

Responding to Accidents and Emergencies

1. General Preparation for Emergencies

- a. All laboratory personnel should know what to do in case of an emergency. Laboratory work should not be undertaken without knowledge of the following points:
 - i. How to report a fire, injury, chemical spill, or other emergency to summon emergency response;
 - ii. The location of emergency equipment such as safety showers and eyewashes;
 - iii. The location of fire extinguishers and spill control equipment; and
 - iv. The locations of all available exits for evacuation from the laboratory.
- b. Laboratory workers should be aware of their level of expertise with respect to use of fire extinguishers and emergency equipment, dealing with chemical spills, and dealing with injuries. They should not take actions outside the limits of their expertise but instead should rely on trained personnel.
- c. Names and telephone numbers of responsible individuals should be posted on the laboratory door.

2. Handling the Accidental Release of Hazardous Substances

- a. Experiments should always be designed so as to minimize the possibility of an accidental release of hazardous substances.
- b. Experiments should use the minimal amounts of hazardous compounds practical.
 - i. Materials should be transported properly, using break-resistant bottles or secondary containers. See P:NAU:CHM:1 – Hazardous Material Transport.
 - ii. Personnel should be familiar with the properties (physical, chemical, and toxicological) of hazardous substances before working with them.
- c. In the event of a laboratory-scale spill, the following general guidelines for handling it should be followed in the indicated order:
 - i. Notify other laboratory personnel of the accident and, if necessary, evacuate the area.
 - ii. Tend to any injured or contaminated personnel and, if necessary, request help.
 - iii. Take steps to confine and limit the spill if this can be done without risk of injury or contamination.
 - iv. Clean up the spill using appropriate procedures.

- v. Dispose of contaminated materials properly.

3. Notification of Personnel in the Area

- a. Other nearby workers should be alerted to the accident and the nature of the chemicals involved.
- b. In the event of the release of a highly toxic gas or volatile material, the laboratory should be evacuated and personnel posted at entrances to prevent other workers from inadvertently entering the contaminated area. In some cases (e.g., incidents involving the release of highly toxic substances and spills occurring in non-laboratory areas), it may be appropriate to activate a fire alarm to alert personnel to evacuate the entire building. The proper authorities should be called on for emergency assistance.

4. Treatment of Injured and Contaminated Personnel

- a. If an individual is injured or contaminated with a hazardous substance, tending to him or her generally takes priority over implementing spill control measures. It is important to obtain medical attention as soon as possible by calling the posted number.
- b. For spills covering small areas of skin, follow these procedures:
 - i. Immediately flush with flowing water for no less than 15 minutes.
 - ii. If there is no visible burn, wash with warm water and soap, removing any jewelry to facilitate clearing of any residual materials.
 - iii. Check the Material Safety Data Sheet (MSDS) to see if any delayed effects should be expected.
 - iv. Seek medical attention for even minor chemical burns.
 - v. Do not use creams, lotions, or salves.
- c. Take the following steps for spills on clothes:
 - i. Do not attempt to wipe the clothes.
 - ii. Quickly remove all contaminated clothing, shoes, and jewelry while using the safety shower.
 - iii. Seconds count, so do not waste time because of modesty.
 - iv. Take care not to spread the chemical on the skin or, especially, in the eyes.
 - v. Use caution when removing pullover shirts or sweaters to prevent contamination of the eyes; it may be better to cut the garments off.
 - vi. Immediately flood the affected body area with warm water for at least 15 minutes. Resume if pain returns.
 - vii. Get medical attention as soon as possible.
 - viii. Discard contaminated clothes or have them laundered separately from other clothing.
- d. For splashes into the eye, take these steps:
 - i. Immediately flush with tepid potable water from a gently flowing source for at least 15 minutes.

