This chapter addresses the programs, principles, and methods of emergency management used to protect a laboratory's employees, property, and equipment. Specific aspects of laboratory emergency management described include planning for emergencies, emergency action, and incident investigation and analysis.

The U.S. Federal Property Management Regulations (FPMR) require the U.S. General Services Administration (GSA) to assist each EPA laboratory in developing and maintaining an Occupant Emergency Program (OEP). This program is intended to provide procedures for safeguarding lives and property during emergencies in federal facilities such as EPA laboratories. After an incident occurs at an EPA laboratory, an investigation must be performed to gather evidence. This information is critical in determining the root cause of the incident in order to prevent further occurrences.

This chapter provides guidance to EPA laboratories on emergency management in the following chapters:

Chapter	Topic
G2	Emergency Planning
G3	Emergency Action
G4	Investigation and Analysis

1.0 Introduction

EPA laboratories must prepare and implement an emergency action plan. However, there are benefits to going beyond compliance to mitigate potential consequences of an evolving emergency situation. Using a risk-based approach to emergency response planning results in technical focus and cost-effectiveness.

In using a risk-based approach, laboratories should perform hazard assessments to identify all hazards and events that present of risk of fatalities, injuries, property damage, and/or business interruption. From a cost-benefit standpoint, resources must first be allocated to address the risks with a high probability of occurrence. Consequence analysis is performed in conjunction with hazard identification to help determine the impact of a risk (e.g., on-site or off-site).

Hazard assessments provide a basis for investing resources in equipment and programs. Such an approach can be used in laboratories to lay the foundation for comprehensive planning and implementation. Chapter B of this manual discusses risk analysis techniques. This chapter includes planning and prevention measures for potential EPA laboratory emergencies.

EPA Program Requirements

To ensure that EPA laboratories properly prepare for emergencies, they must:

- Assist the command center team in program development
- Assess laboratory-specific hazards that may affect emergency planning and response
- Prepare and train staff for potential laboratory emergencies
- Ensure that emergency medical treatment is available
- Provide employees with emergency response notification information
- Implement emergency prevention techniques
- Ensure that adequate means of egress is provided

Program Administration

To effectively manage emergency situations, responsibilities should be assigned for:

- Developing the emergency response program with the command center team.
- Designating floor team coordinators, damage control coordinators, and technical advisors.
- Assessing laboratory hazards that may affect emergency planning and response.
- Training laboratory staff in emergency response techniques, evacuation procedures, first aid, and cardio-pulmonary resuscitation (CPR), as appropriate.
- Posting emergency notification information and evacuation routes.
- Performing a head count of laboratory personnel upon evacuation.
- Implementing emergency prevention measures.

2.0 Regulatory Requirements

All EPA laboratories must comply with applicable federal, state, and local requirements for emergency planning, response, investigation and follow-up. The following sections summarize these requirements.

2.1 GSA

The U.S. General Services Administration (GSA) is the agency responsible for ensuring the safety and security of all occupants of federally owned or leased facilities. The Federal Property Management Regulations (FPMR) in Part 101-20, "Management of Buildings and Grounds," require GSA to assist the federal agencies that occupy these facilities in establishing and maintaining an Occupant Emergency Program. This program is defined by FPMR as "a short-term emergency response guide that establishes procedures for safeguarding lives and property during emergencies in particular facilities."

2.2 OSHA

The U.S. Occupational Safety and Health Administration (OSHA) has established various fire prevention standards and emergency procedures to provide industries with a mechanism to maintain a safe and healthful working environment for employees. Emergency action and fire prevention plans described in 29 CFR 1910.38 (a) and (b), respectively must be prepared:

- If required by a particular OSHA standard (e.g., 29 CFR 1910.157, Portable Fire Extinguishers)

OR

- Where facilities provide fire extinguishers that are not intended for employee use, specifically:
  - — A facility providing portable fire extinguishers for employee use in fighting incipient-stage fires is required to have an emergency action plan but is not required to have a fire prevention plan.
  - — A facility providing portable fire extinguishers for selected employee use in fighting incipient stage fires must have an emergency action plan, but is not required to have a fire prevention plan.
  - — A facility equipped with portable fire extinguishers but requiring total evacuation of all employees in an emergency must have an emergency action plan and a fire prevention plan.

Fire prevention plans and emergency action plans each must have certain elements. The plan must be written, except for those employers with 10 or fewer employees. In that case, the plan may be communicated orally. The requirement for a written employee emergency action or fire prevention plan is based on the number of employees that are physically in a facility at any time of the working day and not on the number of employees that are employed.

2.3 EPA

There are several federal statutes and implementing regulations that require reporting of releases to the environment. A release into the environment is generally defined as any:

- Spilling
- Leaking
- Pumping
- Pouring
- Emitting
- Emptying
- Discharging
- Injecting
- Escaping
- Leaching
- Dumping
- Disposing

The term "environment" is also defined very broadly and generally includes all navigable and other surface waters, land-surface or subsurface waters, groundwaters, drinking water supplies, land surface or subsurface strata, and ambient air. Reporting of releases under CERCLA, EPCRA, CWA, and/or RCRA depends on the *substance and quantity released to the environment.* Different federal and state agencies must also need to be contacted, depending on the substance and quantity released. In addition, the facility's air permit(s) and water discharge permit(s) may specify release-reporting requirements (generally, if there are releases or emissions in excess of permit limitations, these exceedances must be reported to the appropriate state regulatory authorities).

The environmental regulations applicable to emergency response notification are in Table G2-1.

Table G2-1: Environmental Regulations for Emergency Response

Environmental Standard	Release Type
40 CFR 110	Oil into navigable waters
40 CFR 280	Petroleum and hazardous substances from underground storage tanks
40 CFR 302	Hazardous substances into the environment
40 CFR 355	Hazardous substances and extremely hazardous substances into the environment
40 CFR 60	Air emissions regulated under New Source Performance Standards
40 CFR 61	Air emissions regulated under National Emission Standards for Hazardous Air Pollutants
40 CFR 63	Air emissions regulated under National Emission Standards for Hazardous Air Pollutants for Source Categories
Facility Air Permit	Air emissions
Facility Wastewater Discharge Permits	Wastewater to surface water or municipal treatment plant

EPA laboratories and facilities are less likely to be subject to 40 CFR 60, 61, and 63, but in some cases, certain requirements may apply. More detailed discussions of these requirements are discussed in Chapter C.

2.4 NFPA

The principle industry standard that applies to the fire safety of laboratories is the National Fire Protection Association (NFPA) Standard No. 45, "Standard on Fire Protection for Laboratories Using Chemicals." It addresses such topics as laboratory unit design and construction, fire and explosion hazard protection, laboratory ventilating systems, chemical storage and handling, and waste disposal. Other more general NFPA standards also apply, such as those listed in Table G2-2.

NFPA 101 establishes minimum requirements that will provide a reasonable degree of public safety from fire in buildings and other structures. The code addresses those construction, protection, and occupancy features necessary to minimize danger from fire, smoke, fumes, or panic. NFPA 101 also identifies the minimum criteria for design of egress facilities to allow prompt escape of occupants from buildings or, where desirable, into safe areas within the building.

3.0 Content of the Emergency Plan

The occupant emergency plan (OEP) contains emergency information such as telephone numbers; facility information such as number and layout of occupants; the emergency organization; and response guidance for specific emergencies.

Table G2-2: Summary of Generally Applicable NFPA Standards

NFPA Standard	Title
10	Standard for Portable Fire Extinguishers
13	Standard for the Installation of Sprinkler Systems
45	Standard on Fire Protection for Laboratories Using Chemicals
101	Life Safety Code

A comprehensive list of emergency information that should be considered and addressed, as appropriate, is presented in Attachment G2-1. Each laboratory should review this list and select areas to address that are relevant to their operations. If a laboratory determines that disaster recovery planning is needed to ensure business continuity, the information in the OEP can be adapted to address events that could result in downtime (e.g., electrical outage, ventilation system failure, etc).

3.1 Emergency Organization

A chain-of-command structure is used for the coordination of emergency response procedures. This organization typically consists of a command center team, floor teams, and damage control teams as shown in Figure G2-1. Duties of organization members should be clear to provide for efficient response. The team sizes should be limited to the minimum number needed to respond, as too many people may get in the way and inhibit efficiency. Titles and

telephone numbers for members of the organization must be included in the plan and posted as appropriate.

3.1.1 The Command Center Team

Emergency operations are directed by the command center team from the laboratory's command center. The team will generally have the following members:

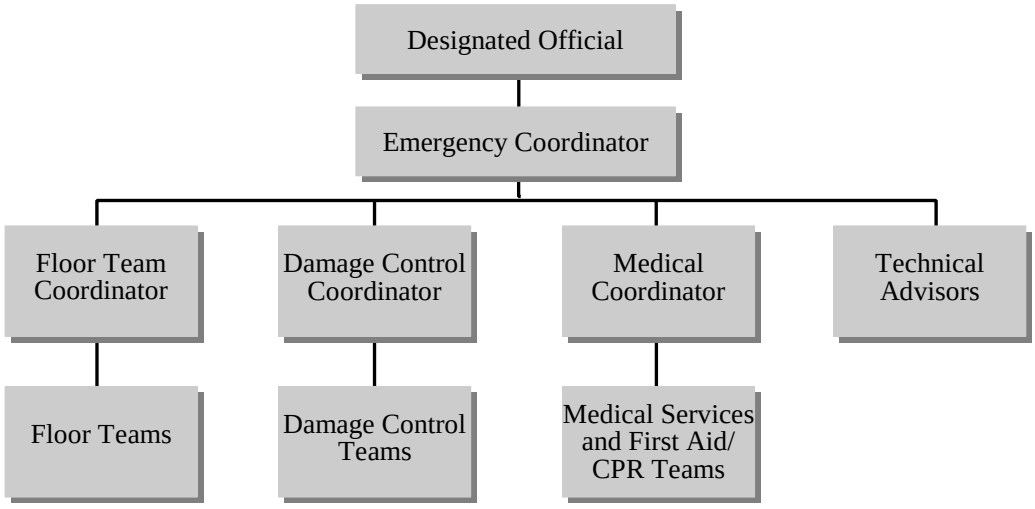
- Designated Official
- Emergency Coordinator
- Floor Team Coordinator(s)
- Damage Control Coordinator
- Medical Coordinator
- Advisor(s)

For small laboratories, some people may fulfill more than one duty. Team members must have quick access to the command center and be available for emergency notification. Laboratories that are typically a unit of a facility must have direct contact with the command center, as well as input into the emergency plan. Laboratory personnel may also serve as team members. The following sections summarize the responsibilities of the command center team members.

Designated Official

The Designated Official is usually the team member who develops the emergency plan and coordinates with facility occupants. Laboratory management should work with the Designated Official to ensure that emergency plans are consistent with laboratory activities and occupants. The Designated Official will ensure that appropriate procedures are followed during a response. Any appropriate notifications to federal, state, and local agencies are made by the Designated Official.

Figure G2-1: Typical Chain-of-Command Structure



Emergency Coordinator
The Emergency Coordinator acts as a direct assistant to the Designated Official and fulfills primary responsibilities in the Designated Official's absence. The Emergency Coordinator will also typically act as a liaison between the Designated Official and other team members.

Floor Team Coordinator
The Floor Team Coordinator facilitates occupant movement during an emergency. Areas that floor teams are responsible for include:
- Wings
- Floors
- Stairwells
- Elevators
- Alternative routes for people requesting assistance

Damage Control Coordinator
The Damage Control Coordinator is responsible for emergency response equipment and affected systems, including:
- Utilities
- Alarms
- Communication systems

Medical Coordinator
The Medical Coordinator identifies and communicates with medical services. This coordinator is also responsible for first aid equipment and medical training, such as cardiopulmonary resuscitation (CPR) and first aid. Typically, the Medical Coordinator will maintain lists of all medically trained personnel.

Advisors
Advisors typically consist of the Building Manager, a Security Specialist, and any other occupants who may be familiar with the building's utilities and mechanical systems. These advisors may have primary responsibilities such as shutting down mechanical systems during certain types of emergencies.

