



Guide for Chemical Spill Response Planning

The objective of this guide is to provide laboratory employees with a framework for spill response planning. This planning must be done in advance, not after a spill occurs.

All spills are different; this guide cannot give definitive guidance on how to handle every one. One thing is clear, however a professional response to spills, from planning to properly using cleanup equipment, will reduce the eventual costs (in injury, pollution, dollars, pride, and job security).

This is NOT a regulatory compliance document. Many of the terms used in this guide have regulatory significance; however, this document refers to their common (not legal) meaning. Although this document may be used in conjunction with regulatory compliance programs, it only provides an overview of technical considerations required to respond safely to laboratory spills.

Further, this guide is designed only to prepare laboratory workers for spill cleanup. Understanding this guide requires a basic level of chemical knowledge and training. If you do not have the basic knowledge to confidently make the decisions required, request assistance from others.

Reading this guide will help the employee, have fewer spills. It will also help you plan for an appropriate response when spills do occur.

Many spills in the work area can be prevented. Development and implementation of good practices will significantly reduce the likelihood of a spill. While this guide is oriented to spill response, spill prevention methods are included.

All spills generate waste. In spite of our best efforts, spills happen. When they do, it makes sense to respond to them as carefully and efficiently as possible. The good news is that, for many spills, you may be able to safely clean them yourself. Not only does that save time, but your initiative demonstrates your accountability for maintaining a safe laboratory.

Spills can seriously disrupt factory operations. Not only is valuable material lost, but a spill increasingly results in the temporary evacuation of a room or an entire building. For many reasons explained in this booklet, people have become more cautious when responding to spills.

Introduction

If handled properly, a spill may be nothing more than a nuisance. If handled improperly, a spill can seriously disrupt your activities and the work of your colleagues. At worst, a spill can cause bodily harm or property damage.

In most cases, spills involve small quantities of material and, if precautions are taken, present minimal hazards. Employees are usually the most appropriate people to clean up their spills because they are more likely than others to be familiar with the spilled material's hazardous characteristics; can respond at least as quickly as, and usually more quickly than, anyone else; know about other potential hazards or complicating factors in their work area; and should be familiar with the proper cleanup techniques for a particular spill.

Some spills require outside assistance because of the size or its unusual hazards. Trained hazardous material spill responders have learned that it is much better to be overly cautious in responding to a

spill than to risk lives for something that "shouldn't be too dangerous." Do not downplay the seriousness of potentially hazardous spills.

Emergency Preparedness

To prepare for spills, you should: (1) learn about the hazards of the chemicals in your place of work, (2) write response procedures to address those hazards, and (3) make sure that you have the equipment and training necessary to follow those procedures.



Know Your Hazards

As an integral part of any work procedure, you must identify the hazardous or potentially hazardous properties of all chemicals used or produced in your work area. Before using any chemicals, you should evaluate the consequences of potential spills and develop appropriate response procedures. If necessary, consult published data (such as material safety data sheets and chemical dictionaries) for response planning. Additionally, communicate potential hazards to other workers in your area.

When planning laboratory work and preparing for potential problems, determine the hazard class of all the chemicals to be used. The following chemical properties are of most concern when preparing for possible chemical spills:

- Flammability,
- Reactivity to air or water,
- Corrosion, and
- High toxicity.

Write Spill Response Procedures

Every workplace should develop written spill response procedures. Such procedures should detail the initial steps to take when a spill occurs and include such elements as staff responsibilities, communication methods, instructions on using spill response equipment, and spill cleanup and residue disposal. Communicate these procedures to all individuals who use chemicals or who might assist during spill cleanup. Periodically review and update these procedures to ensure that all workers are familiar with the current information. Each procedure should indicate the date it was last reviewed. The Workplace Chemical Hygiene Plan is a good place to include these procedures.

Spill response procedures should include elements such as

- A listing of appropriate protective clothing, safety equipment, and cleanup materials required for spill cleanup (gloves, respirators, etc.) and an explanation of their proper use;
- Appropriate evacuation zones and procedures;
- Availability of fire suppression equipment;
- Disposal containers for spill cleanup materials; and
- The first aid procedures that might be required.

