Safety & Health Guide for the Chemical Industry

U.S. Department of Labor
Occupational Safety and Health Administration
1986

OSHA 3091

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William E. Brock, Secretary

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Introduction

More than two thousand deaths from a methyl isocyanate chemical leak in Bhopal, India, drew world attention to the serious hazards in the chemical industry. Following that tragedy, the Occupational Safety and Health Administration (OSHA) developed guidelines to aid employers in reducing the number of potential hazards in chemical industries.

This publication is designed to encourage chemical industry employers to review and strengthen overall safety precautions to guard against chemical disasters. It contains guidelines used by OSHA compliance officers to evaluate employer safety programs, particularly in the areas of disaster prevention and emergency response. It also includes two lists of acutely toxic chemicals whose presence in the workplace should signal the need for safety and health measures to protect workers.

The guidelines are aimed at the conditions and processes found in the "chemical industry," including (but not limited to) firms in SICs 28 and 29.[1] However, they are written to be used in a wide spectrum of workplaces which produce industrial and consumer chemical products.

OSHA also publishes a manual called "How to Prepare for Workplace Emergencies" which can help any type of business in developing an emergency plan. A free copy may be obtained from any OSHA area office.

[1] *Standard Industrial Classification Manual*, 1972 Edition. Office of Management and Budget, Statistical Policy Division, Government Printing Office, Washington. (Pages 111-128.)

Disaster Prevention

There are three tasks to perform before any meaningful analysis of an emergency response system can begin. The first task is to identify the key processes and elements of the production process and to understand **how** operational processes are kept within safe bounds under normal conditions. Conceptually, it is the normal process instrumentation and control measures that provide the first and greatest degree of protection to plant employees and to the public. The four areas listed below identify some major **subsystems** or components which are commonly found in chemical plants. Each has a bearing on the safety of operations under normal and emergency conditions.

1. A **management subsystem** which includes management personnel, process specifications, plant design, standard operating procedures, and the written emergency plan.

2. A **personnel subsystem** which assigns and defines roles, for both normal and emergency operations, and provides appropriate training. This may also include labor/management safety committees.

3. A **physical subsystem** which may include transportation systems for materials, ventilation systems, waste removal systems, containment systems, refrigeration systems, storage areas, communications systems, and other process-related equipment.

4. An **emergency services subsystem** including in-plant and community components.

A second task is to understand how critical failure points are identified, and what controls are used to ensure safe operations. This involves assessing the interrelation of the components and, particularly, identifying which safety features in the system should be backed up with alternative instrumentation, procedures, or equipment designed to ensure that process variables are kept within safe limits.

The third task is to identify the **emergency response system** that is embedded in the operating system. Conceptually, it is a **latent** system that is active only when preventive measures have failed and an incident has occurred. This system is the most difficult to evaluate because:

1. It is not observable except in emergencies.

2. The emergency response system also may involve resources and subsystems that lie wholly or partially outside of the physical or managerial boundaries of the chemical plant. For example, local firefighters may supplement in-plant fire brigades; local hospitals may provide care to injured workers in addition to in-plant first aid; local police may be involved with traffic control, evacuating of workers and community, and expediting communications and the flow of emergency and rescue equipment.

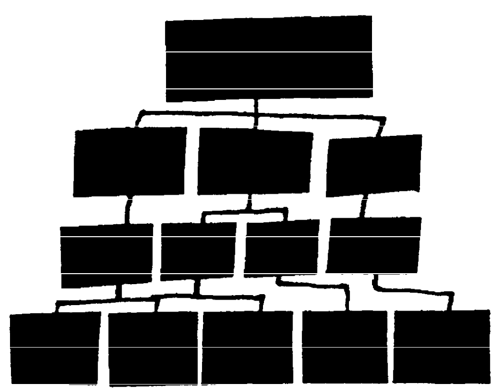
3. Finally, there is the question of defining the point at which the emergency system "shuts down" and normal operations begin after an emergency.

Plant Management

All the planning and preparation of safe plant operation is meaningless, unless it can be implemented. In the event of a problem, there is no time for committee or front office decisions. Correct decisions have to be made at the lowest organizational level possible, and those decisions have to be communicated to other affected personnel. This section is intended to establish whether those elements have been considered in the program.

1. Who is in charge? What are the lines of authority under normal operating conditions? In transition times, like during startup and shutdown procedures? In emergencies?

2. Can information be transmitted quickly and easily from: worker to supervisor? supervisor to worker?



3. How is information exchange accomplished during transition periods (starting and stopping work)?

4. Is operator jargon commonly and completely understood by those affected by the jargon? Examples: MIC—methyl isocyanate, Black Betsy—boiler, Monitor—stationary firefighting nozzles.

5. Are signals clear? Are audible signals distinguishable and understood?

6. How has management complied with requirements of the OSHA Hazard Communication Standard (29 CFR 1910.1200)? Are monitoring records, training records, and material safety data sheets available?

7. Standard operating procedures should be examined and discussed. The process of updating these procedures—including modifications, communication, and training—should be understood.

8. Does a **written emergency plan** exist? It should be discussed with management. It should be understood which contingencies are included in the plan, why they are included, and why management considers them to be adequate for the process, site, and situation.

The Personnel Subsystem

1. What are the job classifications of employees who work at the site? Are all job titles present on all work shifts? Are there potentially crucial omissions?

2. Are employees aware of their roles during emergencies? Are all critical tasks represented on all shifts?

3. Who is responsible for training employees? How often is training provided covering standard operating procedures? Emergency procedures? How is effectiveness of training evaluated by management?

The Physical Subsystem.

It is obviously important to see the physical plant and to relate information contained in operating procedures, emergency plans, and "blueprints" with actual structures, materials, and processes. In inspecting the physical plant, the underlying question is "What keeps this operation—or this phase of the operation—within safe limits, including mechanical and electronic systems, human intervention, and routine maintenance activity?" Particular attention should be given to:

Plant Layout

Plant layout has some specific safety aspects. Examples include:

1. Separation and isolation

    - Chemicals which may react with one another are to be physically separated, e.g., oxidizers are to be stored in areas remote from fuel storage.

    - Areas of potential explosions (e.g., storage of explosives, reaction vessels) are to be isolated so if there is an explosion, the damage and risk to employees is minimized.

2. Drainage

    - Where hazardous liquids may leak or spill from piping or vessels, what provisions are made to prevent their spread to areas where employees may be exposed to the hazard? Examples of possible methods include **diking** and **grading**.

    - Has the company made any provisions to control unexpected hazardous vapor or gas releases within the drain lines?

3. Housekeeping

    - Are work areas well maintained?

4. Enclosed spaces

    - Some processes which are safe in open air may become hazardous if enclosed. If areas of potential or frequent leaks or spills are enclosed to prevent environmental contamination or the spread of the chemical, are there adequate precautions to protect employees? Examples include ventilating the room and treating the exhaust; automatically sampling the air in the room or vault; having employees sample before entering the room.

Materials Compatibility

At least two factors should be considered in materials selection: First, will the material(s) contaminate or cause a reaction in the chemicals to be handled or processed? Second, will the chemicals to be processed attack or destroy the equipment? For all chemical processes, there are preferred materials; preferences sometimes are economic, and sometimes they are based on chemical reactivity or compatibility. The intent here is to identify readily available materials that might be used but that are incompatible with the chemicals involved. (For example, copper tubing should not be used with acetylene because it catalyzes a reaction in the acetylene.) These questions are pertinent to chemicals in all categories (i.e., health, flammability, reactivity). Among questions to be asked are:

1. Are any metals incompatible with the chemicals so that they should not be used for process equipment, piping, or storage systems?