3.2 Laboratory-Specific Information

In order to prepare an emergency plan, specific information about the laboratory must be provided. This information includes:
- Laboratory operations
- Description of the physical area
- Prevailing weather conditions
- Potential laboratory hazards
- Natural hazards

For EPA laboratories, it is essential to share all operations and potential hazards with emergency coordinators to facilitate a response in all situations. This can be accomplished through the use of signage on laboratory doors that states the emergency contacts, types of hazardous materials in the laboratory, and information on local alarms. An example of such a form is presented in Attachment G2-2. This information, in addition to facility plans and material safety data sheets (MSDSs) for hazardous chemicals, should be maintained at the command center or security office.

3.3 Preparation for Typical Emergencies

In an EPA laboratory, a variety of emergency situations could occur. This chapter discusses the preparation for fires, chemical spills and releases, medical emergencies, bomb incidents, evacuation, radiation emergencies, biological emergencies, emergencies involving animals.

3.3.1 Fires

The potential for fire and/or explosion is always present at any laboratory. While the probability and consequences associated with such events may vary as a function of laboratory design and operations, steps can be taken to minimize potential losses.

All occupants must know locations of fire alarm boxes and extinguishers, how to use them, and procedures to follow in the event of an alarm. They should also be familiar with notification procedures when they pull an alarm, so the command center team can be activated.

3.3.2 Chemical Spills and Releases

To adequately prepare for the unlikely event of a chemical spill or release, EPA laboratories must assess potential spill and release scenarios and have appropriate absorption, containment, and neutralization equipment available. Employees must be trained in both appropriate response techniques for incidental spills and in response measures and notification for larger releases.

In the event of a non-incidental spill, employees are required to evacuate the laboratory (based on laboratory-specific Emergency Action Plans). Where employees are trained for response to non-incidental releases, the laboratory must develop programs in accordance with OSHA's standard on hazardous waste operations and emergency response in 29 CFR 1910.120.

3.3.3 Medical Emergencies

Policies for providing emergency medical treatment should be integrated with the EPA laboratory facility's Emergency Action Plan. Arrangements should be made in advance for emergency transportation to, and treatment at, a nearby medical facility. In addition, local emergency transport and hospital personnel should be educated about possible medical problems that could occur at the facility, including the types of hazards and their consequences, potential for exposure, and the scope and function of the medical program. Providing medical facilities with MSDSs and protocols involving hazardous materials is an effective means of informing medical personnel of potential emergencies.

Employees should be aware of all personnel trained to respond to medical emergencies (e.g., first aid, CPR). They must also be familiar with command center team notification procedures. If available, on-site medical support staff can usually provide immediate medical attention.

3.3.4 Bomb Emergencies

Each EPA laboratory must develop bomb incident procedures as part of their overall emergency plan. By establishing a laboratory-specific bomb incident plan and training employees on the proper procedures, EPA laboratories can reduce the potential for:

- Death or significant injuries to EPA staff, customers or the public
- Physical or environmental damage
- Business interruption
- Damage to the agency and the laboratory's public image or financial standing

Employees must be trained to immediately report a suspicious object. Appropriate search teams and disposal units can then be notified. Occupants should be prepared for evacuation when a suspicious object is reported.

3.3.5 Evacuation

In planning for a timely and efficient evacuation in case of an emergency, a suitable means of egress should be carefully considered and addressed. Egress can be defined as a continuous path of travel from any point in a building or structure to the open air outside at ground level. Considerations for safe egress include:

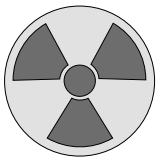
- The type, width, number, access, and arrangement of exits
- Lighting and identification of exits
- Travel distance to exits
- Exit capacity

There are several primary considerations in the design or assessment of means of egress. Every section or area of a laboratory should have at least two separate means of egress arranged so that the possibility of any fire blocking both of them is minimized. In planning for building evacuation, the following requirements set forth in NFPA No. 101 should be met:

- A sufficient number of unobstructed exits of adequate capacity and proper design, with convenient access
- Protection of exits against fire and smoke during the length of time they are designed to be in use
- Alternate exit(s) for use in the event that a primary exit is blocked by fire
- Subdivision of areas and construction to provide areas of refuge in those occupancies where evacuation is the last resort
- Protection of vertical openings to limit fire effects to a single floor
- Alarm systems to alert occupants and notify the fire department
- Adequate lighting of, and paths of travel to, exits
- Signs indicating the direction of travel to reach exits
- Safeguarding of equipment and areas of unusual hazard (e.g., flammable liquid storage areas) that could produce a fire capable of endangering the safety of persons exiting

- Exit drill procedures to ensure orderly exit
- Control of psychological factors conducive to panic
- Control of interior design to prevent a fast-spreading fire that could trap occupants

Specific facility requirements concerning means of egress depend on the particular occupancy. Attachment G2-3 provides a partial listing of general requirements. Each EPA laboratory should assess and implement laboratory-specific requirements as described in NFPA No. 101.



3.3.6 Radiation Emergencies

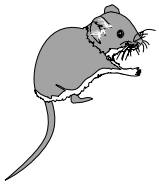
Every EPA laboratory that uses radioactive materials or radiation-generating devices should have procedures for responding to associated emergencies such as:

- Spills (non-incidental and incidental)
- Staff exposure
- Staff contamination

Based on the specific radiation hazard in the laboratory, staff must understand their role in responding to a radiation emergency. For example, if there is an incidental spill of radioactive materials, laboratory staff who are trained in monitoring and decontamination techniques may handle the spill without additional outside assistance.

3.3.7 Biological Emergencies

Biological emergencies can involve dermal contact with spills of biohazardous agents, inhalation of aerosols, ingestion of bio-hazards, accidental injection or inoculation, and release of an agent to the environment. Laboratories should be prepared to respond to biological emergencies that are likely due to the types of experimental procedures that are being performed. This not only includes emergency response procedures and training staff on their implementation, but also having adequate biological spill cleanup equipment.



3.3.8 Emergencies Involving Animals

In the event of an emergency in a laboratory animal facility, response personnel should notify the animal manager or veterinarian responsible for the animals. Emergency notification procedures for responsible staff, including their names and telephone numbers, should be posted in prominent locations in the animal facility and provided to security as part of the emergency action plan. In addition, emergency procedures for handling animals with special hazards (e.g., chemical carcinogens, radioactive materials, infectious agents) should be prominently posted.

4.0 Emergency Prevention

The preferred practice is to prevent all types of emergencies. Prevention is achieved through proper planning, training, and the practices outlined in the following sections for:

- Utility service interruption
- Fires
- Chemical spills and releases
- Medical emergencies
- Bomb emergencies
- Radiation emergencies
- Biological emergencies

4.1 Utility Service Interruption

Interruption of utility service to a laboratory can cause major problems. An interruption can be caused by storms, earthquakes, vandalism, maintenance outages, and equipment breakdowns. Each laboratory must have a comprehensive plan that outlines its response to a loss of utilities. If the loss does not create an emergency, it will render the laboratory more vulnerable to an emergency situation. Therefore, a utility interruption contingency plan should be included as part of a laboratory's emergency action plan.

EPA laboratories must have a tested backup power source with automatic changeover equipment that is sufficient to preserve the integrity of the testing experiment. Emergency power must support those critical areas such as animal rooms, inhalation chambers, heating, ventilation and air-conditioning (HVAC) systems, storage freezers/refrigerators, etc. Essential mechanical equipment must be guarded or alarmed. In addition, provisions for prompt maintenance response must be made. Alternative air-handling systems for inhalation studies are also required.

4.1.1 Functions of an Emergency Power Generator System

All emergency equipment must be equipped with auxiliary backup power. Exit signs, lighting, evacuation alarms, and other emergency equipment must not be disabled at a time when they will be needed. Frequent operational checks must be conducted where backup batteries are used to ensure a constant state of readiness. If a system-wide backup generator is used, it must be designed to provide power immediately. In addition, equipment to be used by emergency personnel must be immediately available in the event of a power outage.

Employee exposure-control apparatus must also be kept operating during a power outage. Air-moving and air-cleaning devices critical to personal safety and health must be equipped with backup power. In addition, if the effectiveness of the ventilation system may be compromised by a power outage, the rate at which air contaminants are generated must be minimized.

If auxiliary power is used to maintain the ventilation system, the characteristics of the system running on auxiliary power must be evaluated (e.g., by checking pressure gauges). Any change in air flow between rooms, or in any operational parameter of the ventilation system, must be recognized. The impact of these changes on the safety and health of laboratory personnel must also be assessed. For example, if during a power failure the laboratory ventilation is supported by an emergency generator, but the hood system is not, the air balance in the room may be compromised by the loss of the

exhaust provided by the hood. If the hood system was providing most of the exhaust, then the laboratory may become positive in relation to the clean corridor and may contaminate it.

Laboratories should provide auxiliary power to ensure the integrity of experiments in progress. The effect of power interruption on dose administration and environmental control must be known and controlled. Backup power must be provided to refrigerated areas, and a continuous source of power must be supplied to computers.

Any interruption of utilities may have adverse consequences that place a facility, its employees, and the surrounding community at an elevated risk. In addition, the substantial investment in ongoing experiments may be placed in jeopardy. It is the responsibility of EPA laboratories to foresee these consequences and to make adequate preparations to minimize them.

4.1.2 Maintenance and Testing

At EPA laboratories, all emergency power systems must be placed on a maintenance program. The maintenance program should include testing emergency equipment (e.g., generators, batteries, etc.) at regular periods as recommended by the manufacturer or engineering department. This testing program should be documented and described in a formal plan.

4.2 Fires

This section discusses two steps involved in fire prevention: identifying existing fire hazards in the workplace and taking action to resolve them. The inspection checklist, in Attachment G4-2, provides a guide for fire-safe practices that should be followed.

Material hazards should be identified, as evident on the specific MSDSs, and labeled on containers as soon as they arrive in the laboratory. The identification system should be consistent with the laboratory's hazard communication program.

4.2.1 Material Storage and Handling

The storage of material should be arranged such that adequate clearance is maintained away from heating surfaces, air ducts, heaters, flue pipes, and lighting fixtures. All storage containers or areas should prominently display signs to identify the material stored within. Storage of chemicals should be separated from other materials in storage, from handling operations, and from incompatible materials. All individual containers should be identified as to their contents.

Only containers designed, constructed, and tested in accordance with the U.S. Department of Transportation (DOT) specifications and regulations are to be used for storage of compressed or liquefied gases. Compressed gas storage rooms should be areas reserved exclusively for that purpose with good ventilation and at least a one-hour fire resistance rating. The gas cylinders must be secured in place and stored away from any heat or ignition source. Pressurized gas cylinders shall never be used without pressure regulators. For more information on work practice controls for chemicals, refer to Chapter F3 of this manual.

Combustible Materials
Wooden pallets must not be stacked over six feet high. If feasible, extra pallets should be stored outside or in separate buildings to reduce the risk of fire hazards. Piles of combustible materials must be stored away from buildings and apart from each other to prevent the spread of fire, and to provide room for firefighters.

Flammable Materials
Bulk quantities of flammable liquids must be stored outdoors and away from buildings. Smaller quantities are then brought into a mixing room where they are prepared for use. The mixing room must be located next to an outside wall equipped with explosion-relief vents, if necessary. The room must also have sufficient mechanical ventilation to prevent the accumulation of flammable vapor concentrations in the explosive range. Flammable liquids must never be transferred from one container to another by applying air pressure to the original container. Pressurizing such containers may cause them to rupture, creating a serious flammable liquid spill. Quantities must be limited to an amount necessary to perform an operation for one working shift, and must be stored in, and dispensed from, approved safety containers equip-ped with vapor-tight, self-closing caps, screens, or covers.

The storage and use areas should include fire-resistant separations, automatic sprinklers, special ventilation, separation of incompatible materials, and the separation of flammable materials from other materials, as appropriate.