Make Materials and Equipment Available

Before starting any work with chemicals, verify that all necessary safety equipment and spill cleanup materials are available and in good working order. Additionally, ensure that the individuals who may be involved in spill response are properly trained in equipment use and spill cleanup procedures. Finally, regularly inspect all materials and equipment to ensure that they will function properly when needed.

First Steps When a Spill Occurs: Communication and Determination

Whenever you spill a chemical or discover a spill or release, tell your colleagues and laboratory director-no matter how small or insignificant the spill or release appears. In order to assess a spill's risks and to obtain advice on cleanup procedures, it always helps to obtain the advice of others. Even a small spill can result in a harmful exposure to you or others or can result in hazards that are not obvious; therefore, notification of regulatory officials may be required.

When a spill occurs, you and others should move well away from the area when determining the appropriate response. There are two types of spills: simple spills, which you can clean up yourself, and complex spills, which require outside assistance. A simple spill is defined as one that

- Does not spread rapidly,
- Does not endanger people or property except by direct contact, and
- Does not endanger the environment.

Three basic steps should be taken to determine whether a spill is simple or complex: (A) evaluating the spill's risks; (B) evaluating quantities; and (C) evaluating the spill's potential impact.

A. Evaluate the Risks

The first step in evaluating whether a spill is "simple" is to estimate the risks created by the spill. In spill response, the key risks of concern are human health effects, property damage, and environmental damage.

Human Health Effects

Potential health effects is the most important hazard category to consider when deciding whether or not to attempt a spill cleanup. Some chemical releases may result in health hazards such as fires or explosions. Other chemical releases may present health threats because of their ability to spread rapidly and enter the body readily. A spill is not "simple" if it presents these risks.

If the potential for fire or explosion exists, seek outside assistance from trained emergency responders. Releases of flammable chemicals (liquid or solid) can present significant fire and explosion risks when one or more of the following is present:

- Volatile vapors,
- Water reactive or air reactive chemicals,
- Ignition sources,
- Oxidizers, and
- Significant quantities of combustible materials.

Toxic vapors and dust are also hazardous. Avoid direct contact with such hazards because they spread quickly, are easily absorbed through the skin, and may damage tissue.

A chemical spill is not a health risk if it has a low toxicity (especially if it is not volatile or a dust), is not highly corrosive, and is not a strong oxidizer. Such spills may be considered "simple" only if physical damage or environmental factors are absent. When a spilled chemical's toxicity is unknown, treat the spill like a potential human health hazard by avoiding exposure and seeking outside assistance.

Physical Damage to Property



The potential for physical damage to property (equipment, building materials, structures, or cleanup materials) also is important when determining whether you have a simple spill. Remember—a common first response to a spill is to try to protect equipment and property, but any real threat to such items will also threaten the persons cleaning up the spill. Do not attempt to protect property if there are any human health or fire/explosion hazards present.

In addition to potential fire and explosion hazards, strong corrosives and oxidizers typically fall under the property damage category. If any hazards are present that would damage property, treat the spill as complex and contact the appropriate authorities.

Environmental Threats

Some spills have the potential for escaping into the environment. Spills may release into the atmosphere, discharge into the sewer system, or leak directly into soils or surface water. While few spills present environmental threats, it is necessary to notify the appropriate authorities if a spill has the potential to cause environmental damage. If you can do so safely, it may be prudent to take interim measures before the hazardous materials response team arrives, such as blocking a spreading spill with absorbents or covering a floor drain with a rubber mat.

Though small amounts of some chemicals pose environmental problems, most environmental risks are presented by large-quantity releases of materials. A large-quantity release that threatens the environment is not a simple spill, but requires the attention of trained responders.