2. Are any sealing materials for use in packing (e.g., pumps) or gaskets (e.g., flanges) incompatible with the chemicals so they should not be used in process equipment, piping, or storage systems?

3. If incompatible materials are identified, what procedures does the company have to ensure that only acceptable materials are used in new or refurbished equipment? Besides purchase order specifications, is there also inspection by plant personnel to ensure the specifications were followed?

Contamination Control

Potentially reactive chemicals may have their reactions catalyzed by common materials which easily enter systems whenever seals are opened. Examples include water or rust which may easily enter a system during transfer from one vessel to another, either during hookup or disconnect, or during pressurizing or venting of tanks.

1. If such potential catalysts are identified, how are they excluded from the system? Examples include:

   - If vessels are pressurized by inert gases, are there filters in the gas lines to remove solid particles?

   - If vacuum relief or pressure relief valves are on the vessels, how are they protected so no potentially hazardous contaminant can enter through them when open?

2. When systems are opened for maintenance purposes, what precautions are taken to prevent contamination? What is done to safeguard the system while it is open? What precautions are taken to ensure that replacement parts are free of contaminants and/or incompatible materials? When connections are made and broken (e.g., during transfer from rail cars or trucks), what measures are taken to ensure contaminants do not enter the system?

Physical Facilities

Much plant equipment could be considered ancillary to the production processes. Examples of systems that may need to be present, properly inspected, and functional are:

1. Emergency eye wash or shower.

2. Fixed fire suppression equipment.

3. Portable firefighting equipment, if employees or a fire brigade are to use portable firefighting equipment.

Questions to be asked about these systems include: How often are they tested? What capacity do they have? Is the capacity sufficient for the anticipated emergency?

Inspection and Maintenance

All equipment must be shut down sometime, no matter how infrequently. When safety systems are shut down, what backup systems or procedures are available to provide replacement protection (e.g., stop process until safety systems are available again)? If shutoff valves can isolate safety relief valves, what measures ensure that the system is protected from over-pressurization (e.g., person stationed to monitor pressure)? What system is in place to ensure that maintenance of critical safety features are corrected immediately? What ensures that less critical features are corrected within a reasonable period?

Pressure vessels also need periodic inspection and testing because of normal wear and potential corrosion either at welds or in the base material. The combination of pressure and volume determine the hazard: high volume, low pressure systems can have the same potential energy for release as low volume, high pressure systems.

When potentially corrosive chemicals are used (e.g., acids, caustics), or the plant atmosphere is corrosive (e.g., near the ocean, or from chemical releases within the plant), what measures are taken to ensure system integrity? Examples include periodic pressure testing, x-ray, etc.

General Containment and Controls

During normal operations it is difficult if not impossible to keep a material completely in a closed system. Vacuum must be relieved when a liquid level drops, and pressure must be relieved when the tank is refilled. For toxic, flammable, and reactive chemicals, the questions to be asked focus on minimizing such necessary releases and rendering the released chemicals harmless before discharge to the atmosphere. Examples of questions to be pursued include:

1. Where do emergency relief vents discharge? Are they piped to scrubbers, neutralizers, incinerators, precipitators, etc. to remove hazardous materials?

2. What precautions are taken to minimize spills when connections are broken? Is the line purged prior to the disconnect? Are purge gases treated? Are quick disconnects used? Do employees wear personal protective equipment (PPE) when disconnecting? Is there a dike or some method to collect and contain small spills or releases? Is the area ventilated and is ventilated air treated?

Material Handling

As long as chemicals are maintained in a closed system, they are safe and harmless. Chemical processes using hazardous chemicals should be designed to maintain that closed system. After design and maintenance, the only potential problems are: introduction of raw materials into the closed system and the removal of products (either the desired product for shipment or waste) from the closed systems. This section deals with those hazards.

1. How are raw materials received and shipped?

2. Are raw materials transfers accomplished in a closed system?

   - Who performs transfer (company or shipper)?

   - Is the system pressurized or blanketed?

   - Do critical systems have connections that are not interchangeable? Examples: potable water with process water? water and reactive chemicals? incompatible reactive chemicals?

3. How are unwanted products disposed of:

   - Vents: are vents properly directed?

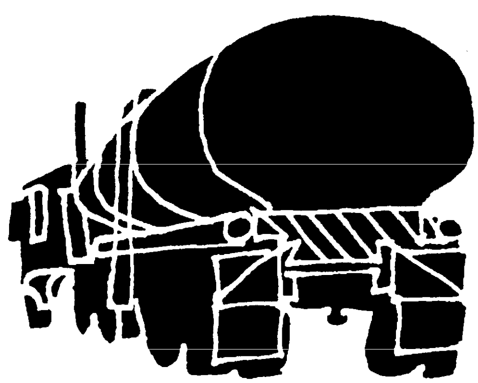
   - Flare towers?

   - Scrubbers?

   - Ditches: properly lined? Where do they drain?

   - Tertiary treatment?

   - Are provisions made or considered to preclude incompatible chemical mixing in waste drainage?



Instrumentation

Suitable controls and instruments should be provided for both normal conditions of operation and for emergencies. Instrumentation includes sensors, indicators, recorders, and transmitters for measurements such as temperature, pressure, flow, liquid level, and analysis.

Many self-acting control devices, such as pressure regulators, normally fail in the open position, which may be the unsafe position. In such cases, emergency backup controls should be provided. In the case of pressure regulators, this includes pressure relieving devices down-stream and automatic shutoff valves interlocked with excess pressure switches.

1. Do instruments and controls consider failure in their design?

   - Examples: Control valves should be arranged so that, on loss of instrument air or actuating power, they will go into the safe position. Where loss of instrument air or power could lead to an unsafe condition, emergency air or power supplies should be provided.

2. Are instruments made of material capable of withstanding the corrosive or erosive conditions to which they are subjected?

3. Do instrument sensors measure the true status of the system they are designed to protect or control?

   - Examples: In a large reactor, many thermocouples may be needed since the temperature may not be uniform throughout. In sensing liquid flow through a pipe, a flow switch in the pipe is more reliable than monitoring power supply to a pump.

4. Are grouped instrument leads and control locations protected against exposure to explosion, fire, or toxic chemicals where they are critically needed to shut down the process safely? In addition to normal controls, are accessible emergency controls provided by which pumps or automatic valves controlling the flow of flammable liquids could be operated in event of fire?

5. Are all indicating dials, indicating lights, recorders, alarms, and switches which affect process safety conspicuously labeled as to their function and meaning?

6. Are instruments constructed and installed so that they can be easily inspected and maintained?

7. Are separate safety control and interlock systems relied upon rather than relying on the production process control system for safety supervision of the process?

8. Are instruments in hazardous areas (as defined in National Electrical Code) intrinsically safe or enclosed so that they will not act as ignition sources?

9. Are critical measurements recorded (as is preferable) rather than merely indicated by lights or dials so that rate of change in processes will be more readily evident, and greater management supervision can be maintained over operator practices?

10. Do important control valves have steel bodies and are they yoked to withstand fire exposure, impact, and vibration?

11. How often is routine maintenance or replacement performed on key instruments?

Piping Systems

Piping and instrument diagrams are used to follow the formulation or reaction process and also to check safety devices and system protections. Questions that may be asked include:

1. Do reaction vessels, storage tanks, or pressure vessels have safety relief devices to prevent over-pressurization?

2. Are there shutoff valves that can render safety relief devices ineffective? If so, what additional precautions are taken?