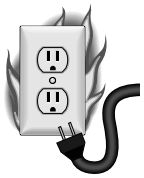
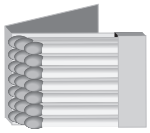
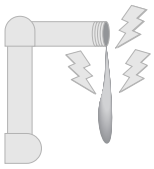
4.2.2 Potential Ignition Sources
The following precautions can be taken to eliminate potential ignition sources:

- Use classified electrical equipment in accordance with Article 500 of the National Electrical Code
- Provide grounding and bonding in accordance with NFPA No. 77, Recommended Practice on Static Electricity
- Ensure that utility lights always have a wire guard over them.
- Never install a fuse rated higher than specified for the circuit.
- Investigate any appliance or equipment that smells strange. Space heaters, microwave ovens, hot plates, coffee makers, and other small appliances must be rigidly regulated and closely monitored.
- The use of extension cords to connect heating devices to electric outlets must be prohibited.

Table G2-3 lists common sources of ignition that cause fires in the workplace, gives examples in each case, and suggests preventive measures.

4.2.3 Welding And Cutting
Welding and cutting will not be permitted in areas not authorized by the Safety, Health, and Environmental Management Program (SHEMP) Manager. If practical, welding and cutting operations must be conducted in well-ventilated rooms with a fire-resistant floor. If this practice is not

Table G2-3: Examples of Common Sources of Ignition and Preventive Measures

Sources of Ignition	Examples	Preventive Measures
Electrical equipment 	Electrical defects, generally due to poor maintenance, mostly in wiring, motors, switches, lamps, and hot elements.	Use only approved equipment. Follow National Electrical Code. Establish regular maintenance program.
Open flames 	Cutting and welding torches, gas and oil burners, misuse of gasoline torches.	Follow established welding precautions. Keep burners clean and properly adjusted. Do not use open flames near combustibles.
Smoking and matches 	Dangerous near flammable liquids and in areas where combustibles are stored or used.	Smoke only in permitted areas. Make sure matches are out. Use appropriate receptacles.
Static electricity 	Occurs where liquid flows from pipes.	Ground equipment. Use static eliminators. Humidify the atmosphere.
Hot surfaces 	Exposure of combustibles to furnaces, electric lamps, or irons.	Provide ample clearances, insulation, air circulation. Check heating apparatus prior to leaving it unattended.

feasible, the SHEMP Manager must ensure that the work areas have been surveyed for fire hazards; the necessary precautions are taken to prevent fires; and a work permit is issued. This work permit must only encompass the area, item and time which is specified on it.

If welding is to be performed over wooden or other combustible-type floors, the floors will be swept clean, wetted down, and covered with either fire-retardant blankets, metal or other noncombustible coverings.

Welding will not be permitted in or near areas containing flammable or combustible materials (e.g., liquids, vapors, or dusts) or closed tanks that contain, or have contained, flammable liquids unless they have been thoroughly drained, purged, and tested free from flammable gases or vapors. Welding must not begin until all combustible materials have been removed at least 35 feet from the affected areas or, if unable to relocate, covered with a fire-retardant covering. This also applies to walls, partitions, ceilings, or roofs made of combustible materials. Openings in walls, floors, or ducts must be covered if located within 35 feet of the intended work area. Welding will not be permitted on any closed containers.

Fire extinguishers will be provided at each welding or cutting operation. A trained watcher will be stationed at all times during the operation and for at least 30 minutes following the completion of the operation. This person will ensure that no stray sparks cause a fire and will immediately extinguish fires that do start.

4.2.4 Open Flames

No open flames will be permitted if any spraying operations take place. If indoor spray-painting work needs to be performed outside of standard spray-painting booths, adequate ventilation will be provided. All potential ignition sources will also be eliminated.

4.2.5 Static Electricity

It is impossible to prevent the generation of static electricity in every situation, but the hazard of static sparks can be avoided by preventing the buildup of static charges. One or more of the following preventive methods should be used: grounding, bonding, maintaining a specific humidity level (e.g., 60 to 70 percent), and ionizing the atmosphere.

Where a static-accumulating piece of equipment is unnecessarily located in a hazardous area, it is better to move the equipment, rather than attempt to prevent static accumulation.

4.2.6 Housekeeping Preventive Techniques

The following are housekeeping techniques and procedures to prevent occurrences of fires:

- Keep storage and working areas free of trash.
- Place oily rags in covered containers and dispose of daily.
- Do not use gasoline or other flammable solvent or finish to clean floors.

- Use noncombustible oil-absorptive materials for sweeping up sawdust or other combustible material treated with oil.
- Dispose of materials in noncombustible containers that are emptied daily.
- Remove accumulation of combustible dust.
- Do not refuel gasoline-powered equipment in a confined space, especially in the presence of equipment such as furnaces or water heaters.
- Do not refuel gasoline-powered equipment while it is hot.
- Follow proper storage and handling procedures.
- Ensure that combustible materials are present only in quantities required for the work operation.
- Clean up any spill of flammable liquids immediately.
- Ensure that if clothing becomes contaminated with flammable liquids, the clothing is changed before continuing work.
- Post "No Smoking" signs near the storage areas.
- Report any hazardous condition, such as old wiring, worn insulation, or broken electrical equipment, to the supervisor.
- Keep motors clean and in good working order.
- Do not overload electrical outlets.
- Ensure that all equipment is turned off at the end of the work day.
- Maintain the right type of fire extinguisher available for use.
- Use the safest cleaning solvents (e.g., nonflammable and nontoxic) when cleaning electrical equipment. Such solvents include inhibited methyl chloroform, or a blend of Stoddard solvent and perchloroethylene.
- Ensure that all passageways and fire doors are unobstructed. Stairwell doors must never be propped open, and materials must not be stored in stairwells.
- Periodically remove overspray residue from walls, floors, and ceilings in areas where spray operations may take place.
- Do not allow materials to block automatic sprinkler systems or fire extinguisher locations.
- Check daily for any discarded lumber, broken pallets, or pieces of material stored on-site, and remove promptly.
- Restack any pile of material that falls into an aisle or passageway.

4.3 Chemical Spills and Releases

Each laboratory should be equipped with spill cleanup materials for response to incidental spills. Equipment and materials may include the following:

- Plastic pail
- Bentonite clay
- Plastic bags
- Dust pan and brush (polypropylene)
- Disposable nitrile gloves
- Tags and stickers to label waste
- Shoe covers
- Sign "Spill Area—Keep Out"
- Instruction information for cleanup

4.4 Medical Emergencies

At each EPA laboratory, an emergency first-aid station(s) should be established that is capable of providing both general first aid (e.g., minor cuts, sprains, and abrasions), and stabilization for patients requiring off-site treatment. The station(s) should contain a standard first-aid kit, or equivalent supplies, plus additional items such as stretchers, ice, emergency eye-washes, and fire extinguishing blankets. Supplies should also include:

- Ipecac syrup or table salt for inducing vomiting
- Activated charcoal for making a slurry to drink
- Maalox ™, Milk of Magnesia ™, or aluminum gel to neutralize dilute acids

4.5 Bomb Emergencies

There are a number of mitigation mea-sures that EPA locations can take to reduce the risk or consequences of a bomb emergency.

Tightened security and controlled access should be used to make access to likely hiding places—both inside and outside the building—as difficult as possible. The local police department may be contacted for assistance in identifying specific prevention measures for the laboratory. The following general measures can be used as guidance to increase security against bomb incidents:

- Restrict visitor entrances. Secure visitor identification and require all visitors to sign a register indicating their name and the company they represent, as well as the name and location of the person whom they wish to visit.

- If possible, restrict parking to 300 feet from the building to minimize effects of bombs being delivered in a car or left in a car. If restricted parking is not feasible, consider having properly identified employee vehicles parked closer to the building, with visitor vehicles parked at a distance.

- Keep heavy shrubs and vines close to the ground to reduce their potential to conceal bombs. Remove window boxes and planters, or, if they must remain, have a security patrol check them during regular rounds.

- Ensure adequate illumination—both inside and outside—and emergency lighting.

- Install an adequate access control and intrusion system and post signs that such a system is in place.

- Keep doors or access to areas such as boiler rooms, mail rooms, computer areas, switchboards, and elevator control rooms locked.

- Provide for effective key control. Establish a procedure for accountability of keys.

- Enforce good housekeeping practices to minimize debris in trash or dumpster areas.

- Install detection devices at all entrances and closed-circuit television in those areas identified as likely places where a bomb may be placed. Post signs that such measures are in place.

- Discourage the mailing of personal packages to the business address.

- Establish a procedure for inspecting mail and packages for suspicious objects.

4.6 Radiation Emergencies

Spills, fires, or explosions that can cause radioactive materials to be spread around the laboratory or come into contact with personnel are the emergencies most likely to be encountered at a radiation laboratory. The following guidelines should be followed, when appropriate, to reduce the risk of spills and contamination of the workplace:

- Use double containers and/or leakproof trays when transferring radionuclides in solution from one area to another. A cart should be used when transferring samples between laboratories.

- Use protective coverings and lids.

- Use unbreakable containers to store radionuclides, if possible.

- Use extreme caution in transfers—try a trial run to test the procedure.

- Use a glove box or hood for dusty and volatile materials and operations.

- Do not pipette by mouth. Use rubber bulbs, syringes, or pipettors.

- Always plan the procedure to be used. Have a safety plan developed before beginning work.

- Cover the work area and use absorbent paper with a nonpermeable backing to absorb the radioactive materials in the event of a spill, and replace it when wet or torn.

- Check for contamination with radiation survey instruments and/or wipe test the work area after completing procedures where contamination may have occurred.

- Store liquid radioactive materials in trays capable of containing the volume should a spill or breakage occur.

- Notify the Radiation Safety Officer (RSO) immediately in the event of a spill containing radionuclides.

4.7 Biological Emergencies

Each laboratory must be equipped to handle incidental biological emergencies. Contents of a basic biological spill kit include the following:

- Spill cleanup procedure
- Personal protective equipment (e.g., latex gloves, safety glasses)
- Chemical disinfectant (e.g., 5 percent Wescodyne ™ or 5 to 10 percent bleach)
- Absorbent material (e.g., spill pillows, padding, paper towels, etc.)
- Disposal bags and hazard labels
- Sharps container
- Forceps for picking up broken glass or sharps
- Paper, incident reporting form, and pen or pencil to document the spill and any possible personnel exposure

Attachment G2-1: Elements of a Comprehensive Emergency Response Plan

Purpose: To provide a list of all the elements that could be considered for inclusion in a comprehensive emergency response plan.

Instructions: Use this list as a guide to determine whether the laboratory emergency response plan addresses all of the emergency scenarios that could occur at the laboratory.