Evaluate Quantities

The next step to take when determining whether a spill is "simple" is to evaluate the quantity of material released. If a spilled chemical is not hazardous, its cleanup (without the assistance of an emergency response team) is dependent on the ability to control the spill, as well as the availability of sufficient spill control materials (e.g., an absorbent for liquids). Factors that may complicate a cleanup effort (such as the unique characteristics of a spill's surroundings or the restricted access to a spill) must be determined on a case-by-case basis.

If the spilled chemical is hazardous, the threshold quantity for a simple spill cleanup depends on the spilled chemical's physical properties and hazards. This quantity depends on situational factors such as

- The training and experience of personnel,
- The availability of spill control materials,

- The availability of personal protective equipment, and the physical layout of the spill location.

The more toxic, corrosive, or flammable a material is, the less likely that the spill can be defined as "simple". Thresholds for flammable liquids and solids, as well as volatile toxics, should be relatively low. Spills of reactive chemicals should only be managed by trained responders.

Evaluate Potential Impacts

The third step to take when deciding whether a spill can be managed as a simple spill is to evaluate the potential broader impacts of the spill. A chemical spill in an area where its potential risks are magnified by specific situations (such as physical situations or the presence of a large number of people) should not be managed as a simple spill. For instance, the presence of boxes, chemicals, and other ignition sources would magnify the impact of a one-gallon release of acetone. Since acetone is highly flammable and volatile, this situation would be immediately dangerous to both human health and property, and cleanup should be handled by an emergency responder. Other factors that may magnify a spill's impact and require emergency response are

- The possibility that hazardous vapors or dusts might enter the building's ventilation system (and be distributed to other areas);
- The possibility that spilled liquids might flow into other areas, thus expanding the threat of harm (such as reaching ignition sources, exposing other people, damaging delicate equipment);
- The presence of incompatible chemicals;
- The proximity of classrooms or offices containing people who could be harmed by the spill's consequences; and
- Spills in sinks that might be connected to other sinks through the plumbing system.

When evaluating potential impacts, a prompt response can minimize adverse consequences. On the other hand, an inappropriate response can turn a simple spill into a complex situation.

To determine whether a spill is simple or complex (which is often the hardest part of spill response), you need to know (1) the hazard(s) posed by the spilled chemical and (2) the spill's potential impact. Both these factors are, in large part, determined by the spill's size. The following information will help you determine whether you have a simple spill:

- The type of chemical(s) spilled,
- The amount,
- The hazardous characteristics of the spilled chemical(s),
- The location,
- The proper method for cleaning up the spill,
- The personal protective equipment available, and
- The training of the personnel.

Recommended Procedures for Cleaning Up Simple Spills

General Response Guidelines

For simple spills, emergency responders do not need to be notified. However, you should contact the environmental health and safety office or other responsible person within your facility. Prior to cleaning up a simple spill, be sure that you can do so safely. You must have the right personal protective equipment, including, at a minimum, appropriate eye protection, protective gloves, and a lab coat. Additional protective equipment may be required for spills that present special hazards (such as corrosive or reactive spills or spills that have a splash potential). As a rule of thumb, if you need a respirator, you should request outside assistance because you do not have a simple spill. The following steps should be taken during spill cleanup.

1. Prevent the spread of dusts and vapors.

If the substance is volatile or can produce airborne dusts, close all doors and increase ventilation (through fume hoods, for example) to prevent the spread of dusts and vapors to other areas.

2. Neutralize acids and bases, if possible.

Spills of most liquid acids or bases, once neutralized, can be mopped up and rinsed down the drain (to the sanitary sewer). However, be careful because the neutralization process is often vigorous, causing splashes and yielding large amounts of heat. Neutralize acids with soda ash or sodium bicarbonate. Bases can be neutralized with citric acid or ascorbic acid. Use pH paper to determine when acid or base spills have been neutralized.

3. Control the spread of the liquid.

Contain the spill. Make a dike around the outside edges of the spill. Use absorbent materials such as vermiculite, cat litter, or spill pillows.