3. Where do materials vent when released through the safety relief devices?

4. If there is a loss of electrical or pneumatic power, do controls fail in a mode that is safe?

5. Will instrumentation detect leaks and spills? (E.g., when material is being pumped from one vessel to another, is there any check to assure that as the level falls in one vessel, it rises in the other?)

6. Are temperature or liquid level controls or alarms provided?

7. Are piping, valves, and fittings designed according to the recognized standards for the working pressures, temperatures, structural stresses, and chemical conditions to which they may be subjected? Is non-destructive testing conducted routinely to ensure that minimum wall thicknesses are maintained?

8. Is piping well-supported and protected against physical damage?

9. Are pipe lines for reactive chemicals pitched to drain, with drain valves at low points?

10. Are main shutoff valves which can affect the safety of the system conspicuously labeled?

11. Do shutoff valves indicate their "open" or "shut" position?

12. Where improper operations or leaking of valves can lead to hazardous situation, are interlocked valves or double valves and vents used to minimize hazard?

Protective Systems (not quality control)

1. Heating or cooling systems may be for product control or for safety control. Cooling may be necessary to prevent a runaway reaction in reaction vessels. Reactive chemicals also may be cooled in storage to provide more time to respond to an initiated reaction.

   - What protective devices are there for the heating or cooling systems? temperature alarms? backup systems or redundancies? procedural controls?
   - Are heat transfer materials for heating or cooling incompatible with reactive materials?
   - Is refrigeration automatically actuated in emergencies?
   - Are manual valves located in safe areas?
   - Are intermittent power failures considered and backup provisions implemented?

2. Are there explosion suppression systems? How are they tested and maintained?

3. Are systems inerted to exclude contaminants which may be catalysts or reactive materials? Examples include:

   - Passivating vessels and piping or components (before system startup).
   - Providing an inert gas atmosphere such as a nitrogen blanket on flammable materials.
   - Submerging reactive materials (such as sodium in kerosene).

Direct Fired Systems

Do furnaces and heaters have:

1. Adequate draft?
2. Positive fuel ignition?
3. Combustion safeguards?
4. Fuel controls?
5. Water or liquid level indicators?
6. Pressure relief devices?
7. High temperature alarms?
8. Emergency shutoff facilities?
9. Backflow protection?

Electrical Equipment

All wiring and electrical equipment in chemical plants must be installed in accordance with the National Electrical Code. Equipment used must be approved where applicable.

1. Proper installation and maintenance is essential.

2. Adequate clearance or insulation should be provided between conduits and hot surfaces to prevent damage to the wiring insulation.

3. Equipment must be properly grounded and/or bonded in hazardous areas to minimize static electricity, both within and outside of equipment. Are other appropriate steps taken to prevent buildup of a static charge?

4. Equipment should be shielded from lightning by protective ground wires, rods, or masts.

Pressure Vessels and Storage Tanks

The design and construction of pressure vessels and storage tanks must be in accordance with accepted engineering principles.

1. **Pressure vessels** must be designed and constructed in accordance with applicable codes, standards, state and local laws, and regulations.

   - Vessels should be equipped with overpressure protection as required. Vents should be arranged to discharge to a point where ignition of escaping vapors or liquids will not seriously expose personnel, the equipment, or structures. Relief devices should be kept free of corrosion or fouling and should be operable at all times.

   - Often an inert atmosphere is maintained in a vessel or tank to keep the atmosphere out of the flammable range. The consequences of contamination or failure to use an inert gas should be analyzed and equipment or procedures should be devised to cover the situation.

   - Unprotected sight glasses should be avoided in process equipment wherever possible.

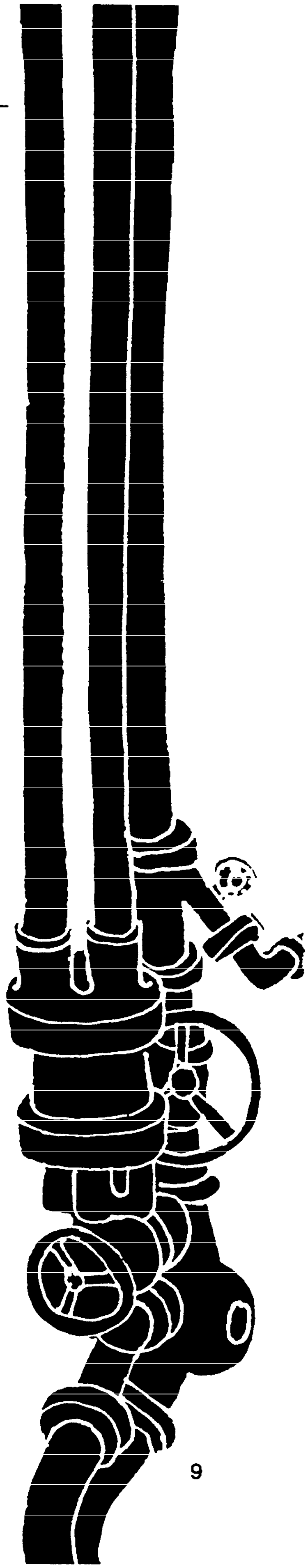
2. **Storage tanks** should be designed based on the quantity, temperature, pressure, reactivity, and corrosiveness of the material stored. The design should include overpressure equipment and vents and should consider the interrelationship of each part of the overall system, e.g., the effect of a gasket which blows out at 25 psi at one point in the system when the relief valves are set at 60 psi.

Pumps and Compressors

Pumps and compressors are the work horses of chemical plants for moving every type of liquid and gas.

1. Failure of moving parts or packing glands can cause escape of flammable or toxic liquids or gases. Remotely controlled switches and shutoff valves are needed to control the flow of fuel in an emergency.

2. Equipment used for transfer of flammable vapors or gases should be installed to minimize vibration and thus to avoid loosening of fittings and joints.



Response to Emergencies

General Principles

Assessing the adequacy of a written emergency plan is an art, not a science. It involves judgment as to the reasonableness of the assumptions underlying the plan (e.g., what is a reasonable worst-case estimate?) as well as the adequacy of countermeasures designed to protect life and to limit environmental and property damage.

A few general principles may be useful in approaching this task:

1. Are the priorities of the plan clearly stated as to—safety of plant personnel and the public? control of hazard? minimizing damage to property?

2. Does the plan deal with reasonable accident scenarios (minor incident to "worst case")?

3. Is the plan practical?

4. Is the plan simple?

5. Is the plan easy to understand?

6. Will it deal with any type of emergency? For example, are contingencies included for: fire and explosion? release of highly toxic materials? large chemical spills? acts of nature? power failure? sabotage including bomb threats, etc.?

7. Has attention been given to emergencies which may occur during inclement weather?

8. Is the plan updated periodically, e.g., annually or whenever processes, materials, procedures, or key personnel change?

9. Are there emergency drills or simulations involving all members of the response team including public agencies?

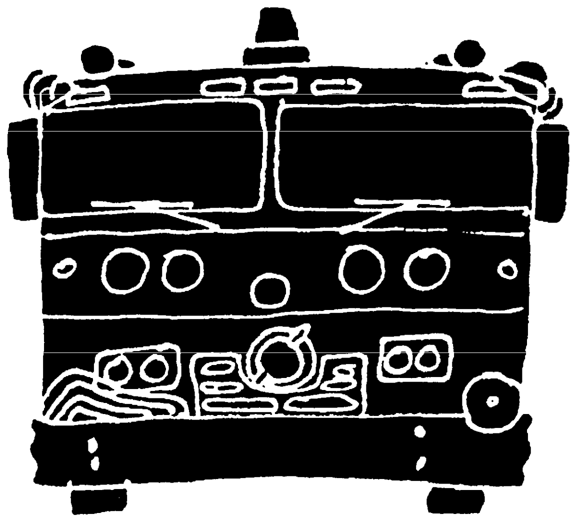
   - Are responses reviewed to determine areas where improvement is needed?