Attachment G2-1: Elements of a Comprehensive Emergency Response Plan

Preface to Plan
• List of key telephone numbers • Table of contents • Preface • Record of changes • Distribution list
Laboratory Policy and Plan Objectives
• Introduction • Purpose of plan • Laboratory policy regarding emergency planning • Coordination and cooperation with Local Emergency Planning Committees • Update procedures and schedule
Emergency Response Organization: Structure and Duties
• Authority • Designation of site Emergency Coordinator/Commander and alternatives • Duties of site Emergency Coordinator/Commander • Chain-of-command • Designation of key personnel and alternatives, including — Medical Emergency Director — Fire Brigade Team Leader — Oil Spill Response Team Leader — HazMat Spill Response Team Leader — Public Affairs Coordinator/Press Officer — Legal Counsel — Security Coordinator — Insurance and Claims Coordinator — Emergency Communications System Coordinator — Coordinator of Personnel Services — Purchasing and Logistical Support Coordinator — Maintenance and Engineering Support Coordinator — Scientific/Environmental Documentation Coordinator — Others (as needed) • Responsibilities and duties of key personnel • Designation of laboratory emergency operations center • Establishment of field emergency command post

Detection, Alarm, and Notification Procedures
• Notification check-off lists for various types of events • Telephone rosters • On-site accident detection and alarm procedures • Identification and policy for notification of: — Local authorities — State authorities — Federal authorities — Various facility personnel — Special off-site occupancies — Downstream waterusers — Water treatment plants — Electric and gas utilities — Air, rail, and marine traffic — Laboratory management — Person(s) responsible for initial notification and continuation of communications (where necessary) — Documentation of communications during emergencies
Emergency Communication Systems
• Intrafacility communication systems • Links to public authorities • Need and availability of backup systems • Links to the public
On-Site Evacuation and Security
• On-site alert/alarm systems • Employee awareness program • Evacuation procedures and policies • Provisions for handicapped employees or visitors • Places of refuge • Designated assembly areas and alternates • Procedure for identification of the missing • Search and rescue procedures • On-site traffic control • Accident site boundary control • Facility access control • Procedures for protection of vital records • Periodic drills • Documentation of drills and activities during emergencies

Attachment G2-1: Elements of a Comprehensive Emergency Response Plan

Emergency Facility Shutdown Procedures
• References to emergency operating procedures • Operator training for emergencies • Safety features of control rooms and other locations for control of facility processes • Drills and exercises • Documentation of training and drills
Medical Emergency Procedures
• On-site health care resources • Available Ambulance Services and Emergency Medical Technicians (EMTs) • Coordination of emergency planning with off-site medical facilities • Toxic substance information resources • Special antidotes and supplies • Victim decontamination procedures • Provisions to protect medical providers from contamination • Documentation of activities before and during emergencies
On-Site Emergency Response Teams
• Fire Brigade team organization • Oil spill team organization • HazMat team organization • Response team activation procedures • Response times during normal working hours • Response times on nights and weekends • State and federal training requirements • Actual training provided • Drills and exercises • Documentation of training and drills
Personal Protection of Response Teams
• List of hazardous materials likely to be encountered • Selection of respiratory protective devices • Availability of respiratory protective devices • Resupply of Self-Contained Breathing Apparatus • Selection of protective clothing • Availability of protective clothing • Medical surveillance and care • Decontamination procedures • Documentation of activities during emergencies

Fire Response Procedures
• General procedures by incident type • Required resources for postulated events • Available resources for postulated events • Documentation of activities during emergencies
Spill Containment and Cleanup Procedures
• Plugging/stopping of leaks • Suppression of hazardous gas or vapor evolution • Intentional ignition of combustible toxic gases • Containment of spills on land • Cleanup of spills on land • Containment of spills on water • Cleanup of spill on water • Support services for response forces • Field maintenance of response equipment • Waste handling and disposal • Documentation of activities during emergencies
Environmental Monitoring
• Tracking of oil spills on water • Surveillance of other types of spills • Monitoring of atmospheric and environmental conditions • Sampling/monitoring of environmental contamination • Documentation of activities during emergencies
Public Relations in Emergencies
• Corporate policy directives • Designation of media briefing location • Communications with the Command Center • Provision of Press Officer support (including legal counsel) • Coordination and cooperation with public authorities • Availability of press kits • Media contact list • Documentation of activities and statements during emergencies
Application of Plan to Natural Hazards
• Procedures and policies for various hazards • Need and availability of special resources • Documentation of activities during emergencies • Documentation of statements during emergencies

Off-Site Post-Incident Recovery
• Monitoring the status of injured parties • Wildlife rescue and rehabilitation • Assessment of environmental damage • Restoration of the environment • Assessment of off-site property damage or loss of business • Availability of insurance and other resources • Claim-handling procedures • Documentation of activities
On-Site Post-Incident Recovery
• Post-incident response debriefing and review • Assistance to families of injured employees • Assistance to employees laid-off due to the incident • Investigation of causal factors • Site property damage assessment • Site decontamination and cleanup • Waste and debris disposal • Site reconstruction/restoration • Post-incident response debriefing • Pre-startup checklist • Documentation of activities
Off-Site Sources of Assistance
• Corporate resources • Mutual-aid cooperatives • Spill cleanup contractors • Other types of key contractors • Expert consultants • Local government • State government • Federal government • Private and volunteer organizations • Expected response time

Resource Listings: Supplies and Supplemental Services
• Specialized medical supplies • Oil spill dispersants and application equipment • Oil spill burning/wicking agents and application equipment • Sorbent materials • Neutralization agents • Portable liquid-transfer systems • Temporary storage containers and systems • Vacuum trucks • Fire-extinguishing agents and equipment (including foams for vapor suppression) • Portable contaminant-detectors/monitors • Contaminant sampling equipment and supplies • Laboratory analysis services • Communications equipment • Earth-moving equipment • Oil skimmers • Support boats • Fixed-wing aircraft • Helicopters • Trucks, vans, and buses • Emergency lighting • Emergency power generators • Fuel supplies • Canteen services • Temporary housing • Portable sanitation facilities • Work clothes and footwear • Photography and videotaping services • Sources of general hardware • Other potentially required supplies and equipment not addressed here or in previous sections

Attachment G2-1: Elements of a Comprehensive Emergency Response Plan

Facility Planning Basis and Hazard Analysis
• Facility layout and maps • Details of potentially hazardous operations • Oil/chemical accident prevention measures • History of accidents/incidents • Type of expected frequency of natural hazards • Potential impact of natural hazards • Credible accident scenarios and associated probabilities • Estimated accident impacts and associated safety zones • Identification and description of environmentally sensitive areas subject to impact • Procedures for real-time hazard assessment during emergencies • Technical references

Attachment G2-2: Emergency Information Form

Purpose: To provide an example of the types of emergency information that should be posted on the door of each laboratory.

Instructions: Use this sample as a guide to developing emergency information posting for the laboratory, or to supplement current posting.

Emergency Information Form

Laboratory Emergency Data

Room #

Emergency contacts:

Name Ext.

Section responsible:

Date completed:

Completed by:

This laboratory contains:
(Check all that apply)

Flammable liquids	
Compressed gases	
Explosives	
Radioactive material	
Biohazards	
High voltage equipment	
Water reactive material	
Carcinogens	
Toxic chemicals	
Controlled substances	
Corrosives	

Attachment G2-3: Examples of NFPA Egress Requirements

Purpose: To provide a summary of some of the NFPA egress requirements.

Instructions: Use this list to familiarize laboratory staff with some of the NFPA egress requirements.

Attachment G2-3: Examples of NFPA Egress Requirements

Doors: Doors should swing with exit travel flow direction (vertical or rolling doors should not be used). The latch or locking devices should provide a knob, handle, panic bar, or other mechanism to allow operation even in the dark. No door opening should be less than 32 inches wide.

Corridors/pathways: The minimum width of any corridor or passageway serving as an exit, exit access, or exit discharge should have a clearance of 44 inches.

***Panic hardware*:** Devices should be installed that permit egress and release in an emergency with a pressure not to exceed 15 pounds, and placed not less than 30, nor more than 44, inches above the floor.

***Horizontal exits*:** Passages to an area of refuge (i.e., at least three square feet per person) in nearby buildings or around a firewall or partition should be provided for.

***Stairs*:** Inside or outside stairs should have a minimum width of 44 inches and a minimum height of four inches, and permit exiting at a reasonable rate. (Ramps are required in place of stairways where the difference in elevation would be less than three steps.) Stairs with a slope depth of 11 inches, exceeding 1 in 15, should have handrails on both sides.

***Exit passageways*:** Any use of exit components (e.g., hallways, passages, tunnels, etc.) is prohibited if it interferes with exiting, or presents additional fire hazards (i.e., storage or transfer of flammable materials).

***Fire escape stairs*:** Fire escape stairs should only be used to correct exit deficiencies in existing buildings, should not be considered during primary exit design, and should not pass along windows or walls exposed to fire dangers. Access to fire escapes should be open at all times.

***Escalators, moving walkways, and elevators*:** Elevators should never be recognized as exits; escalators or moving walkways seldom qualify as exits.

***Windows*:** Windows should not be considered exits, but they are required for rescue and ventilation purposes.

***Vertical openings*:** In industrial occupancies, vertical openings must be fully enclosed when used for emergency exits.

***Exit lighting*:** Where artificial lighting is used in an occupancy, exit lighting should be not less than one foot-candle measured at the floor. Where natural light is used, exit illumination and emergency lighting may be modified.

Attachment G2-3: Examples of NFPA Egress Requirements

***Emergency lighting*:** Emergency lighting should provide necessary exit floor illumination automatically in the event of failure of normal lighting and with no appreciable interruption of illumination during the changeover.

***Exit signs*:** All exits and access ways must be identified by signs of such size, color, and design as to ensure visibility. Signs that state "TO EXITS" are frequently required where direction of travel to the nearest exit is not readily apparent. Signs that state "NOT AN EXIT" are important to ensure that doors, passages, or stairs that are not exits are not mistakenly used as such in an emergency.

***Alarm systems*:** Alarms that have distinctive pitch and quality of sound (or visual distinction for the deaf) should be manually operated.

***Fire exit drills*:** Drills are essential in providing familiarity with exits and their orderly use. Drills should be appropriately planned.

***Exit maintenance*:** All exits should be maintained in a safe operating condition to prevent loss of life in the event of fire.

1.0 Introduction

When necessary, appropriate emergency actions must take place according to the measures outlined in the Emergency Action Plan and/or Occupant Emergency Plan. The command center team maintains the authority for all laboratory responses. Employees must be trained and encouraged to follow all command center team instructions in the event of an emergency. To ensure appropriate and effective response to an emergency, laboratory facilities must rely on personnel training and emergency preparation. Response equipment must be provided and located to facilitate response. Also fundamental to effective and immediate response are the methods of emergency communication, including internal and external notification. Following an emergency response, additional notifications must be made as appropriate. This chapter outlines notification procedures and actions for potential laboratory emergencies.

EPA Program Requirements

To facilitate and provide appropriate emergency action, EPA laboratories must:

- Prepare for, and provide, appropriate emergency notifications.
- Develop standard operating procedures (SOPs) for typical emergency responses.
- Train employees in emergency response methods and equipment use.

Program Administration

To implement emergency response actions, responsibilities must be assigned for the following:

- Posting emergency notification information
- Providing post-emergency notification
- Developing specific emergency response procedures
- Training employees for emergency actions based on potential hazards and risks

2.0 Notification

Notification of an emergency is to be performed as soon as the emergency is identified. Each laboratory should have internal emergency notification procedures and telephone numbers posted at each telephone.

Often, an emergency response will involve the notification of external organizations (e.g., fire department, medical facilities, etc.). All external notifications should be handled by the command center team. For certain emergency actions, it may be appropriate to provide external notification (i.e., 911) prior to internal notification. These situations should be outlined in the emergency action plan. In order to identify the applicable release reporting obligations, the facility should know what regulations it is subject to, what air and wastewater permits it holds, and what hazardous substances are stored and handled on site.

Attachment G3-1 summarizes federal safety, health, and environmental reporting obligations, including the type of release, the reporting obligations, the timeframe within which the release must be reported, and the applicable federal law. Reporting obligations are typically dependent on the type and quantity of a substance or substances released into the environment. States may have additional or more stringent reporting requirements.

In addition, laboratories may be asked for specific information from the media and must be prepared to respond. Laboratories should ensure that they have a communication plan that discusses how to respond to outside requests for information. Communications to the media, unions, and other organizations should be cleared by appropriate laboratory representatives and delivered by a designated laboratory representative. All staff and members of the incident command and emergency teams must follow the communications protocol outlined by the laboratory.

Typically, the Designated Official reports to a member of laboratory management or the designated spokesperson dealing with outside distractions and emergency organizations. However, on occasion, team members may need to present their findings to, and/or to work with, outside organizations during the investigation (e.g., arson, sabotage, workplace violence, etc.). If the spokesperson is a team member, care must be taken to resist the temptation to offer conclusions.

3.0 General Response Procedures

Outlined below are typical response procedures for potential laboratory emergencies. These are *general* response measures. The specific measures outlined in the emergency action plan should include these measures, but supersede these general guidelines.

