in accordance with any of the following criteria:

(A) After inhalation exposure of 6-7 hours per day, 5 days per week, for a significant portion of a lifetime to dosages of less than 10 mg/m(3);

(B) After repeated skin application of less than 300 (mg/kg of body weight) per week; or

(C) After oral dosages of less than 50 mg/kg of body weight per day.

"Unstable (reactive)" means a chemical which is the pure state, or as produced or transported, will vigorously polymerize, decompose, condense, or will become self-reactive under conditions of shocks, pressure or temperature.

"Water-reactive" means a chemical that reacts with water to release a gas that is either flammable or presents a health hazard.

(c)Permissible exposure limits. For laboratory uses of OSHA regulated substances, the employer shall assure that laboratory employees' exposures to such substances do not exceed the permissible exposure limits specified in 29 CFR part 1910, subpart Z.

(d)Employee exposure determination -

(d)(1)Initial monitoring. The employer shall measure the employee's exposure to any substance regulated by a standard which requires monitoring if there is reason to believe that exposure levels for that substance routinely exceed the action level (or in the absence of an action level, the PEL).

(d)(2)Periodic monitoring. If the initial monitoring prescribed by paragraph (d)(1) of this section discloses employee exposure over the action level (or in the absence of an action level, the PEL), the employer shall immediately comply with the exposure monitoring provisions of the relevant standard.

(d)(3)Termination of monitoring. Monitoring may be terminated in accordance with the relevant standard.

(d)(4)Employee notification of monitoring results. The employer shall, within 15 working days after the receipt of any monitoring results, notify the employee of these results in writing either individually or by posting results in an appropriate location that is accessible to employees.

(e)Chemical hygiene plan - General. (Appendix A of this section is non-mandatory but provides guidance to assist employers in the development of the Chemical Hygiene Plan).

(e)(1)Where hazardous chemicals as defined by this standard are used in the workplace, the employer shall develop and carry out the provisions of a written Chemical Hygiene Plan which is:

(e)(1)(i)Capable of protecting employees from health hazards associated with hazardous chemicals in that laboratory and

(e)(1)(ii)Capable of keeping exposures below the limits specified in paragraph (c) of this section.

(e)(2)The Chemical Hygiene Plan shall be readily available to employees, employee representatives and, upon request, to the Assistant Secretary.

(e)(3)The Chemical Hygiene Plan shall include each of the following elements and shall indicate specific measures that the employer will take to ensure laboratory employee protection;

(e)(3)(i)Standard operating procedures relevant to safety and health considerations to be followed when laboratory work involves the use of hazardous chemicals;

(e)(3)(ii)Criteria that the employer will use to determine and implement control measures to reduce employee exposure to hazardous chemicals including engineering controls, the use of personal protective equipment and hygiene practices; particular attention shall be given to the selection of control measures for chemicals that are known to be extremely hazardous;

(e)(3)(iii)A requirement that fume hoods and other protective equipment are functioning properly and specific measures that shall be taken to ensure proper and adequate performance of such equipment;

(e)(3)(iv)Provisions for employee information and training as prescribed in paragraph (f) of this section;

(e)(3)(v)The circumstances under which a particular laboratory operation, procedure or activity shall require prior approval from the employer or the employer's designee before implementation;

(e)(3)(vi)Provisions for medical consultation and medical examinations in accordance with paragraph (g) of this section;

(e)(3)(vii)Designation of personnel responsible for implementation of the Chemical Hygiene Plan including the assignment of a Chemical Hygiene Officer, and, if appropriate, establishment of a Chemical Hygiene Committee; and

(e)(3)(viii)Provisions for additional employee protection for work with particularly hazardous substances. These include "select carcinogens," reproductive toxins and substances which have a high degree of acute toxicity. Specific consideration shall be given to the following provisions which shall be included where appropriate:

(e)(3)(viii)(A)Establishment of a designated area;

(e)(3)(viii)(B)Use of containment devices such as fume hoods or glove boxes;

(e)(3)(viii)(C)Procedures for safe removal of contaminated waste; and

(e)(3)(viii)(D)Decontamination procedures.

(e)(4)The employer shall review and evaluate the effectiveness of the Chemical Hygiene Plan at least annually and update it as necessary.

(f)Employee information and training.

(f)(1)The employer shall provide employees with information and training to ensure that they are apprised of the hazards of chemicals present in their work area.

(f)(2)Such information 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. The frequency of refresher information and training shall be determined by the employer.

(f)(3)Information. Employees shall be informed of:

(f)(3)(i)The contents of this standard and its appendices which shall be made available to employees;

(f)(3)(ii)the location and availability of the employer's Chemical Hygiene Plan;

(f)(3)(iii)The permissible exposure limits for OSHA regulated substances or recommended exposure limits for other hazardous chemicals where there is no applicable OSHA standard;

(f)(3)(iv)Signs and symptoms associated with exposures to hazardous chemicals used in the laboratory; and

(f)(3)(v)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 received from the chemical supplier.

(f)(4)Training.