   - How are the results of the drill evaluations communicated to the employees?

   - Are drills conducted for all shifts?

10. Are safety responsibilities a "critical element" in supervisors' performance standards? For example, how is safety performance considered relative to production demands and is it factored into performance appraisals?

11. Has plant management worked with community leaders to develop an appropriate public response plan?



Control and Coordination

When assessing the adequacy of a written emergency plan, questions concerning control and coordination include:

1. Will one person be designated to coordinate all efforts? Is there always an individual onsite who has been trained and has the ability to take the initial actions necessary to minimize the emergency?

2. Has there been prior consideration/coordination of all potential response groups or agencies such that there will not be loss of control due to over- or underresponse?

3. Does the safety committee have oversight relative to the plan? Are employee representatives an integral part of the committee? Are members involved in plant audits? How do they receive feedback on action taken relative to their recommendations?

4. Has the plan been distributed to:

   - All key personnel up and down the company chain of command including employee representatives and the switchboard operator?
   - Police officials?
   - Fire officials and paramedics?
   - Local government?
   - Hospitals and physicians?
   - Mutual aid industries?
   - Utility companies?

5. When changes are made in the emergency plan, have provisions been established to communicate those changes to individuals with a need to know?

6. What mechanisms exist to allow the reporting of unsafe acts or unauthorized employees in high hazard areas?

7. Will a control center be established in a safe location? Alternatively, are process control centers already established in safe locations, with appropriate architecture and support systems?

8. Are procedures in place for notifying transient personnel on the site, such as delivery and shipping services, of an emergency through the most likely site contacts (e.g., shipping, receiving sections)?

9. Are emergency rosters and call out plans developed?

10. Are emergency service listings and phone numbers developed and distributed? Does the switchboard operator have a copy? Do all phones have a brief listing of immediately needed emergency numbers posted on them?

11. Are organizational charts developed and distributed for day-to-day operators and emergency operators?

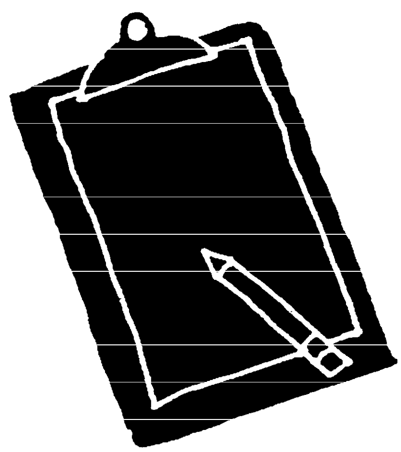
12. Are lists of raw materials, intermediates, products, and their locations within the plant provided with the plan?

    - Are the associated hazardous chemicals listed in accordance with the OSHA Hazard Communication Standard?
    - Are flammable, reactive, physical, radioactive, and other hazards listed?
    - Are appropriate disposal methods listed?

13. Are current maps, flow charts, diagrams, and blueprints part of the plan? overall site map? adjoining city and/or state maps including local topography?

14. Will additional security be needed and planned for?

    - Will strict accountability of personnel entering and leaving the area be maintained?
    - Will only authorized personnel be granted entry?
    - Will traffic control be a problem?
    - Are certain areas of the site more vulnerable to sabotage?



Procedures

The questions concerning the procedures set forth in a written emergency include:

1. Are condensed instructions (such as checklists for evacuation or shutdown) part of the written plan?

2. Are designated duties and alternate duties of each person clearly and briefly described? Are vacations, holidays, weekends, and 2nd and 3rd shift situations considered?

3. Have procedures been established for employees who remain on site to perform critical operations during emergency situations?

4. Have responsibilities and procedures been established for those who are assigned rescue or firefighting duties? Are these employees required to take physical examinations which demonstrate their fitness to perform such duties? If so, how frequently are these examinations administered?

5. If the company has elected to use a fire brigade are the appropriate requirements of 29 CFR 1910.156 being met?

6. What is the company's position on the use and availability of fire extinguishers?

7. Are rescue teams formally trained in search and rescue procedures? Are they familiar with the location of utility disconnects and all evacuation routes? Are they provided with appropriate PPE and trained in first aid/emergency medical treatment? Are they provided with communication equipment? Are rescue/response personnel provided with a properly equipped vehicle(s) to reduce response time?

8. Are documents readily available for reference in an emergency? Are decision logic (decision-making) charts (or other documents) formulated for planning and executing the following activities:

   - Selection of protective clothing?
   - Selection of respiratory protection?
   - Emergency shutdown of equipment?
   - Evacuation of the plant?
   - Evacuation of the surrounding populace?
   - How did management arrive at these decisions?

9. Have definite volumes of air contaminants been established which, when released, trigger either onsite and/or offsite emergencies?

10. Have dispersion models been calculated to assist in planning of evacuation? If not, how does management deal with a hazard that is spreading into new areas of the plant and the community?

11. Are employees or recovery personnel trained and are procedures in place for monitoring the site and adjacent areas to identify levels of contaminants as well as their location (atmosphere/land/water) and direction of travel.

12. Is emergency equipment provided in adequate quantities and placed in useable locations; e.g., emergency power generators for emergency lighting and shutdowns; pumps and valves located for supplying water to fight fires; PPE, safety showers connected to alarms, etc.?

   - Is emergency equipment checked, tested, and calibrated periodically for operational readiness?
   - Are personnel trained and experienced in its use?
   - Is emergency equipment of appropriate type for any emergency which may occur?

13. Are local emergency response personnel brought into the site periodically for familiarization?

   - Are potential problem areas and processes pointed out and discussed?
   - Are locations where personnel normally work pointed out?

14. Are primary and backup two-way communication systems developed and in place? Are they vulnerable to power failure or other disruption? Do ambient plant noise levels interfere with voice communication?

15. Is mutual aid equipment that might be borrowed in an emergency compatible with site equipment?

16. Is there a written spill control plan, e.g., containment, neutralization, disposal, appropriate PPE, etc.?

17. Are incompatibilities of released material anticipated?

18. Are normally innocuous materials likely to become hazardous due to an emergency? For example, any materials which are water reactive would influence the method of firefighting; certain materials when heated release hazardous levels of toxic substances not existing during normal conditions, etc.

19. Are hospitals, physicians, and other medical/paramedical staff provided with:

   - Lists of hazardous chemicals and Material Safety Data Sheets?

- Acute symptoms?
- Delayed symptoms?
- Bioassay tests?
- Special treatment required?

20. Have local health care professionals been involved in the development or review of the plan?

21. Is public information planned and is one person designated as spokesperson to avoid speculation and panic? coordinated with other responding groups?

22. Are there formal accident and near-miss investigation responsibilities and procedures developed? What is the policy on investigating injury versus non-injury accidents? Are reports required? Are causal analyses performed?

23. Has any consideration been given to potential sewer contamination during an emergency/disaster, e.g., introduction of flammable/explosive or toxic materials into the system?

Recordkeeping Requirements

The Secretary of Labor has said that "the cornerstone of any successful, effective safety and health program is accurate and complete recordkeeping." Because of its importance, OSHA places special importance on recordkeeping.

Employers of 11 or more employees must maintain records of occupational injuries, illnesses, and deaths as they occur. The purposes of keeping such records are to inform employees of the effectiveness of their employer's safety and health program, to permit the Bureau of Labor Statistics (BLS) to complete survey material, and to help define hazardous industries.