- ii. Hold the individual's eyelids away from the eyeball, and instruct him or her to move the eye up and down and sideways to wash thoroughly behind the eyelids.
- iii. Use an eyewash. If one is not available, place the injured person on his or her back and pour water gently into the eyes for at least 15 minutes.
- iv. Follow first aid by prompt treatment by a member of a medical staff or an ophthalmologist who is acquainted with chemical injuries.

5. Spill Containment

- a. Every laboratory in which hazardous substances are used should have spill control kits tailored to deal with the potential risk associated with the materials being used in the laboratory. These kits are used to confine and limit the spill if such actions can be taken without risk of injury or contamination. A specific individual should be assigned to maintain the kit. Spill control kits should be located near laboratory exits for ready access. Typical spill control kits might include these items:
 - i. Spill control pillows. These commercially available pillows generally can be used for absorbing solvents, acids, and caustic alkalis, but not hydrofluoric acid.
 - ii. Inert absorbents such as vermiculite, clay, sand, kitty litter, and Oil Dri®. Paper is not an inert material and should not be used to clean up oxidizing agents such as nitric acid.
 - iii. Neutralizing agents for acid spills such as sodium carbonate and sodium bicarbonate.
 - iv. Neutralizing agents for alkali spills such as sodium bisulfate and citric acid.
 - v. Large plastic scoops and other equipment such as brooms, pails, bags, and dust pans. Appropriate personal protective equipment, warnings, barricade tapes, and protection against slips or falls on wet floor during and after cleanup.

6. Spill Cleanup

- a. Materials of low flammability that are not volatile or that have low toxicity. This category of hazardous substances includes inorganic acids (e.g., sulfuric and nitric acid) and caustic bases (e.g., sodium and potassium hydroxide).
 - i. For cleanup, appropriate protective apparel, including gloves, goggles, and (if necessary) shoe coverings should be worn.
 - ii. Absorption of the spilled material with an inert absorbent and appropriate disposal are recommended.
 - iii. The spilled chemicals can be neutralized with materials such as sodium bisulfate (for alkalis) and sodium carbonate or bicarbonate (for acids), absorbed on Floor-Dri® or vermiculite, scooped up, and disposed of according to NAU's hazardous waste program.

- b. Flammable solvents - Fast action is crucial when a flammable solvent of relatively low toxicity is spilled. This category includes petroleum ether, pentane, diethyl ether, dimethoxyethane, and tetrahydrofuran.
 - i. Other workers in the laboratory should be alerted.
 - ii. All flames extinguished, and any spark-producing equipment turned off.
 - iii. In some cases the power to the laboratory should be shut off with the circuit breaker, but the ventilation system should be kept running.
 - iv. The spilled solvent should be soaked up with spill absorbent or spill pillows as quickly as possible.
 - v. These should be sealed in containers and disposed of properly.
 - vi. Nonsparking tools should be used in cleanup.
- c. Highly toxic substances.
 - i. The cleanup of highly toxic substances should not be attempted alone.
 - ii. Other personnel should be notified of the spill, and the appropriate safety or industrial hygiene office should be contacted to obtain assistance in evaluating the hazards involved. These professionals will know how to clean up the material and may perform the operation.

7. **Handling Leaking Gas Cylinders** - Leaking gas cylinders constitute hazards that may be so serious as to require an immediate call for outside help. Workers should not apply extreme tension to close a stuck valve. Personal protective equipment should be worn. The following guidelines cover leaks of various types of gases:

- a. Flammable, inert, or oxidizing gases
 - i. The cylinder should be moved to an isolated area, away from combustible material if the gas is flammable or an oxidizing agent.
 - ii. Signs should be posted that describe the hazards and state warnings.
 - iii. Care should be taken when moving leaking cylinders of flammable gases so that accidental ignition does not occur. If feasible, leaking cylinders should always be moved into laboratory hoods until exhausted.
- b. Corrosive gases.
 - i. Corrosive gases may increase the size of the leak as they are released, and some corrosives are also oxidants, flammable, and/or toxic.
 - ii. The cylinder should be moved to an isolated, well-ventilated area, and suitable means used to direct the gas into an appropriate chemical neutralizer.
 - iii. If there is apt to be a reaction with the neutralizer that could lead to a "suck-back" into the valve (e.g., aqueous acid into an ammonia

tank), a trap should be placed in the line before starting neutralization.