3.1 Fire

Every employee must know the location of fire extinguishers and fire blankets and be familiar with the alarm system. The first person to observe a fire should immediately sound the fire alarm by activating the nearest fire alarm pull station and then report the fire to the

SHEMP Manager. If possible, and if trained to do so, use an appropriate fire extinguisher to extinguish or contain the fire. If fire extinguishment attempts fail, evacuate the area, shut off gas supplies, close the door to contain the fire, and evacuate.

The following sections provide information on response to specific types of fires:

Solvent fires can usually be extinguished by the proper use of dry chemical or carbon dioxide extinguishers. Fires in small containers of solvent can often be snuffed out by placing the lid on the container tightly enough to exclude air. If a lid is not available, a piece of sheet metal or other similar noncombustible material will suffice.

Gas fires can be extinguished by closing a valve in the gas supply line, thereby shutting off the fuel supply. The building's gas valves should be identified by a sign and arrow. The building manager is called to turn off the building gas valves. Gas fires can also be extinguished by the proper use of carbon dioxide or dry chemical extinguishers. Serious consideration should be given to allowing gas fires to burn until the source of gas can be stopped to prevent possible explosions.

Chemical fires can be of many different types. Often special methods of fire fighting must be used. For example, a metal fire (e.g., sodium, titanium, magnesium, potassium, lithium) should be smothered with dry sand, graphite, salt, or inert gas in confined areas, never with water. All laboratory workers must be taught the particular methods of handling these unusual types of fire hazards located in their work area.

Electrical fire response must begin with turning off the power to the motor or other electrical equipment involved in the fire. If the power cannot be turned off, call the building manager to turn off the power. Use carbon dioxide or dry chemical extinguishers on electrical equipment, never water. Electrical equipment involved in fires should not be returned to operation until it has been inspected or repaired.

3.2 Chemicals

The spill procedures discussed below are to be used by laboratory employees only for incidental chemical releases. An incidental release is a release in which the substance(s) can be absorbed, neutralized, or otherwise controlled at the time of release by personnel in the immediate release area, and where there is no potential risk of health hazards (i.e., fire, explosion, or chemical exposure). The spill procedures discussed in Table G3-1 are to be used by laboratory staff for incidental chemical spills or releases.

Clean-up of incidental chemical spills is performed once the initial response and assessment of the extent of the spill have been completed. Table G3-2 presents general procedures for clean-up of incidental chemical spills.

Table G3-1: Procedure for Response to Incidental Chemical Spills or Releases

Step	Action
1	Notify staff in the immediate area to leave the room immediately.
2	Determine if laboratory staff have been contaminated. Decontaminate eyes using the nearest eyewash station and skin using the nearest safety shower, as applicable to the extent of contamination. Notify the SHEMP Manager, Laboratory Director and emergency medical responders for assistance. Discard any contaminated protective clothing (refer to Chapter C15 for waste management information).
3	Assess the hazards associated with the spill or release.
4	Determine if the spill or release can be contained and cleaned up.
5	Determine the neutralization process for the chemical spilled from material safety data sheets.
6	Restrict access to the laboratory until neutralization and clean-up have been completed, unless staff are equipped with appropriate personal protective equipment.

In the event of staff exposure, medical assistance must immediately be sought. Personnel who are helping the exposed staff member must be prepared to provide the medical personnel information such as the type of exposure (i.e., chemical), the exposure route (i.e., skin contact, inhalation, ingestion), and the degree or amount of exposure. Trained personnel must provide immediate first aid appropriate to the exposure.

3.3 Medical

In the event of an emergency medical situation, the names, phone numbers, addresses, and procedures for contacting the emergency medical resources should be posted conspicuously (with duplicates near telephones). This may include a first-aid team, a hospital/clinic, and emergency medical technicians/paramedics. In case of exposure to a hazardous material, it is advisable to take the applicable MSDS to the emergency room along with the exposed victim. After a medical emergency, follow-up should be done to ensure that accident reports are filed and a response critique is performed.

Table G3-2: Clean-up of Incidental Chemical Spills

Step	Action
1	Conduct an initial assessment and evaluation of the spill area.
2	Gather containment, control, and clean-up supplies, materials and equipment.
3	Put on appropriate personal protective equipment.
4	Solid Spill: Carefully push a solid spill into a scoop with a sponge, pad or other suitable device. Do not sweep the solids with a broom. Liquid Spill: Contain and confine to an area as small as possible use sorbent booms and absorbent particulate. Place sorbent particulate on the spilled material and let it soak in.
5	Clean-up both liquid and solid spills using an “outside-in” approach. Practice contamination avoidance.
6	Place contaminated sorbent or other contaminated material into an approved receptacle.
7	Wash/wipe down the area two times with a mild detergent and water using sponges, cloth, etc.
8	Dry the area with paper towels, cloths, rags, etc.
9	Wipe down any material, containers, or equipment that may have been contaminated in the spill.
10	Place any waste material generated in the cleanup (rags, etc.) into approved receptacle.
11	Remove PPE and place in approved receptacle.
12	Close and seal waste receptacle.
13	Contact laboratory supervisor or other designated individual to oversee removal.

3.4 Bomb

The following section includes information for response to the identification of a suspicious object. Suspicious objects are assumed to be bombs until a professional assessment proves otherwise.

3.4.1 Recognition

It is important for employees to be aware of suspicious objects, and to know who to contact in the event that one is received through shipping or identified in the work area. Some employees may receive bomb threats over the telephone, over the Internet, or in the mail.

Suspicious Packages in the Mail

Bombs may be received by EPA locations through the mail or special delivery. Parcel or letter bombs sometimes have common traits that can be identified through visual inspection. Points for recognizing suspicious packages are presented in Table G3-3.

EPA laboratories may have X-ray machines or magnetometers located in receiving areas or mail rooms to further evaluate incoming packages. If a suspicious package is detected in the X-ray machine, it should be left inside the chamber as the appropriate evaluation and response procedures are being implemented.

Bomb Threats

EPA laboratories may also be subject to bomb threats. Bomb threats may either be specific or nonspecific. Specific threats may provide information on the bomb, its placement, explanation for the attack, and the time of detonation. Nonspecific threats generally provide little information other than that a bomb has been placed. Both types of threats should be considered seriously and evaluated.

3.4.2 Response

Once a potential bomb incident is recognized, it is essential that the proper response procedures be efficiently and

Table G3-3: Points for Recognizing Suspicious Packages

Foreign mail, airmail, or special delivery	Incorrect titles
Confidential or personal markings	Titles, but no names
Excessive postage (usually stamps)	Oily stains or discoloration
Handwritten addresses	No return address
Poorly typed addresses	Excessive weight
Misspellings of common words	Rigid envelope
Excessive fastenings (tape, string, etc.)	Lopsided or uneven envelope
Visual distractions	Protruding wires or tinfoil

accurately implemented to evaluate and act on the situation. The following sections provide guidance on response to suspicious packages in the mail, objects in the workplace, and bomb threats.

Suspicious Packages in the Mail

Upon identification of a suspicious package, receiving area or mail room personnel should notify the contact designated by the Command Center Team in the laboratory's emergency action plan. This contact must be responsible for notifying laboratory management and recording all pertinent information on the suspicious package. Then the designated responder should attempt to contact the sender of the package for information on the contents. Examples of questions to be asked include:

- Is the addressee familiar with the name and address of the sender?
- Is the addressee expecting a package from the sender? If so, what would be the contents of the item and an approximate size?
- If the sender is unknown, is the addressee expecting any correspondence from the city, state, or origin of the suspect package?
- Is the addressee aware of any friends, relatives, or business acquaintances currently on vacation or business trips in the area of origin?

If the package cannot be identified, responders should contact the local bomb squad and notify the Command Center Team to implement the bomb incident plan.

Bomb Threats

Once a bomb threat is received, the response procedures outlined in the emergency action plan must be implemented. All employees who may receive a bomb threat (either written or over the telephone) should be trained and drilled on the response procedures. As part of the response, the local agency (e.g., Federal Protective Service, Federal Bureau of Investigation, police, etc.) outlined in the emergency plan should be notified of the threat. If a written threat is received, it should be handled as little as possible. All materials, including any envelope or container, should be placed in a plastic bag and given to the response organizations. Evidence such as fingerprints, handwriting or typewriting, paper, and postal marks can then be used in tracing the threat. A recipient of a written bomb threat should attempt to note all personnel who were involved with the movement of the written document through the channels to the point where discovery of its intent was made.

Bomb threats received over the Internet should be stored in an archive and/or forwarded to a predesignated site. Information specialists may be able to determine information on the sender from reviewing the message received. The message should also be printed out so it can be easily used and reviewed during the evaluation and follow-up process.

Bomb threats received over the telephone are more common than written threats. A calm response over the telephone may result in additional information, especially if the caller wishes to avoid injuries or fatalities. Establish specific bomb threat

response procedures in the incident plan to outline the notification, communication, and evaluation procedures. In developing this portion of the emergency plan and the training materials, these guidelines should be followed for individuals receiving a bomb threat over the telephone:

- Keep the caller on the line as long as possible.
  - — Notify your supervisor or security officer by a prearranged signal while the caller is on the line.
  - — Keep the caller talking. Ask the caller to repeat the message. Pretend difficulty with hearing.
  - — Record every word spoken by the caller.

- Ask for the location of the bomb or the time of possible detonation.
  - — If told that the building is occupied or can not be evacuated in time, the caller may be willing to give more specific information on the bomb's location, components, or method of detonation.
  - — Ask what type of bomb it is.

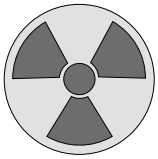
- Listen for background noises.

- Pay close attention to the voice characteristics, speech, language, accent, and manner.

3.5 Evacuation

In the event of a facility evacuation, employees should be trained in alarm methods, evacuation routes, and meeting locations. All personnel must follow the directions of floor teams, since access to some routes may be limited based on the emergency location. The use of elevators must be avoided. Responsibility for closing doors to laboratories should be assigned to floor team members. All personnel must proceed directly to the assigned meeting location for a head count. The facility's emergency action plan highlights the personnel responsible for performing the head count. If any staff member is not accounted for, the Command Center Team must be immediately notified. Re-entry is not permitted unless announced by authorized personnel.

3.6 Radiation



Emergency situations that can cause radioactive materials to be spread around or come into contact with personnel may be encountered in a laboratory. The following procedures describe responses to several general radiation emergency situations.

3.6.1 Minor Spill

In the event of a minor spill involving no radiation hazard to personnel:

- Immediately notify all other persons in the room.

- Notify the SHEMP Manager and Radiation Safety Officer (RSO). The RSO will verify that no radioactive materials were involved in the spill.

- Permit only the minimum number of persons necessary into the area to deal with the spill.

- Confine the spill immediately, as follows:

For minor spills of radioactive liquids:
- Consult the Material Safety Data Sheets (MSDS) for required protective clothing and equipment.
- Don protective gloves, lab coat, shoe covers, and respirator as required (if trained).
- Dam the spill with absorbent material.
- Neutralize as required.
- Drop absorbent paper on the spill.

For a dry spill of radioactive material:
- Consult the MSDS for required protective clothing and equipment.
- Don protective gloves, coveralls, and respirator as required (if trained).
- Dampen thoroughly, taking care not to spread the contamination.
- Decontaminate the area.
- Monitor all persons involved with the spill and cleanup operations.
- A complete assessment of the accident and subsequent remedial or protective measures must be documented and submitted for review to the SHEMP Manager, the RSO, and the Laboratory Director.

3.6.2 Major Spill

For major spills involving potential radiation hazard to laboratory personnel:

- Notify all persons not involved in the spill to vacate the room at once. Limit the movement of displaced persons to confine the spread of contamination.
- Notify the RSO and SHEMP Manager immediately.
- Evaluate the non-radioactive hazards associated with the spill. If required, consult MSDS for appropriate action.
- If the spill is on the skin, flush skin thoroughly with cold water and wash with soap and water.
- If the spill is on clothing, monitor and/or discard outer or protective clothing at once.
- Take immediate steps to decontaminate personnel involved, as necessary.
- Decontaminate the area.
- Document a complete assessment of the accident and subsequent remedial or protective measures and submit it to the SHEMP Manager, RSO, and the Laboratory Director for review.