In addition, while the following items are not required for all OSHA standards, they should be recorded to accurately monitor and assess occupational hazards.

Initial and periodic monitoring, including the date of measurement, operation involving exposure, sampling and analytical methods used and evidence of their accuracy; number, duration, and results of samples taken; type of respiratory protective devices worn; and name, social security number, and the results of all employee exposure measurements. This record should be kept for 30 years.

Employee physical/medical examinations, including the name and social security number of the employee; physician's written opinions; any employee medical complaints related to exposure to toxic substances; and information provided to the examining physician. These records should be maintained for the duration of employment plus 30 years.

Employee Training. These records should be kept for one year beyond the last date of employment by that employee.

All records should be made available, upon request, to the OSHA Assistant Secretary, the Director of NIOSH, affected employees, former employees, and designated representatives.

Training

An adequate emergency plan will address a training program. The following questions apply:

1. Are supervisors trained periodically? Are front line supervisors and employees involved in plan review and development in their areas?

2. Have employees and front line supervisors been trained in the recognition of early warning signs (e.g., unusual odors or sounds, signs and symptoms of exposure, unusual vessel temperature or pressure readings, leaks, vibration, etc.)?

3. Is safety and emergency plan training provided to all new employees and all other employees who assume a new job? How often is emergency response training repeated?

4. Are front line supervisors involved in training employees? To what extent?

5. Is there a method to evaluate training?

6. Are contractors who come on site required to undergo specific training in hazards and precautions?

Evacuation

It is essential that an effective plan for evacuation of an area during an emergency situation be included in the overall written emergency plan. Questions concerning this aspect of the plan include:

1. Are decision logic charts available such that supervisors on each shift could make an informed decision to evacuate the site?

2. Are decision logic charts available such that the supervisors on each shift could provide local authorities the information necessary to decide when to evacuate the surrounding population?

3. Has cooperation of the local weather bureau been coordinated to predict temperature, winds, inversion levels, and other meteorologic conditions that could affect gas or vapor concentrations?

4. Are formulas or dispersion models provided for calculating concentrations of air contaminants down wind?

5. Have evacuation routes inside and outside the plant been planned and coordinated with local authorities?

   - Have employees and the local populace been informed of the routes to be used?

   - Are primary and alternate evacuation routes clearly indicated in the plan?

6. Are detection and alarm systems provided, e.g., for fire or toxic release?

   - Are there any periodic checks to ensure that detection and alarm systems are maintained in operable conditions?

   - Do alarm systems meet the requirements, as appropriate, of 29 CFR 1910.165?

7. Are evacuation instructions and signals for evacuation clear and understood by employees and by the surrounding populace?

8. Have provisions been made for the evacuation of handicapped persons?

9. Have "safe distances" been considered when regrouping areas were designated?

10. Have evacuation wardens been designated?

11. Are supervisors on each shift capable of executing the entire plan on their own?

12. Are employees instructed to proceed to regrouping points located cross wind from the contaminant's source and at a "safe distance" from the danger zone? Are the regrouping points well known by employees? Have restrictive topographical conditions been considered?

    - Is there a wind sock or wind vane on the site to determine wind direction?

    - Is a complete copy of the emergency plan located in a safe place?

    - Are adequate supplies and equipment located at these points?

    - Are key personnel designated to make accountability checks at the regrouping points and to report the medical conditions of those present and the names of those missing?

    - Are adequate communication systems available at these points?

Reentry and Cleanup

When evaluating plans for reentry and cleanup of an area which has been evacuated due to an emergency situation, the following questions should be considered:

1. Will safe levels for reentry be determined through environmental sampling by competent persons?

2. Are chemical residues likely to present a hazard?

3. Could the disaster have created unstable chemicals?

4. Are "booby traps" likely to be present from the incident?

   - Hangup?

   - Unstable structures?

   - Developed pressure in pipes, vessels, containers, and pumps?

5. Are employees qualified to do cleanup tasks? Will greater hazards likely result from attempting to maintain their employment rather than with contract companies who are experienced in the required tasks?

6. How is equipment decontaminated?

7. Is critical safety equipment on hand prior to startup operations?

APPENDIX I

Toxic Chemicals

The following list was developed as part of an international effort to identify chemical hazards. OSHA adopted the list as published in 1985 by the International Labor Organization as an aid in ranking hazards for inspection targeting purposes.

1. 4-Aminodiphenyl
2. Benzidine
3. Benzidine salts
4. Dimethylnitrosamine
5. 2-Naphthylamine
6. Beryllium (powders, compounds)
7. Bis(chloromethyl)ether
8. 1,3-Propanesultone
9. 2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
10. Arsenic pentoxide, Arsenic (V) acid and salts
11. Arsenic trioxide, Arsenious (III) acid and salts
12. Arsenic hydride (Arsine)
13. Dimethylcarbamoyl chloride
14. 4-(Chloroformyl) morpholine
15. Carbonyl chloride (Phosgene)
16. Chlorine
17. Hydrogen sulphide
18. Acrylonitrile
19. Hydrogen cyanide
20. Carbon disulphide
21. Bromine
22. Ammonia
23. Acetylene (Ethyne)
24. Hydrogen
25. Ethylene oxide
26. Propylene oxide
27. 2-Cyanopropan-2-ol (Acetone cyanohydrin)
28. 2-Propenal (Acrolein)
29. 2-Propen-1-ol (Allyl alcohol)
30. Allylamine
31. Antimony hydride (Stibine)
32. Ethyleneimine
33. Formaldehyde (concentration≥90%)
34. Hydrogen phosphide (Phosphine)
35. Bromomethane (Methyl bromide)
36. Methyl isocyanate
37. Nitrogen oxides
38. Sodium selenite
39. Bis(2-chloroethyl) sulphide
40. Phosacetim
41. Tetraethyl lead
42. Tetramethyl lead
43. Promurit (1-(3,4-Dichlorophenyl) -3-triazenethio-carboxamide)
44. Chlorfenvinphos
45. Crimidine
46. Chloromethyl methyl ether
47. Dimethyl phosphoramidocyanidic acid
48. Carbophenothion
49. Dialifos
50. Cyanthoate
51. Amiton
52. Oxydisulfoton
53. OO-Diethyl S-ethylsulphinylmethyl phosphorothioate
54. OO-Diethyl S-ethylsulphonylmethyl phosphorothioate
55. Disulfoton
56. Demeton
57. Phorate
58. OO-Diethyl S-ethylthiomethyl phosphorothioate
59. OO-Diethyl S-isopropylthiomethyl phosphorodithioate
60. Pyrazoxon
61. Pensulfothion
62. Paraoxon (Diethyl 4-nitrophenyl phosphate)
63. Parathion
64. Azinphos-ethyl
65. OO-Diethyl S-propylthiomethyl phosphorodithioate
66. Thionazin
67. Carbofuran
68. Phosphamidon
69. Tirpate (2,4-Dimethyl-1,3-dithiolane-2-carboxaldehydeO- methylcarbamoyloxime
70. Mevinphos
71. Parathion-methyl
72. Azinphos-methyl
73. Cycloheximide
74. Diphacinone
75. Tetramethylenedisulphotetramine
76. EPN
77. 4-Fluorobutyric acid
78. 4-Fluorobutyric acid, salts
79. 4-Fluorobutyric acid, esters
80. 4-Fluorobutyric acid, amides
81. 4-Fluorocrotonic acid
82. 4-Fluorocrotonic acid, salts
83. 4-Fluorocrotonic acid, esters
84. 4-Fluorocrotonic acid, amides
85. Fluoroacetic acid
86. Fluoroacetic acid, salts
87. Fluoroacetic acid, esters
88. Fluoroacetic acid, amides
89. Fluenetil
90. 4-Fluoro-2-hydroxybutyric acid
91. 4-Fluoro-2-hydroxybutyric acid, salts
92. 4-Fluoro-2-hydroxybutyric acid, esters