(f)(4)(i)Employee training shall include:

(f)(4)(i)(A)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.);

(f)(4)(i)(B)The physical and health hazards of chemicals in the work area; and

(f)(4)(i)(C)The measures employees can take to protect themselves from these hazards, including specific procedures the employer has implemented to protect employees from exposure to hazardous chemicals, such as appropriate work practices, emergency procedures, and personal protective equipment to be used.

(f)(4)(ii)The employee shall be trained on the applicable details of the employer's written Chemical Hygiene Plan (g)Medical consultation and medical examinations.

(g)(1)The employer shall provide all employees who work with hazardous chemicals an opportunity to receive medical attention, including any follow-up examinations which the examining physician determines to be necessary, under the following circumstances:

(g)(1)(i)Whenever an employee develops signs or symptoms associated with a hazardous chemical to which the employee may have been exposed in the laboratory, the employee shall be provided an opportunity to receive an appropriate medical examination.

(g)(1)(ii)Where exposure monitoring reveals an exposure level routinely above the action level (or in the absence of an action level, the PEL) for an OSHA regulated substance for which there are exposure monitoring and medical surveillance requirements, medical surveillance shall be established for the affected employee as prescribed by the particular standard.

(g)(1)(iii)Whenever an event takes place in the work area such as a spill, leak, explosion or other occurrence resulting in the likelihood of a hazardous exposure, the affected employee shall be provided an opportunity for a medical consultation. Such consultation shall be for the purpose of determining the need for a medical examination.

(g)(2)All medical examinations and consultations shall be performed by or under the direct supervision of a licensed physician and shall be provided without cost to the employee, without loss of pay and at a reasonable time and place.

(g)(3)Information provided to the physician. The employer shall provide the following information to the physician:

(g)(3)(i)The identity of the hazardous chemical(s) to which the employee may have been exposed;

(g)(3)(ii)A description of the conditions under which the exposure occurred including quantitative exposure data, if available; and

(g)(3)(iii)A description of the signs and symptoms of exposure that the employee is experiencing, if any.

(g)(4)Physician's written opinion.

(g)(4)(i)For examination or consultation required under this standard, the employer shall obtain a written opinion from the examining physician which shall include the following:

(g)(4)(i)(A)Any recommendation for further medical follow-up;

(g)(4)(i)(B)The results of the medical examination and any associated tests;

(g)(4)(i)(C)Any medical condition which may be revealed in the course of the examination which may place the employee at increased risk as a result of exposure to a hazardous workplace; and

(g)(4)(i)(D)A statement that the employee has been informed by the physician of the results of the consultation or medical examination and any medical condition that may require further examination or treatment.

(g)(4)(ii)The written opinion shall not reveal specific findings of diagnoses unrelated to occupational exposure.

(h)Hazard identification.

(h)(1)With respect to labels and material safety data sheets:

(h)(1)(i)Employers shall ensure that labels on incoming containers of hazardous chemicals are not removed or defaced.

(h)(1)(ii)Employers shall maintain any material safety data sheets that are received with incoming shipments of hazardous chemicals, and ensure that they are readily accessible to laboratory employees.

(h)(2)The following provisions shall apply to chemical substances developed in the laboratory:

(h)(2)(i)If the composition of the chemical substance which is produced exclusively for the laboratory's use is known, the employer shall determine if it is a hazardous chemical as defined in paragraph (b) of this section. If the chemical is determined to be hazardous, the employer shall provide appropriate training as required under paragraph (f) of this section.

(h)(2)(ii)If the chemical produced is a byproduct whose composition is not known, the employer shall assume that the substance is hazardous and shall implement paragraph (e) of this section.

(h)(2)(iii)If the chemical substance is produced for another user outside of the laboratory, the employer shall comply with the Hazard Communication Standard (29 CFR 1910.1200) including the requirements for preparation of material safety data sheets and labeling.

(i)Use of respirators. Where the use of respirators is necessary to maintain exposure below permissible exposure limits, the employer shall provide, at no cost to the employee, the proper respiratory equipment. Respirators shall be selected and used in accordance with the requirements of 29 CFR 1910.134.

(j)Recordkeeping.

(j)(1)The employer shall establish and maintain for each employee an accurate record of any measurements taken to monitor employee exposures and any medical consultation and examinations including tests or written opinions required by this standard.

(j)(2)The employer shall assure that such records are kept, transferred, and made available in accordance with 29 CFR 1910.1020.

(k)Dates -

(k)(1)Effective date. This section shall become effective May 1, 1990.

(k)(2)Start-up dates.

(k)(2)(i)Employers shall have developed and implemented a written Chemical Hygiene Plan no later than

January 31, 1991.

(k)(2)(ii)Paragraph (a)(2) of this section shall not take effect until the employer has developed and implemented a written Chemical Hygiene Plan.

(l)Appendices. The information contained in the appendices is not intended, by itself, to create any additional obligations not otherwise imposed or to detract from any existing obligation.

[61 FR 5507, Feb. 13, 1996]