4. Absorb the liquid.

Add absorbents to the spill, working from the spill's outer edges toward the center. Absorbent materials, such as cat litter or vermiculite, are relatively inexpensive and work well, although they are messy. Spill pillows are not as messy as other absorbents. Note that special absorbents are required for chemicals such as hydrofluoric and concentrated sulfuric acids.

5. Collect and contain the cleanup residues.

The neutralized spill residue or the absorbent should be scooped, swept, or otherwise placed into a plastic bucket or other container. For dry powders or liquids absorbed to dryness, double bag the residue using plastic bags. Additional packaging may be required before the wastes can be transported from your laboratory. For spills of powders or solid materials, you may need to add a dust suppressant. Be sure to place descriptive labels on each container.

6. Dispose of the wastes.

Keep cleanup materials separate from normal trash. Contact your environmental health and safety officer for guidance in packaging and labeling cleanup residues. Promptly place cleanup wastes in an appropriate hazardous waste receptacle.

7. Decontaminate the area and affected equipment.

Ventilating the spill area may be necessary. Open windows or use a fan unless the area is under negative pressure. In some instances, your environmental health and safety officer can test the air to ensure that hazardous vapors are gone. For most spills, conventional cleaning products, applied with a mop or sponge, will provide adequate decontamination. If you have any question about the suitability of a decontaminating agent, seek expert advice.

Special Precautions

The following precautions apply to chemicals that have hazardous characteristics. Note that some chemicals may exhibit more than one characteristic.

1. Flammable Liquids

Remove all potential sources of ignition. Vapors are what actually burn, and they tend to accumulate near the ground.

Flammable liquids are best removed through the use of spill pillows or pads. Spill pads backed with a vapor barrier are available from most safety supply companies. Because flammable liquids will probably be incinerated, avoid using inert absorbents such as cat litter. All used absorbent materials should be placed in heavy-duty poly bags, which are then sealed, labeled, and disposed through your facility's hazardous waste management program. Before resuming work, make sure the spill area has been adequately ventilated to remove flammable vapors.

2. Volatile Toxic Compounds

Use appropriate absorbent material to control the extent of the spill. Spill pillows or similar absorbent material usually work best because they do not have the dust associated with cat litter, vermiculite, or corn cobs. Place all used absorbent materials in heavy-duty poly bags. Seal the bags, label them, and hand them over to your facility's hazardous waste management program. Again, make sure the spill area has been adequately ventilated before resuming work.

3. Direct Contact Hazards

Carefully select suitable personal protective equipment. Make sure all skin surfaces are covered and that the gloves you use protect against the hazards posed by the spilled chemical. Often it is a good idea to wear two sets of gloves: one as the primary barrier, the second as a thin inner liner in the event the primary barrier fails. When the cleanup is completed, be sure to wash hands and other potentially affected skin surfaces.

4. Mercury Spills

Mercury spills rarely present an imminent hazard unless the spill occurs in an area with extremely poor ventilation. The main exposure route of mercury is via vapor inhalation. Consequently, if metallic mercury is not cleaned up adequately, the tiny droplets remaining in surface cracks and crevices may yield toxic vapors for years.

When a mercury spill occurs, first cordon off the spill area to prevent people from inadvertently tracking the contamination over a much larger area. Generally, a special mercury vacuum cleaner provides the best method of mercury spill cleanup. DO NOT use a regular vacuum cleaner, because you will only disperse toxic vapors into the air and contaminate your vacuum cleaner. If a special mercury vacuum is not available, first use an appropriate suction device to collect the big droplets, then use a special absorbent (available from most laboratory supply vendors) to amalgamate smaller mercury droplets.

Ideally, mercury spills should be prevented in the first place. Examine all uses of mercury to see if substitutes are available. If substitutes are not available, use trays or other equipment to provide spill

containment. Spilled mercury often accumulates in sink traps. Be prepared to contain the mercury when servicing such facilities.

Documentation

After cleaning up a spill, a simple write-up should be prepared to document what happened, why, what was done, and what was learned. Such documentation can be used to avoid similar instances in the future. Major incidents are almost always preceded by numerous near misses.