93. 4-Fluoro-2-hydroxybutyric acid, amides
94. Hydrogen fluoride
95. Hydroxyacetonitrile (Glycolonitrile)
96. 1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin
97. Isodrin
98. Hexamethylphosphoramide
99. Juglone (5-Hydroxynaphtalene-1,4-dione)
100. Warfarin
101. 4,4'-Methylenebis (2-chloroaniline)
102. Ethion
103. Aldicarb
104. Nickel tetracarbonyl
105. Isobenzan
106. Pentaborane
107. 1-Propen-2-chloro-1,3-diol-diacetate
108. Propyleneimine
109. Oxygen difluoride
110. Sulphur dichloride
111. Selenium hexafluoride
112. Hydrogen selenide
113. TEPP
114. Sulfotep
115. Dimefox
116. 1-Tri(cyclohexyl)stannyl-1H-1,2,4-triazole
117. Triethylenemelamine
118. Cobalt (powders, compounds)
119. Nickel (powders, compounds)
120. Anabasine
121. Tellurium hexafluoride
122. Trichloromethanesulphenyl chloride
123. 1,2-Dibromoethane (Ethylene dibromide)
124. Flammable substances as defined in Annex IV (c)(i)
125. Flammable substances as defined in Annex IV (c)(ii)
126. Diazodinitrophenol
127. Diethylene glycol dinitrate
128. Dinitrophenol, salts
129. 1-Guanyl-4-nitrosaminoguanyl-1-tetrazene
130. Bis (2,4,6-trinitrophenyl)amine
131. Hydrazine nitrate
132. Nitroglycerine
133. Pentaerythritol tetranitrate
134. Cyclotrimethylene trinitramine
135. Trinitroaniline
136. 2,4,6-Trinitroanisole
137. Trinitrobenzene
138. Trinitrobenzoic acid
139. Chlorotrinitrobenzene
140. N-Methyl-N,2,4,6-N-tetranitroaniline
141. 2,4,6-Trinitrophenol (Picric acid)
142. Trinitrocresol
143. 2,4,6-Trinitrophenetole
144. 2,4,6-Trinitroresorcinol (Styphnic acid)
145. 2,4,6-Trinitrotoluene
146. Ammonium nitrate [1]
147. Cellulose nitrate (containing > 12.6% nitrogen)
148. Sulphur dioxide
149. Hydrogen chloride (liquified gas)
150. Flammable substances as defined in Annex IV (c)(iii)
151. Sodium chlorate [1]
152. tert-Butyl peroxyacetate (concentration ≥ 70%)
153. tert-Butyl peroxyisobutyrate (concentration≥80%)
154. tert-Butyl peroxymaleate (concentration ≥ 80%)
155. tert-Butyl peroxy isopropyl carbonate (concentration≥80%)
156. Dibenzyl peroxydicarbonate (concentration≥90%)
157. 2,2-Bis (tert-butylperoxy) butane (concentration≥ 70%)
158. 1,1-Bis (tert-butylperoxy) cyclohexane (concentration≥ 80%)
159. Di-sec-butyl peroxydicarbonate (concentration ≥80%)
160. 2,2-Dihydroperoxypropane (concentration ≥ 30%)
161. Di-n-propyl peroxydicarbonate (concentration ≥80%)
162. 3,3,6,6,9,9-Hexamethyl-1,2,4,5-tetroxacyclononane(concentration ≥ 75%)
163. Methyl ethyl ketone peroxide (concentration ≥60%)
164. Methyl isobutyl ketone peroxide (concentration≥ 60%)
165. Peracetic acid (concentration ≥ 60%)
166. Lead azide
167. Lead 2,4-6-trinitroresorcinoxide (Lead styphnate)
168. Mercury fulminate
169. Cyclotetramethylenetetranitramine
170. 2,2',4,4',6,6'-Hexanitrostilbene
171. 1,3,5-Triamino-2,4,6-Trinitrobenzene
172. Ethylene glycol dinitrate
173. Ethyl nitrate
174. Sodium picramate
175. Barium azide
176. Di-isobutyryl peroxide (concentration ≥ 50%)
177. Diethyl peroxydicarbonate (concentration ≥ 30%)
178. tert-Butyl peroxypivalate (concentration ≥ 77%)

[1] Where this substance is in a state which gives it properties capable of creating a major-accident hazard.

APPENDIX II

Acutely Toxic Chemicals

The Environmental Protection Agency published this comprehensive list of acutely toxic chemicals in November, 1985 to help identify hazardous chemicals in use in the United States. This alphabetical list contains the chemical name as well as the Chemical Abstract Service (CAS) number.

Common Name	CAS Number
Acetone cyanohydrin	00075-86-5
Acetone thiosemicarbazide	01752-30-3
Acrolein	00107-02-8
Acrylyl chloride	00814-68-6
Aldicarb	00116-06-3
Aldrin	00309-00-2
Allyl alcohol	00107-18-6
Allylamine	00107-11-9
Aluminum phosphide	20859-73-8
Aminopterin	00054-62-6
Amiton	00078-53-5
Amiton oxalate	03734-97-2
Ammonium chloroplatinate	16919-58-7
Amphetamine	00300-62-9
Aniline, 2,4,6-trimethyl-	00088-05-1
Antimony pentafluoride	07783-70-2
Antimycin A	01397-94-0
Antu	00086-88-4
Arsenic pentoxide	01303-28-2
Arsenous oxide	01327-53-3
Arsenous trichloride	07784-34-1
Arsine	07784-42-1
Azinphos-ethyl	02642-71-9
Azinphos-methyl	00086-50-0
Bacitracin	01405-87-4
Benzal chloride	00098-87-3
Benzenamine, 3-(trifluoromethyl)-	00098-16-8
Benzene, 1-(chloromethyl)-4-nitro-	00100-14-1
Benzenearsonic acid	00098-05-5
Benzenesulfonyl chloride	00098-09-9
Benzotrichloride	00098-07-7
Benzyl chloride	00100-44-7
Benzyl cyanide	00140-29-4
Bicyclo[2.2.1]heptane-2-carbonitrile, 5-chloro...	15271-41-7
Bis(chloromethyl) ketone	00534-07-6
Bitoscanate	04044-65-9
Boron trichloride	10294-34-5
Boron trifluoride	07637-07-2
Boron trifluoride compound with methyl ether (1:1)	00353-42-4
Bromadiolone	28772-56-7
Butadiene	00106-99-0
Butyl isovalerate	00109-19-3
Butyl vinyl ether	00111-34-2
C.I. basic green 1	00633-03-4
Cadmium oxide	01306-19-0
Cadmium stearate	02223-93-0
Calcium arsenate	07778-44-1
Camphechlor	08001-35-2
Cantharidin	00056-25-7
Carbachol chloride	00051-83-2
Carbamic acid, methyl-, o-[[(2,4-dimethyl...	26419-73-8
Carbofuran	01563-66-2
Carbophenothion	00786-19-6
Carvone	02244-16-8
Chlordane	00057-74-9
Chlorfenvinfos	00470-90-6
Chlorine	07782-50-5
Chlormephos	24934-91-6
Chlormequat chloride	00999-81-5
Chloroacetaldehyde	00107-20-0
Chloroacetic acid	00079-11-8
Chloroethanol	00107-07-3
Chloroethyl chloroformate	00627-11-2
Chloromethyl ether	00542-88-1
Chloromethyl methyl ether	00107-30-2
Chlorophacinone	03691-35-8
Chloroxuron	01982-47-4
Chlorthiophos	21923-23-9
Chromic chloride	10025-73-7
Cobalt	07440-48-4
Cobalt carbonyl	10210-68-1
Cobalt, [[2,2'-[1,2-ethanediylbis (nitrilomethy...	62207-76-5
Colchicine	00064-86-8
Coumafuryl	00117-52-2
Coumaphos	00056-72-4
Coumatetralyl	05836-29-3
Cresylic acid	00095-48-7
Crimidine	00535-89-7
Crotonaldehyde	00123-73-9
Crotonaldehyde	04170-30-3
Cyanogen bromide	00506-68-3
Cyanogen iodide	00506-78-5
Cyanophos	02636-26-2
Cyanuric fluoride	00675-14-9
Cycloheximide	00066-81-9
Cyclopentane	00287-92-3
Decaborane(14)	17702-41-9
Demeton	08065-48-3
Demeton-S-methyl	00919-86-8
Dialifos	10311-84-9
Diborane	19287-45-7
Dibutyl phthalate	00084-74-2
Dichlorobenzalkonium chloride	08023-53-8
Dichloroethyl ether	00111-44-4