Personnel involved in decontamination must use adequate protective equipment to avoid the risk of external and/or internal contamination.

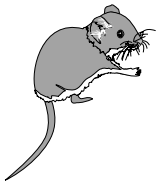
3.6.3 Injuries or Exposures to Personnel

All radiation emergencies involving injuries or exposures to personnel (e.g., wounds, exposure, ingestion, inhalation)

must be reported to the RSO immediately. If deemed necessary, a physician qualified to treat radiation injuries will be called. No person involved in a radiation injury shall return to work without the approval of the attending physician, the RSO, and the SHEMP Manager. A complete assessment of the accident and subsequent remedial or protective measures must be documented and submitted for review to the SHEMP Manager, RSO, and the Laboratory Director.

3.7 Biological

When accidents occur that involve the mishandling or escape of biohazardous materials, the PI or laboratory supervisor is to be notified immediately. Spills of high-risk organisms (e.g., certain Class 2 and all Class 3 organisms) should be reported to the SHEMP Manager or biosafety officer. All employees have an obligation to themselves and their colleagues to report accidents immediately in order to minimize potential hazards. Refer to Chapter F2 of this manual for specific guidelines on decontamination of laboratory surfaces after a spill of biohazardous materials.



Laboratory Animal Bite, Scratch, or Splash

Laboratory personnel working with animals are at risk of contracting a variety of diseases during contact. Table G3-4 presents a summary of some diseases that could result from types of animal contact. All animal bites and scratches should be washed promptly with an antibacterial soap, and medical attention must be given to the employee. Dog or cat bites require notification of the animal facility veterinarian so the animal can be quarantined for rabies observation.

Table G3-4: Diseases Resulting from Laboratory Animal Contact

Type of Animals	Type of Disease
General animal handling	Tetanus
Nonhuman primates	Tuberculosis Cercopithecine Herpes virus I Pox viruses Salmonella Shigella Intestinal parasites
Carnivores (e.g., dogs and cats)	Rabies
Cats	Toxoplasmosis (women of child-bearing age)

Nonhuman primates can present a variety of risks to animal users. They are wild animals and can be aggressive toward humans. In the event of a bite, scratch or splash of body fluids from a nonhuman primate, follow the guidelines in Table G3-5.

3.8 Utility Failure

Utility failures, or outages, can occur any time for a variety of reasons and for extended periods of time. The effect an outage will have on the facility and its occupants is related to the type of service lost, duration of outage, time of day, weather conditions, and day of the week. Employees are placed at risk when an outage occurs at the facility for an extended period of time. Loss of communication services, building environmental controls, and elevator service and reduced visibility could increase the risk of employee injury. The command center team will determine how the organization will respond to an outage based on these factors. Information will be provided via voicemail broadcasts or megaphones.

Occupants should leave any area if personal safety is threatened. Utility failures should be reported immediately to security so that the command center team may be alerted. The command center team, in cooperation with security and laboratory staff, should determine the impact of the outage. Evacuation may be initiated if there is a risk of injury to staff, hazardous

Table G3-5: Procedure for a Bite, Scratch, or Splash from Nonhuman Primates

Step	Action
1	Assess the situation. If you have one of the following, follow the procedures below: • A bite or scratch that causes bleeding • A cage scratch that causes bleeding • A puncture by a needle that has previously been in a nonhuman primate • Splashing of feces, urine, saliva, or blood into your eye or mouth
2	Scrub the wound for 15 minutes using a scrub brush and water.
3	For an eye splash, rinse eyes at the eyewash station.
4	Swab the wound deeply, using a viral culture swab.
5	Squeeze the bottom to break the bulb containing the transport media when replacing the swab in its plastic tube. Do not use the swab in eyes.
6	Call for medical assistance and follow the instructions given.

material spills, etc. Only when the utilities have been restored and the command center team announces that it is safe to reenter the facility, should the occupants return to the laboratory.

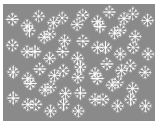
3.9 Natural Disaster

At EPA laboratories, there are a variety of natural hazards associated with adverse weather conditions that could obscure visibility, affect road conditions, or cause heat or cold stress. The following are some unusual and severe weather conditions that could affect laboratories:

- ***Severe Thunderstorms***. Severe thunderstorms are defined as having winds of more than 58 miles per hour or large hail of 3/4 inch or more in diameter. Severe thunderstorms can produce tornadoes, large hail, and heavy rain with possible flooding and lightning.

- ***Tornadoes***. Tornadoes do not usually affect a large area, but they are the most violent type of storm that can occur. Most tornado damage is caused by violent winds, but most injuries and deaths result from wind-blown debris. Large thunderstorms can spawn several tornadoes, and a major outbreak of tornadoes can cause widespread damage. Large hail is often followed by a strong or violent tornado. The National Severe Storms Forecast Center will issue a watch to indicate when and where severe thunderstorms and/or tornadoes are most likely to occur. A warning is issued to indicate when and where such storms are occurring, based on evidence from radar or reports from trained spotters or other reliable sources.

- ***Heavy Snowfall and Blizzards***. Heavy snowfalls and blizzards could occur at some EPA laboratory locations. As such, work should be scheduled around adverse weather if possible. Laboratory staff should try to anticipate heavy snowfalls and blizzards and consider potential travel conditions on the way to the facility from their homes.



For any natural disaster where advance notice is given, directions obtained from radio and television broadcasts must be followed by the Command Center Team and all personnel. Laboratory-specific information should be provided to occupants through broadcasts over intercoms, voice mail, etc., as updates are available. The primary goal of the command center team is to assess facility damage and issue orders to minimize the risk of occupants. The command center team may need to alert laboratory staff who are outdoors to seek refuge inside the facility. If the facility is damaged during the natural disaster, the command center team must determine if evacuation of the facility is necessary to protect staff. If it is safe to evacuate, occupants should follow instructions given by the command center team.

Attachment G3-1: Environmental Notification Requirements

Purpose: To provide a list of notification requirements for safety, health, and environmental incidents.

Instructions: Compare this list to the emergency procedures currently in place at the laboratory. Determine if the procedures provide adequate notification instruction for emergency situations.

Attachment G3-1: Environmental Notification Requirements

Type of Incident	Reporting Obligation	Federal Law/ Regulatory Citation
Release to air in excess of air permit limits	Review permit (typically state-issued) to determine notification requirements.	CAA/Permit
Release to air in excess of applicable NSPS or NESHAP standard	Notify regulatory agency as specified in applicable NSPS or NESHAP standard	CAA/40 CFR 60, 61, 63
Release to water in excess of POTW or NPDES permit limits	Review permit (typically state-issued) to determine notification requirements.	CWA/Permit
A release to the environment of CERCLA hazardous substance listed in 40 CFR 302 that is *within facility boundaries* and is equal to or exceeds the reportable quantity (see 40 CFR 302 for listing of hazardous substances and their reportable quantities)	Notify the National Response Center immediately.	CERCLA/40 CFR 302
A release to the environment of a CERCLA hazardous substance listed in 40 CFR 302 that goes *outside facility boundaries* and is equal to or exceeds the reportable quantity. (See 40 CFR 302 for listing of hazardous substances and their reportable quantities.)	Notify the National Response Center immediately. Notify state and local emergency planning committees immediately, and provide written notification to state and local emergency planning commissions as soon as practical.	CERCLA/40 CFR 302
A release to the environment of an extremely hazardous substance listed in 40 CFR 355 that goes *outside facility boundaries* and is equal to or exceeds its reportable quantity (see 40 CFR 355 for a listing of extremely hazardous substances and their reportable quantities)	Notify state and local emergency planning committees immediately, and provide written notification to state and local emergency planning commissions as soon as practical.	EPCRA/40 CFR 355
Release of oil into navigable water	Notify National Response Center of releases of oil in harmful quantities (quantity that violates applicable water quality standard or that causes a film, sheen, or discoloration of the surface of the water) into navigable water quantities	CWA/40 CFR 110

Attachment G3-1: Environmental Notification Requirements

Type of Incident	Reporting Obligation	Federal Law/ Regulatory Citation
Discharge of hazardous waste or hazardous materials during transportation, including: • As a direct result of hazardous materials: — A person is killed; or — A person receives injuries requiring his or her hospitalization; or — Estimated carrier or other property damage exceeds $50,000; or — An evacuation of the general public occurs lasting one or more hours; or — One or more major transportation arteries or facilities are closed or shut down for one hour or more; or — The operational flight pattern or routine of an aircraft is altered; or • Fire, breakage, spillage, or suspected radioactive contamination occurs involving shipment of radioactive material • Fire, breakage, spillage, or suspected contamination occurs involving shipment of infectious substances (etiologic agents); or • There has been a release of a marine pollutant in a quantity exceeding 450 L (119 gallons) for liquids or 400 kg (882 pounds) for solids; or • A situation exists of such a nature (e.g., a continuing danger to life	• Notify the National Response Center and report in writing to the Director, Office of Hazardous Materials Transportation, Materials Transportation Bureau, Department of Transportation • Notify the nearest FAA Civil Aviation Security Office, by telephone at the earliest practical moment, incidents involving shipments transported by aircraft. • Notify the Director, Centers for Disease Control, U.S. Public Health Service, Atlanta, Georgia for emergencies involving etiologic agents. • Under 40 CFR 302.6, EPA0 requires persons in charge of facilities (including transport vehicles, vessels and aircraft) to report any release of a hazardous substance in a quantity equal to or greater than its reportable quantity, as soon as that person has knowledge of the release, to the U.S. Coast Guard National Response Center. • Notify the National Response Center and report in writing to the Director, Office of Hazardous Materials Transportation, Materials Transportation Bureau, Department of Transportation.	RCRA/40 CFR 263 and Hazardous Materials Transportation Law/49 CFR 171 for hazardous waste Hazardous Materials Transportation Law/49 CFR 171 for hazardous materials

Attachment G3-1: Environmental Notification Requirements

Type of Incident	Reporting Obligation	Federal Law/ Regulatory Citation
• Leak or spill from an underground storage tank	• Report spills or releases to the environment in excess of 25 gallons to the implementing agency within 24 hours of release • Report spills or releases of hazardous substances consistent with 40 CFR 302 and 355 that are equal to or exceed the reportable quantity • Report petroleum spills of less than 25 gallons, or hazardous-substance spills less than the reportable quantity that cannot be cleaned up within 24 hours to the implementing agency	RCRA/40 CFR 280
Each fatality	Within 8 hours after the death of any employee from a work-related incident, orally report the fatality by telephone or in person to the Area OSHA Office, or by using the OSHA toll-free central telephone number.	OSHA/29 CFR 1904.8
Hospitalization of three or more employees occurring within 30 days of an incident	Within 8 hours after the in-patient hospitalization of three or more employees as a result of a work-related incident, orally report the multiple hospitalization by telephone or in person to the Area OSHA Office nearest to the incident, or by using the OSHA toll-free central telephone number.	OSHA/29 CFR 1904.8

1.0 Introduction

Incident investigations determine how and why failures occur. By using the information gained through an investigation, a similar, or perhaps more disastrous, incident may be prevented. Incident investigations should be conducted with incident prevention in mind. Investigations are not intended to place blame. This chapter presents information on incident investigation procedures and incident analysis techniques.

EPA Program Requirements

To ensure that incidents are adequately investigated and root cause(s) are determined, EPA laboratories must:

- Develop an incident investigation program.
- Assign staff to perform incident investigation.
- Train staff on investigation procedures.
- Implement procedures for performing cause analysis.
- Establish incident reporting procedures.

Program Administration

To effectively manage incident investigation and analysis, responsibilities should be assigned for:

- Developing an incident investigation program
- Training staff on investigation procedures
- Activating the investigation
- Leading the investigation
- Preparing and submitting incident reports

2.0 Incident Investigation

A complete incident investigation program should investigate incidents, "near misses," and accidents that result in property damage or personal injury. The investigators should be trained in the proper procedures for conducting an investigation.