Laboratories seeking to minimize and prevent spills should consider the possible results of their choices and procedures. Such consideration should focus on reducing the likelihood of spills, as well as minimizing spill damage. Experimental plans should only involve chemicals that are actually needed for the desired results. Ideally, laboratories should only store chemicals that will be used within a reasonable period of time. Additionally, correct chemical and experimental equipment choices must be made. Finally, the laboratory worker must not settle for inappropriate laboratory arrangements.

Regulatory Overview

This appendix is intended to briefly describe regulations that may apply to laboratory chemical spills. Do not rely on this information for regulatory compliance purposes. Rather, consult the appropriate regulations directly.

Federal regulations that may be applicable to chemical spills in the laboratory address the following issues:

- Releases to the environment (typically to water or air),
- Worker safety and training,
- Planning with public emergency response agencies for major chemical emergencies, and
- Disposal of spill cleanup materials.

1. Releases to the Environment

Any chemical that presents a threat to the environment is defined by the Environmental Protection Agency (EPA) as a hazardous substance. The Agency assigns each hazardous substance a reportable quantity (RQ), which is based on a chemical's inherent risk properties. Virtually all common laboratory chemicals are on this hazardous substance list. While some hazardous substances have RQs as low as one pound, typical RQs are larger than the amounts found in laboratories. All chemical hazardous wastes have an RQ of one pound. A list of reportable quantities can be found in 40 CFR 302.4 (Code of Federal Regulations, Protection of Environment, Designation of Hazardous Substances).

Federal law requires reporting any hazardous substance spill or release that exceeds its RQ to the National Response Center (800-424-8802). State and local governments often have their own spill-reporting requirements, necessitating calls to state and local emergency response agencies as well.

2. Worker Safety and Training

All workers entering a laboratory must be trained (or be accompanied by a trained person) about the laboratory's chemical risks and the actions to be taken in an emergency. Additionally, the federal Occupational Safety and Health Administration (OSHA) requires all laboratories to develop a Chemical Hygiene Plan, which must include procedures to be used in the event of a spill. OSHA also requires laboratories to have evacuation plans.

Workers who clean up their own spills must be trained according to their laboratory's Chemical Hygiene Plan. This plan includes a written certification that all participants are trained on how to use their personal protective equipment. Workers who go into other work areas to assist with spills must be documented as having had additional, special training. Such training covers how to handle the specific material spilled, as well as how to approach hazardous material accidents in unfamiliar locations.

3. Planning with Local Emergency Responders

Preplanning with local emergency responders is required if a workplace has "environmentally hazardous substances" exceeding threshold planning quantities. As with reportable quantities, threshold planning quantities vary according to each chemical's inherent hazards. Although few have sufficient quantities of hazardous chemicals to be subjected to these requirements, preplanning can help avoid miscommunication with local emergency responders.

Some spills require outside help from emergency responders because of the following:

- A confined space,
- The need for emergency medical attention,
- A fire,
- A natural gas leak,
- The need to shut off electricity,
- The need for evacuation,
- The need for traffic control, and
- The need for building security.

Due to a third-party notification, or the miscommunication of a legal spill notification, emergency responders may arrive when their services are not necessary.

4. Disposal of Spill Cleanup Materials

Cleanup materials from hazardous substance spills are regulated as hazardous waste. Follow your facility's guidelines for packaging, labeling, and disposing of these materials.

Spill Prevention Methods

Spills can occur during a chemical's storage, transportation, or transfer. A spill prevention program for storage areas should include the following:

- Sturdy shelves and properly designed storage areas to minimize breakage and tipping;
- Containers stored by hazard class;
- Larger containers stored closer to the floor;
- Containers stored on shelves sufficiently away from the shelf edge to minimize the danger of falling;
- Storage shelves with lips to reduce the danger of falling;
- Regular inspection of the integrity of containers; and
- Seismic security in earthquake-prone areas.