Dichloromethylphenylsilane	00149-74-6	Fluoroacetyl chloride	00359-06-8
Dichlorvos	00062-73-7	Fluorouracil	00051-21-8
Dicrotophos-	00141-66-2	Fonofos	00944-22-9
Diepoxybutane	01464-53-5	Formaldehyde cyanohydrin	00107-16-4
Diethyl chlorophosphate	00814-49-3	Formetanate	23422-53-9
Diethyl-p-phenylenediamine	00093-05-0	Formothion	02540-82-1
Diethylcarbamazine citrate	01642-54-2	Formparanate	17702-57-7
Digitoxin	00071-63-6	Fosthietan	21548-32-3
Diglycidyl ether	02238-07-5	Fuberidazole	03878-19-1
Digoxin	20830-75-5	Furan	00110-00-9
Dimefox	00115-26-4	Gallium trichloride	13450-90-3
Dimethoate	00060-51-5	Hexachlorocyclopentadiene	00077-47-4
Dimethyl phosphorochloridothioate	02524-03-0	Hexachloronaphthalene	01335-87-1
Dimethyl phthalate	00131-11-3	Hexamethylenediamine, N,N'-dibutyl-	04835-11-4
Dimethyl sulfate	00077-78-1	Hydrazine	00302-01-2
Dimethyl sulfide	00075-18-3	Hydrocyanic acid	00074-90-8
Dimethyl-p-phenylenediamine	00099-98-9	Hydrogen fluoride	07664-39-3
Dimethyldichlorosilane	00075-78-5	Hydrogen selenide	07783-07-5
Dimethylhydrazine	00057-14-7	Indomethacin	00053-86-1
Dimetilan	00644-64-4	Iridium tetrachloride	10025-97-5
Dinitrocresol	00534-52-1	Iron, pentacarbonyl-	13463-40-6
Dinoseb	00088-85-7	Isobenzan	00297-78-9
Dinoterb	01420-07-1	Isobutyronitrile	00078-82-0
Dioctyl phthalate	00117-84-0	Isocyanic acid, 3,4-dichlorophenyl ester	00102-36-3
Dioxathion	00078-34-2	Isodrin	00465-73-6
Dioxolane	00646-06-0	Isofluorphate	00055-91-4
Diphacinone	00082-66-6	Isophorone diisocyanate	04098-71-9
Diphosphoramide, octamethyl-	00152-16-9	Isopropyl chloroformate	00108-23-6
Disulfoton	00298-04-4	Isopropyl formate	00625-55-8
Dithiazanine iodide	00514-73-8	Isopropylmethylpyrazolyl dimethylcarbamate	00119-38-0
Dithiobiuret	00541-53-7	Lactonitrile	00078-97-7
EPN	02104-64-5	Leptophos	21609-90-5
Emetine, dihydrochloride	00316-42-7	Lewisite	00541-25-3
Endosulfan	00115-29-7	Lindane	00058-89-9
Endothion	02778-04-3	Lithium hydride	07580-67-8
Endrin	00072-20-8	Malononitrile	00109-77-3
Ergocalciferol	00050-14-6	Manganese, tricarbonyl methylcyclopentadienyl	12108-13-3
Ergotamine tartrate	00379-79-3	Mechlorethamine	00051-75-2
Ethanesulfonyl chloride, 2-chloro-	01622-32-8	Mephosfolan	00950-10-7
Ethanol, 1,2-dichloro-, acetate	10140-87-1	Mercuric acetate	01600-27-7
Ethion	00563-12-2	Mercuric chloride	07487-94-7
Ethoprophos	13194-48-4	Mercuric oxide	21908-53-2
Ethyl thiocyanate	00542-90-5	Mesitylene	00108-67-8
Ethylbis(2-chloroethyl)amine	00538-07-8	Methacrolein diacetate	10476-95-6
Ethylene fluorohydrin	00371-62-0	Methacrylic anhydride	00760-93-0
Ethylenediamine	00107-15-3	Methacrylonitrile	00126-98-7
Ethyleneimine	00151-56-4	Methacryloyl chloride	00920-46-7
Ethylmercuric phosphate	02235-25-8	Methacryloyloxyethyl isocyanate	30674-80-7
Fenamiphos	22224-92-6	Methamidophos	10265-92-6
Fenitrothion	00122-14-5	Methanesulfonyl fluoride	00558-25-8
Fensulfothion	00115-90-2	Methidathion	00950-37-8
Fluenetil	04301-50-2	Methiocarb	02032-65-7
Fluorine	07782-41-4	Methomyl	16752-77-5
Fluoroacetamide	00640-19-7	Methoxyethylmercuric acetate	00151-38-2
Fluoroacetic acid	00144-49-0		

Methyl 2-chloroacrylate	00080-63-7
Methyl chloroformate	00079-22-1
Methyl disulfide	00624-92-0
Methyl isocyanate	00624-83-9
Methyl isothiocyanate	00556-61-6
Methyl mercaptan	00074-93-1
Methyl phenkapton	03735-23-7
Methyl phosphonic dichloride	00676-97-1
Methyl thiocyanate	00556-64-9
Methyl vinyl ketone	00078-94-4
Methylhydrazine	00060-34-4
Methylmercuric dicyanamide	00502-39-6
Methyltrichlorosilane	00075-79-6
Metolcarb	01129-41-5
Mevinphos	07786-34-7
Mexacarbate	00315-18-4
Mitomycin C	00050-07-7
Monocrotophos	06923-22-4
Muscimol	02763-96-4
Mustard gas	00505-60-2
Nickel	07440-02-2
Nickel carbonyl	13463-39-3
Nicotine	00054-11-5
Nicotine sulfate	00065-30-5
Nitric acid	07697-37-2
Nitric oxide	10102-43-9
Nitrocyclohexane	01122-60-7
Nitrogen dioxide	10102-44-0
Nitrosodimethylamine	00062-75-9
Norbormide	00991-42-4
Organorhodium complex	PMN-82-147
Orotic acid	00065-86-1
Osmium tetroxide	20816-12-0
Ouabain	00630-60-4
Oxamyl	23135-22-0
Oxetane, 3,3-bis(chloromethyl)	00078-71-7
Oxydisulfoton	02497-07-6
Ozone	10028-15-6
Paraquat	01910-42-5
Paraquat methosulfate	02074-50-2
Parathion	00056-38-2
Parathion-methyl	00298-00-0
Paris green	12002-03-8
Pentaborane	19624-22-7
Pentachloroethane	00076-01-7
Pentachlorophenol	00087-86-5
Pentadecylamine	02570-26-5
Peracetic acid	00079-21-0
Perchloromethylmercaptan	00594-42-3
Phenarsazine oxide	00058-36-6
Phenol	00108-95-2
Phenol, 2,2'-thiobis(4-chloro-6-methyl-	04418-66-0
Phenol, 2,2'-thiobus[4,6-dichloro-	00097-18-7
Phenol, 3-(1-methylethyl)-, methylcarbamate	00064-00-6
Phenyl dichloroarsine	00696-28-6