Personnel involved in an investigation should avoid the trap of assigning blame to involved employees. By assigning blame, the investigator would be creating a negative work environment that would most likely discourage employees from reporting future incidents and hazardous conditions. This approach may not uncover all contributing factors or the root cause of the problem. Often, a thorough analysis will reveal that more significant program deficiencies led to the incident, (e.g., inadequate equipment, improper training, or insufficient supervision).

An investigation should not only be conducted in response to insurance or regulatory reporting requirements. The investigation should be performed as part of the laboratory's hazard analysis program, with the information used to develop appropriate corrective actions and revise the inventory of site hazards and/or the existing systems for hazard prevention and control. Table G4-1 summarizes the guidelines for developing investigation program, and Attachment G4-1 of this manual provides a sample investigation form.

The actual procedures used in a particular investigation depend on the nature and results of the incident. In general, responsible officials will appoint an individual to be in charge of the investigation.

It is best if the team leader has received some training, has no association with the area where the incident occurred, and has some knowledge of the process. Major events may call for support from headquarters or outside parties. The investigator uses most of the following steps, which are also highlighted in Table G4-2.

1. Define the scope of the investigation.

2. Select the investigators and assign specific tasks to each (preferably in writing).

3. Present a preliminary briefing to the investigation team, including:
   a. Description of the incident, with damage estimates
   b. Normal operating procedures
   c. Maps (local and general)
   d. Location of the incident site
   e. List of witnesses
   f. Events that preceded the incident

4. Visit the incident site to obtain updated information.

5. Inspect the incident site:
   a. Secure the area. Do not disturb the scene unless a hazard exists.
   b. Prepare the necessary sketches and photographs. Label each carefully and keep accurate records.

Table G4-1: Elements of an Incident Investigation Program

Element	Description
Laboratory Policy	Develop a written policy. Management commitment is essential to ensure that employees know that reporting does not result in reprisal and blame.
Incident Definition	Define what constitutes an incident. The reporting of certain injuries, illnesses, and fatalities must be performed according to the applicable regulatory authority. However, the definition should also address nonregulated injuries, illnesses, fatalities, and "near miss" incidents or exposures.
Investigation	Encourage immediate reporting of incidents so the investigation can begin as soon as possible.
Incident Causes	Uncover causes or contributing factors of incidents. These usually fall into the following categories: unsafe conditions or acts, poor supervision, or personal factors.
Response to Recommendations	Develop recommendations from the findings of the investigation and act on these recommendations as soon as possible.
Investigation Report	Do not confuse the investigation report with medical recordkeeping or regulatory logs, such as the OSHA 200 Log.
Investigation Team Training	Ensure that all investigators have had incident investigation training. Otherwise, the results will likely overemphasize blame, and neglect root causes.

6. Interview each victim and witness. Also interview those who were present before the incident and those who arrived at the scene shortly after the incident. Keep accurate records of each interview. Use a tape recorder if desired and if approved.

7. Determine:
   a. What was not normal before the incident
   b. Where the abnormality occurred
   c. When it was first noted
   d. How it occurred

8. Analyze the data obtained in step 7. Repeat any of the prior steps, if necessary.

9. Determine:
   a. Why the incident occurred
   b. A likely sequence of events and probable causes
   c. Alternative sequences

10. Check each sequence against the data from step 7.

11. Determine the most likely sequence of events and the most probable causes.

12. Conduct a post-investigation briefing

13. Prepare a summary report. It should include, at a minimum:
    a. Date and description of the incident
    b. Factors contributing to the incident
    c. Recommendations resulting from the investigation
    d. The names of the people who conducted the investigation

An investigation is not complete until all data are analyzed and a final report is completed. It is critical that there be closure on all recommendations whether they are accepted or not.

2.1 Fact-Finding

Evidence must be gathered from many sources during an investigation. Information is gathered from witnesses, as well as by observation. Witnesses should be interviewed as soon as possible after an incident. The incident site must be inspected before any changes occur. Photographs and sketches of the incident scene are also made immediately. All pertinent data is recorded on maps.

Documents containing normal operating procedures, flow diagrams, maintenance charts, or reports of difficulties or abnormalities are particularly useful. Complete and accurate notes should be kept in a bound notebook. Pre-incident conditions, the incident sequence, and post-incident conditions are recorded. In addition, the location of victims, witnesses, machinery, energy sources, and hazardous materials should be documented.

Table G4-2: Steps for Incident Investigation

Step 1	Define Scope
Step 2	Select Investigators
Step 3	Present Briefing
Step 4	Visit Incident Site
Step 5	Inspect Incident Site
Step 6	Interview Victims and Witnesses
Step 7	Determine How Incident Occurred
Step 8	Analyze Data
Step 9	Determine Event Sequence
Step 10	Compare Sequence With Data
Step 11	Determine Probable Cause
Step 12	Conduct Post-Briefing
Step 13	Prepare Summary Report

In some investigations, a particular physical or chemical law, principle, or property may explain a sequence of events. These laws should be gathered in the notes taken during the investigation or during the analysis of data. In addition, during the investigation, data should be gathered that may lend itself to analysis by these laws, principles, or properties. The report can include an appendix in the final report with an extended discussion.

2.2 Interviews

In general, experienced personnel should conduct interviews. If possible, the team assigned to this task should include an individual with a legal background. In conducting interviews, the team should:

- Appoint a speaker for the group.
- Get preliminary statements as soon as possible from all witnesses.
- Locate the position of each witness on a master chart (including the direction of view).
- Arrange for a convenient time and place to talk to each witness.
- Explain the purpose of the investigation (incident prevention) and put each witness at ease.
- Listen, let each witness speak freely, and be courteous and considerate.
- Take notes without distracting the witness. Use a tape recorder only with consent of the witness.
- Use sketches and diagrams to help the witness.
- Emphasize areas of direct observation. Label hearsay accordingly.
- Be sincere and do not argue with the witness.
- Record the exact words used by the witness to describe each observation. Do not "put words into a witness' mouth."
- Word each question carefully and be sure the witness understands.
- Identify the qualifications of each witness (e.g., name, address, occupation, years of experience, etc.).
- Supply each witness with a copy of his or her statements. Signed statements are desirable.

After interviewing all witnesses, the team should analyze each witness' statement. They may wish to re-interview one or more witnesses to confirm or clarify key points. While there may be inconsistencies in witnesses' statements, investigators should assemble the available testimony into a logical order. This information is analyzed along with data from the incident site.

Not all people react in the same manner to a particular stimulus. For example, a witness who was near the incident may have an entirely different story from one who saw it at a distance. Some witnesses may also change their stories after they have discussed it with others. The reason for the change may be additional clues.

A witness who has had a traumatic experience may not be able to recall the details of the incident. A witness who has a vested interest in the results of the investigation may offer biased testimony. Finally, eyesight, hearing, reaction time, and the general condition of each witness may

affect his or her powers of observation. A witness may omit entire sequences because of a failure to observe them or because their importance was not realized.

3.0 Cause Analysis

There are three approaches to incident cause analysis: simple, team, and complex. Which approach is used depends on the severity of the incident that has occurred in the laboratory. A laboratory's incident investigation program should specify the approach and requirements to be met regarding analysis for each class of incident.

For example, a simple root cause analysis can be performed if the investigator continually asks the question "Why did the incident happen?" This line of questioning is completed until all possibilities are exhausted. A more systematic approach is to provide a list of simple yes/no questions that deal with four major areas: equipment, environment, people and management. The investigator responds to each question, and a yes answer is considered to be a cause of the incident.

As the incident classification scale increases, the analysis becomes more formal. The more complex analyses usually involve inductive analyses (as discussed in section 3.3.2 of this chapter), or some other system-safety method of cause analysis. In some cases, these methods may be used by a facilitator trained in the selected method for analysis of an incident.

Once the laboratory has adopted an approach to analysis of incidents, specific training in the chosen methods should take place. This provides the investigator, who is usually the SHEMP Manager or principal investigator, a guide to completing the analysis. As a result, systems are reviewed for possible root causes.

The following sections discuss analysis approaches in greater detail.

3.1 Simple Root Cause Analysis

Simple root cause (SRC) analysis does not imply a less concerted effort to uncover and identify root causes. It does, however, provide a quick-and-easy systematic approach to cause analysis for low-consequence incidents. Simple root cause analysis is typically performed by the principal investigator or SHEMP Manager when an incident or "near miss" occurs.

SRC requires the principal investigator or SHEMP Manager to repeatedly ask three questions:

- Why did the incident or "near miss" occur?
- What was the underlying cause?
- Was there a system-related deficiency or weakness?

The first thing to do after gathering and analyzing the evidence is to develop a chronological list of the events leading up to the incident. Another helpful tool is to use a logic tree. A logic tree is similar to a fault tree in that you place events and causes in boxes starting with the top

vent—the consequence (e.g., injury)— and work backwards, tracing the causes leading to the injury.

3.2 Team Root Cause Analysis

A team approach to determining incident cause is performed using the issues analysis root cause technique. This technique applies structured logic to finding the root causes of an incident by:

- Asking "What is the critical question in the investigation?"
- Focusing on the logic of the answer
- Providing a framework for management action

By breaking down the overall incident issue into separate issue topics, the problem of identifying root causes becomes more manageable. It also keeps the analysis team from overlooking key issues by rushing down a deductive tree.

The issue breakdown will depend on the situation. Each issue topic should answer the question raised at the next higher level. The issues-as-questions structure can be taken down several levels. After the first two to three sublevels, deductive processes begin to identify specific causes for individual issues.

The team should focus on answering the question "Why did this occur?" until all the fundamental system problems have been identified. Questions should suggest a hypothesis, and that hypothesis should focus on the root causes once the team has finished identifying all of the issues and individual issue topics. The team then develops fact/hypothesis matrices for each issue.

Issues should then be used to develop hypotheses that orient the evidence. Should evidence disprove the hypothesis, the issue is not considered a true cause. If there is insufficient evidence to prove or disprove the hypothesis, the team needs to go back and gather additional evidence or rethink the logic. If the evidence proves the hypothesis, a root cause results is determined.

The team should now perform three tests:

- The first test is for completeness. At this stage, answer the question, "Does it look complete?"
- The second test is to answer the question, "Are the causes related to systems?"
- Finally, answer the question, "Are there any other causes you had in mind that are not shown?"

If the answer to any of the three tests is *yes*, the evidence should be reexamined, more evidence gathered, and/or answers to the questions checked to confirm the logic. If the tests are answered *no*, corrective actions should be developed, follow-up performed, and a report prepared.

3.2.1 Team Meeting Pre-Work

The first step after the gathering and analysis of evidence is to complete some prework prior to the first team meeting. The following is a short list of materials that should be available in the team room:

- Chronology of events (time line)
- Schematic diagram of the physical layout, plot plan, and elevations as needed to show location and events
- Flow sheets, loop sheets, operating instructions, job safety analyses, etc.

- Photographs and video footage
- Documentation logs for evidence

3.2.2 Team Meeting

Next, the team meeting is called. The meeting should be held in a room with minimal outside distractions. The room should be set up to facilitate team interaction. It should also have flip charts, note pads, tape, self-stick removable notes, etc. The team leader should kick off the meeting by presenting an overview of the incident, the sequence of events, and major facts.

Once this is completed, the team can select a facilitator for the meeting to keep the process moving and on track. The facilitator should be a person trained in root cause analysis techniques. Once the team has identified all issue topics and tested the hypothesis against the facts, the agreed-upon root causes should be listed. Before progressing to identification of corrective actions, the three tests for completeness should be done. Finally, the report should be drafted, reviewed, and approved by all team members.

The easiest way to proceed is to use self-adhesive removable notes to lay out the issues tree. The facilitator should ask the team to identify the key issue at the top of the tree and each subsequent level by developing yes/no questions that must be answered to prevent the incident from happening again.