To minimize spills during transport, a laboratory should integrate the following:

- Carts, where appropriate,
- Safety containers,
- Rubberized buckets,
- Straps to secure containers, and
- Properly trained and thoughtful workers.

For the transfer of liquids from one container to another, the risk of spills can be reduced by

- Paying careful attention to the size of containers to avoid overfilling;
- Using pumps or other mechanical devices rather than simply pouring directly into a container;
- Providing spill containment to capture any leaks; and
- Bonding and grounding containers when flammable liquids are involved.

In addition to chemical spills, water spills can be caused by loose connections or breaks in lines to water condensers or cooling systems. Such spills can cause damage and inconvenience, even if they do not present environmental or health risks. Appropriate planning, including use of security clamps or other devices to prevent loosening of connections or automatic shut-off devices, can reduce the likelihood of flood damage. Occasionally, a workplace may be affected by a leaking roof or a flood elsewhere in a building. Planning to prevent damage from incidents should include the protection of instruments that might be harmed by water. Similarly, storing chemicals and supplies so that they will not be touched by leaking water will minimize damage and inconvenience.

While considerable attention is given to potential spills or leaks of liquids, areas using gases should also develop spill prevention plans for these materials. Such plans should consider safety concerns related to securing tanks and other gas containers. Additionally, frequent checks of valves and tubing can be useful in spill and leak prevention. A laboratory should take care to prevent gas from escaping down a drain or up a fume hood.

Finally, pay attention to physical details in the laboratory, such as

- Reducing clutter and unnecessary materials,
- Eliminating tripping hazards and other obstructions, and
- Having all needed equipment readily available before starting work.

Recommended Components of a Chemical Spill Kit



Basic Kit

- Kit Container
- Accessible
- Visible
- Securable

Residue Management

- Whisk broom or hand-held brush
- Plastic dust pan
- Metal dust pan
- Large, sealable (e.g., ZipLoc) plastic bags
- Plastic drum liners
- Waste disposal container with lid

Absorbents

- Paper towels (one roll)
- Pillows and brooms
- Sheets and pads

Personal Protective Equipment (PPE)

- Chemical splash goggles
- Face shields
- Gloves (proper elastomer for the material in the lab)
- Appropriate body protection, such as
- Lab coat
- Elastomeric aprons
- Tyvek suits
- Shoe/foot coverings
- "Saranex" suits

Basic Emergency Equipment (should be close at hand)

- Respirators
- Neutralizers (citric acid, sodium bicarbonate, etc.)
- Special reactants (chelating agents, etc.)
- Decontaminants and biostats (e.g., for blood-borne pathogen cleanup)
- Specialized PPE

Decontamination



Decontamination is the process of physically removing or neutralizing contaminants that have accumulated on personnel and equipment; the last step of spill cleanup.

Evaluate the following? Are they contaminated?

- All cleanup supplies and equipment (brooms, dustpans, shovels, containers, pipettes, suction tubes, sponges, vacuum cleaners, monitoring equipment, etc.)
- Personal protective equipment (chemical suits, respirators, gloves, boots, aprons, etc.)
- Any additional equipment in the area may have been contaminated during the spill or release, but may not be obvious. Examples might include analytical and/or computer equipment (particularly for releases of dusts), glassware, bench tops, etc.

NOTE: The need for decontamination may be avoided by

- Wrapping or bagging monitoring and sampling equipment,
- Wearing disposable outer garments during cleanup,
- Minimizing contact by not walking through areas of obvious contamination.

Decontamination Processes

The probability and extent of permeation is directly linked to the length of contact. The longer the contact, the more effort that will be required to decontaminate.

- Loose contaminants such as dust or vapors may be removed by scrubbing, washing, and rinsing.
- Adhering contaminants such as resins and muds may require physical removal by brushing and wiping. The effectiveness of this removal may be improved by solidifying, freezing, adsorbing and adsorbing procedures.
- Volatile substances may be removed by evaporation together with washing and rinsing. Be aware of worker exposure during this process!