Phenylhydrazine hydrochloride	00059-88-1
Phenylmercury acetate	00062-38-4
Phenylsilatrane	02097-19-0
Phenylthiourea	00103-85-5
Phorate	00298-02-2
Phosacetim	04104-14-7
Phosfolan	00947-02-4
Phosmet	00732-11-6
Phosphamidon	13171-21-6
Phosphine	07803-51-2
Phosphonothioic acid, methyl-, O-(4-nitrophenyl...	02665-30-7
Phosphonothioic acid, methyl-, O-ethyl O-[4-...	02703-13-1
Phosphonothioic acid, methyl-,S-[2-[bis...	50782-69-9
Phosphoric acid, dimethyl 4-(methylthio)phenyl...	03254-63-5
Phosphorous trichloride	07719-12-2
Phosphorus	07723-14-0
Phosphorus oxychloride	10025-87-3
Phosphorus pentachloride	10026-13-8
Phosphorus pentoxide	01314-56-3
Phylloquinone	00084-80-0
Physostigmine	00057-47-6
Physostigmine, salicylate (1:1)	00057-64-7
Picrotoxin	00124-87-8
Piperidine	00110-89-4
Piprotal	05281-13-0
Pirimifos-ethyl	23505-41-1
Platinous chloride	10025-65-7
Platinum tetrachloride	13454-96-1
Potassium arsenite	10124-50-2
Potassium cyanide	00151-50-8
Potassium silver cyanide	00506-61-6
Promecarb	02631-37-0
Propargyl bromide	00106-96-7
Propiolactone, .beta.-	00057-57-8
Propionitrile	00107-12-0
Propionitrile, 3-chloro-	00542-76-7
Propyl chloroformate	00109-61-5
Propylene glycol, allyl ether	01331-17-5
Propyleneimine	00075-55-8
Prothoate	02275-18-5
Pseudocumene	00095-63-6
Pyrene	00129-00-0
Pyridine, 2-methyl-5-vinyl-	00140-76-1
Pyridine, 4-amino-	00504-24-5
Pyridine, 4-nitro-, 1-oxide	01124-33-0
Pyriminil	53558-25-1
Rhodium trichloride	10049-07-7
Salcomine	14167-18-1
Sarin	00107-44-8
Selenium oxychloride	07791-23-3
Selenous acid	07783-00-8
Semicarbazide hydrochloride	00563-41-7
Silane, (4-aminobutyl)diethoxymethyl-	03037-72-7

Sodium anthraquinone-1-sulfonate	00128-56-3
Sodium arsenate	07631-89-2
Sodium arsenite	07784-46-5
Sodium azide (Na(N3))	26628-22-8
Sodium cacodylate	00124-65-2
Sodium cyanide (Na(CN))	00143-33-9
Sodium fluoroacetate	00062-74-8
Sodium pentachlorophenate	00131-52-2
Sodium selenate	13410-01-0
Sodium selenite	10102-18-8
Sodium tellurite	10102-20-2
Strychnine	00057-24-9
Strychnine, sulfate	00060-41-3
Sulfotep	03689-24-5
Sulfoxide, 3-chloropropyl octyl	03569-57-1
Sulfur tetrafluoride	07783-60-0
Sulfur trioxide	07446-11-9
Sulfuric acid	07664-93-9
TEPP	00107-49-3
Tabun	00077-81-6
Tellurium	13494-80-9
Tellurium hexafluoride	07783-80-4
Terbufos	13071-79-9
Tetraethyllead	00078-00-2
Tetraethyltin	00597-64-8
Tetranitromethane	00509-14-8
Thallic oxide	01314-32-5
Thallous carbonate	06533-73-9
Thallous chloride	07791-12-0
Thallous malonate	02757-18-8
Thallous sulfate	07446-18-6
Thallous sulfate	10031-59-1
Thiocarbazide	02231-57-4
Thiocyanic acid, (2-benzothiazolylthio) methyl...	21564-17-0
Thiofanox	39196-18-4
Thiometon	00640-15-3
Thionazin	00297-97-2
Thiophenol	00108-98-5
Thiosemicarbazide	00079-19-6
Thiourea, (2-chlorophenyl)-	05344-82-1
Thiourea, (2-methylphenyl)-	00614-78-8
Titanium tetrachloride	07550-45-0
Toluene 2,4-diisocyanate	00584-84-9
Toluene 2,6-diisocyanate	00091-08-7
Triamiphos	01031-47-6
Triazofos	24017-47-8
Trichloro(chloromethyl)silane	01558-25-4
Trichloro(dichlorophenyl)silane	27137-85-5
Trichloroacetyl chloride	00076-02-8
Trichloroethylsilane	00115-21-9
Trichloronate	00327-98-0
Trichlorophenylsilane	00098-13-5
Trichlorphon	00052-68-6
Triethoxysilane	00998-30-1
Trimethylchlorosilane	00075-77-4
Trimethylolpropane phosphite	00824-11-3
Trimethyltin chloride	01066-45-1
Triphenyltin chloride	00639-58-7
Tris(2-chloroethyl)amine	00555-77-1
Valinomycin	02001-95-8
Vanadium pentoxide	01314-62-1
Vinylnorbornene	03048-64-4
Warfarin	00081-81-2
Warfarin sodium	00129-06-6
Xylylene dichloride	28347-13-9
Zinc phosphide	01314-84-7
Zinc,dichloro[4,4-dimethyl-5-[[[(methylamino)...	58270-08-9
Trans-1,4-Dichlorobutene	00110-57-6

☆U.S. G.P.O. 1987- 181-519:64210

Related Publications

BLS Publication 412-3 - What Every Employer Needs to Know About OSHA Recordkeeping

OSHA 3084 - Chemical Hazard Communication

OSHA 3047 - Comsultation Services for the Employer

OSHA 3088 - How to Prepare for Workplace Emergencies

OSHA 3077 - Personal Protective Equipment

OSHA 3079 - Respiratory Profection

Hazard Communication Regional Coordinators

Region	HCS Coordinator	Telephone
Boston	Joseph Normand	617-223-6710
New York	Cathic Mannion	212-944-3432
Philadelphia	James Johnston	215-596-1201
Atlanta	Charles Anderson	404-347-3573
Chicago	Kenneth Yotz	312-353-2220
Dallas	Dean McDaniel	214-767-4731
Kansas City	Mary Marphy	816-374-5861
Denver	John Healy	303-837-3061
San Francisco	Dean Ikeda	414-556-0585
Seattle	Carl Halgren	206-442-5930

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Occupational Safety and Health Administration
Regional Offices

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Region III
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Region IV
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*These States and territories operate their own OSHA-approved job safety and health programs (except Connecticut and New York whose plans cover public employees only).