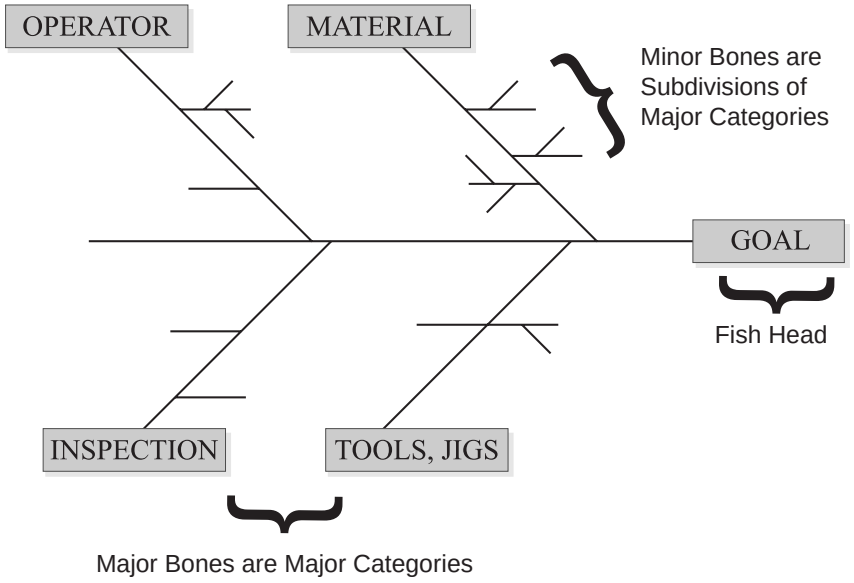
Some people like to complete a bullet list of key issues before the team meets. This can help to move the process along and get the team comfortable with the logic. Remember that the first two to three levels should be inductive, meaning independent, of each other. This will provide the big picture and keep the investigation from missing other possible root causes. In certain complex investigations, it may be wise to use issues analysis during the gathering of evidence as a check on where the investigation is going.

After all of the major issues have been identified, select one issue and complete a deductive analysis by continuing to ask "why?" Once the team feels they have exhausted all the possibilities, use the completeness tests as a quick check on the issues tree. A quick check is whether or not a hypothesis can be developed from the key-issue level of the tree.

During the meeting, the leader may need to facilitate the team. Total quality management (TQM) tools can be helpful. If the team gets stuck on an issue, try brainstorming and group voting. Use of fishbone diagrams (see example in Figure G4-1), flow charts, and selection grids can all aid in the analysis process.

Fact/hypothesis matrices should be completed next for all of the issues on the flip chart; one page for each issue. Once the fact/hypothesis matrices are complete, the completeness test is conducted on the whole process. Finally, corrective actions, report writing, and follow-up are performed. Team participation is key during the analysis. This process requires time. It may take as little as a few hours or as long as a couple of days.

Figure G4-1: Example of a Fishbone Diagram



3.3 Complex Analysis

The principal objective of the investigation and analysis process is to find root causes by applying systematic methods for collecting information about the cause. Two systems-oriented techniques that are used for complex analysis of an incident are deductive analysis and inductive analysis, as described below.

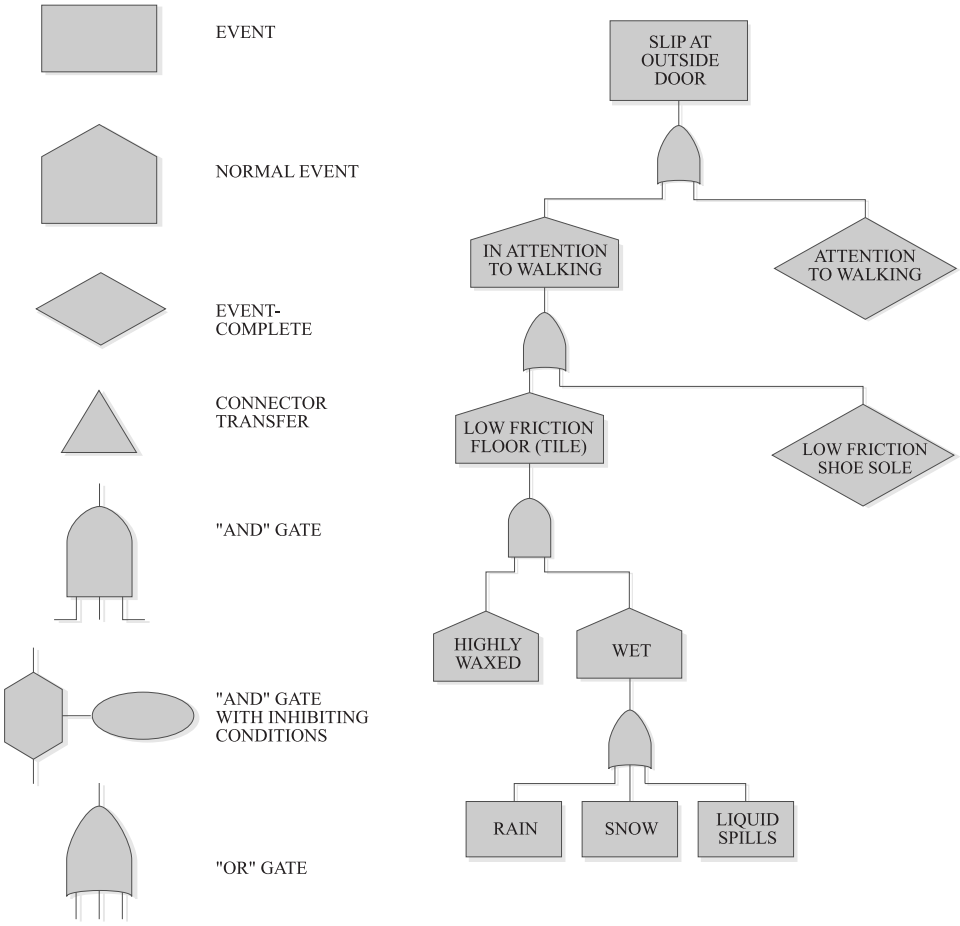
3.3.1 Deductive Analysis

Deductive analysis begins at the occurrence of the incident and works backward in time to determine the root causes of the incident. Examples of deductive analysis techniques include Fault-tree Analysis (FTA) and Management Oversight and Risk Tree (MORT) analysis.

Fault-Tree Analysis

A fault-tree is a symbolic logic diagram that shows the cause-and-effect relationship between an undesirable event and one or more contributing causes. The undesired event appears as the top event on the tree, and is linked to the basic logic gates (the "and" gate and the "or" gate). A rectangular box denotes a "failure" event, and a circle designates a "basic" event. To solve the fault-tree one must find the root cause(s) or a group of basic events that will cause the top event to occur. This set of root cause(s) is known as a "minimal cut set." Figure G4-2 shows an example of a fault-tree.

Figure G4-2: Example Fault-Tree



Management Oversight and Risk Tree Analysis

The basic MORT diagram consists of four elements presented in Table G4-3.

The MORT technique is based on a tree structure laid out vertically and is usually associated with a checklist. As with most of the analytical techniques for incident investigation and analysis, MORT is not considered to be a field technique. It is used as a tool to review evidence brought in from the site.

3.3.2 Inductive Analysis

Inductive analysis uses an overview method of evaluating the entire situation with techniques such as a Hazard and Operability Study (HAZOP). The HAZOP analysis technique is used to identify and evaluate safety, health, and environmental (SHE) hazards and to identify operability problems throughout the entire laboratory. In the HAZOP technique, a team uses a structured, systematic brainstorming session to identify hazards and operability problems.

Table G4-3: Elements of MORT Diagram

Element 1	Investigation of potentially harmful energy flows or environmental conditions
Element 2	People or objects vulnerable to an unwanted energy flow
Element 3	Failure or lack of barriers and controls that are designed to keep potentially harmful energy away from people or objects
Element 4	Precursor event

The final conclusions of the discussions concerning the causes, effects, and safeguards for deviations in each section of the process should be completely documented to facilitate further review.

The overall results of a HAZOP analysis are the findings, which include identification of hazards and operating problems, and recommendations for changes in design procedures to improve safety.

4.0 Reporting

An incident investigation is not complete until a report is prepared and submitted to proper authorities. The final report must be clear, concise, and able to summarize the investigation by:

- Processing findings
- Analyzing conclusions
- Identifying the most probable cause(s)
- Outlining what has been or is being done to prevent a similar incident

Special report forms are available in many cases. Other instances may require a more extended report. Such reports are often very elaborate and may include a cover page, a title page, an abstract, a table of contents, a commentary or narrative portion, a discussion of probable causes, and a section on conclusions and recommendations. Table G4-4 includes useful information to be included in the report.

Finalized copies of the report should be submitted to the following without delay:

- Laboratory Director
- SHEMP Manager
- Principal Investigator

Table G4-4: Information for Accident/Incident Investigation Report

1. Background Information
• Where and when the incident occurred • Who and what were involved • Operating personnel and other witnesses
2. Account of the Incident (What Happened?)
• Sequence of events • Extent of damage • Incident type • Agent or source (of energy or hazardous material)
3. Discussion (Analysis of the Incident—How; Why)
• Direct causes (energy sources; hazardous materials) • Indirect causes (unsafe acts and conditions) • Basic causes (management policies; personal or environmental factors)
4. Recommendations for immediate and long-range action

Attachment G4-1: Sample Incident Investigation Form

Purpose: To perform a causal analysis of laboratory incidents.

Instructions: Select an independent review team to conduct an evaluation of an incident. All team members should first receive training on how to conduct an effective incident investigation.

INCIDENT INVESTIGATION REPORT

	CASE NUMBER
EPA LABORATORY	DEPARTMENT
ADDRESS	LOCATION

1. Name of Injured	2. Social Security Number	3. Sex	4. Age	5. Date of Incident
	__ __ __ /__ __/__ __ __ __	□ M □ F		__ __/__ __/__ __

6. Home Address	7. Employee's Usual Occupation	8. Occupation at Time of Incident
Street Apt. #		
City State Zip Code	9. Length of Employment □ Less than 1 mo. □ 6 mos. to 5 yrs. □ 1 to 5 mos. □ More than 5 yrs.	10. Time in Occup. at Time of Incident □ Less than 1 mo □ 6 mos. to 5 yrs. □ 1 to 5 mos. □ More than 5 yrs.

11. Employment Category	12. Case Numbers and Names of Others Injured in Same Incident
□ Regular, full-time □ Temporary □ Non-employee □ Seasonal □ Regular, part-time	Case Number Name Case Number Name Case Number Name
13. Nature of Injury and Part of Body	

14. Name and Address of Physician	16. Time of Injury	17. Severity of Injury
Name Address	A. _____ A.M./P.M. B. Time within shift □ Yes □ No C. Type of shift: _____	□ Fatality □ Lost workday □ Restricted work activity □ Medical treatment □ First aid □ Other, specify _____
15. Name and Address of Hospital		
Name Address		

18. Specific Location of Incident	19. Phase of Employee's Workday at Time of Injury
Building/Room _____ On Employer's Premises? □ Yes □ No	□ During rest period □ Entering or leaving plant □ During meal period □ Performing work duties □ Working overtime □ Other

20. Describe How the Incident Occurred

_____

_____

_____

	CASE NUMBER
EPA LABORATORY	DEPARTMENT
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21. Incident Sequence: Describe, in reverse order of occurrence, the events preceding the incident. Starting with the injury and moving backward in time, reconstruct the sequence of events that led to the injury.

A. Injury Event _____

B. Incident Event _____

C. Preceding Event #1 _____

D. Preceding Event #2, #3, etc. _____

22. Task and Activity at Time of Incident

A. General type of task
B. Specific activity
C. Employee was working
□ Alone □ With crew or fellow worker
□ Other, specify

23. Posture of Employee

24. Supervision at Time of Incident

□ Directly supervised □ Not supervised

□ Indirectly supervised □ Supervision not feasible

25. Causal Factors (events and conditions that contributed to the incident):

26. Corrective Actions: Those that have been, or will be, taken to prevent recurrence.

Prepared By _____

Title _____

Department _____ Date _____

Approved _____

Title _____ Date _____

Approved _____

Title _____ Date _____