- iv. Signs should be posted that describe the hazards and state warnings.
- c. Toxic gases.
 - i. The same procedure should be followed for toxic gases as for corrosive gases, but for the protection of personnel, a special warning should be given for the added hazard of exposure.
 - ii. The cylinder should be moved to an isolated, well-ventilated area, and suitable means used to direct the gas into an appropriate chemical neutralizer.
 - iii. Signs should be posted that describe the hazards and state warnings. Appropriate personal protective equipment should be worn.

8. Handling Spills of Elemental Mercury - Mercury spills can be avoided by using supplies and equipment that do not contain mercury. However, most mercury spills do not pose a high risk.

- a. The initial response to a spill of elemental mercury should be to isolate the spill area and begin the cleanup procedure.
- b. Those doing the cleanup should wear protective gloves.
- c. The cleanup should begin with collecting the droplets. The large droplets can be consolidated by using a scraper or a piece of cardboard, and the pool of mercury removed with a pump or other appropriate equipment.
- d. A standard vacuum cleaner should never be used to pick up mercury.
- e. If a house vacuum system is used, it can be protected from the mercury by a charcoal filter in a trap.
- f. For cleaning up small mercury droplets, a special vacuum pump may be used, or the mercury may be picked up on wet toweling, which consolidates the small droplets to larger pieces, or picked up with a piece of adhesive tape.
- g. Commercial mercury spill cleanup sponges and spill control kits are available.
- h. The mercury should be placed in a thick-wall high-density polyethylene bottle and transferred to a central depository for reclamation.
- i. After a mercury spill the exposed work surfaces and floors should be decontaminated by using an appropriate decontamination kit.

9. Responding to Fires - Fires are one of the most common types of laboratory accidents. Accordingly, all personnel should be familiar with general guidelines (as stated below) to prevent and minimize injury and damage from fires. Hands on experience with common types of extinguishers and proper choice of extinguisher should be part of basic laboratory training.

- a. The following should be noted:
 - i. Preparation is essential! Make sure all laboratory personnel know the locations of all fire extinguishers in the laboratory, what types

of fires they can be used for, and how to operate them correctly. Also ensure that they know the location of the nearest fire alarm pull station, safety showers, and emergency blankets.

- ii. Even though a small fire that has just started can sometimes be extinguished with a laboratory fire extinguisher, attempt to extinguish such fires only if you are confident that you can do it successfully and quickly, and from a position in which you are always between the fire and an exit to avoid being trapped.
 - iii. Do not underestimate the danger from a fire, and remember that toxic gases and smoke may present additional hazards.
 - iv. Notify trained professionals.
- b. Fires in small vessels can usually be put out by covering the vessel loosely. Never pick up a flask or container of burning material.
 - c. Extinguish small fires involving reactive metals and organometallic compounds (e.g., magnesium, sodium, potassium, and metal hydrides) with Met-L-X® or Met-L-Kyl® extinguishers or by covering with dry sand. Because these fires are very difficult to extinguish, sound the fire alarms before you attempt to extinguish the fire.
 - d. In the event of a more serious fire, evacuate the laboratory and activate the nearest fire alarm. Upon their arrival, tell the fire department and emergency response team what hazardous substances are in the laboratory.
 - e. If a person's clothing catches fire, have him or her immediately drop to the floor and roll. Dousing with water from the safety shower can be effective. Use fire blankets only as a last resort because they tend to hold in heat and to increase the severity of burns. Remove contaminated clothing quickly, douse the person with water, and place clean, wet, cold cloth on burned areas. Wrap the injured person in a blanket to avoid shock, and get medical attention promptly.