American Industrial Hygiene Association Journal
Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/aiha20

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Version of record first published: 04 Jun 2010.

To cite this article: JAMES S. FERGUSON & WILLIAM F. MARTIN (1985): An Overview of Occupational Safety and Health Guidelines for Superfund Sites, American Industrial Hygiene Association Journal, 46:4, 175-180

To link to this article: http://dx.doi.org/10.1080/15298668591394617

Am. Ind. Hyg. Assoc. J. 46(4):175-180 (1985)

An Overview of Occupational Safety and Health Guidelines for Superfund Sites

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An overview of the NIOSH occupational safety and health guidelines for Superfund activities is presented. Critical elements are outlined for site safety plans, site surveys and monitoring plans. The gathering of accurate and adequate information to prepare a plan of action to clean up abandoned hazardous waste sites is the first step and continues throughout any Superfund activity. Major emphasis is placed on selecting personal protective equipment with consideration for preventing heat stress. Decontamination is stressed to prevent exposure of other site workers as well as off-site personnel and the public. Worker training and medical monitoring are key components in a comprehensive occupational safety and health program for hazardous waste workers.

Introduction

This is an overview of the occupational safety and health guidelines that the National Institute for Occupational Safety and Health (NIOSH), in cooperation with the Environmental Protection Agency (EPA), the Occupational Safety and Health Administration (OSHA), and the United States Coast Guard (USCG) have developed for Superfund activities. The guidelines have been under development for two years. The manual *Occupational Safety and Health for Superfund Activities*, currently is scheduled to be completed in 1985. The current topics included by chapters in the manual are:

1 Introduction
2 Hazards
3 Planning
4 Training
5 Medical Monitoring
6 Site Characterization
7 Air Monitoring
8 Personal Protective Equipment
9 Site Control
10 Decontamination
11 Handling Drums and Containers
12 Emergency Response Program
Appendix

The manual provides the framework for an occupational safety and health program for Superfund sites. Several chapters give very specific technical details on selected health and safety topics. The manual is organized in a logic sequence as if a hazardous waste emergency or abandoned hazardous waste site has just been brought to the attention of the state official. These guidelines should help the official to protect the workers that will be employed in the Superfund activity. This presentation will summarize the health and safety recommendations contained in the guidance manual. Start with the gathering of information before going to the site, develop a site safety plan for protecting the workers and train the workers. One of the important problems that will be recognized throughout this presentation is that professional decisions must be made with limited factual data.

Site Safety Plan

A safety plan must be developed to prevent injury and/or exposure to hazardous substances. Safety requirements for site operations must be designed not only to protect personnel against chemical hazards, but also to minimize accidents and injuries that occur during daily activities such as operating heavy equipment or working in confined spaces. The safety plan should also provide measures to minimize accidents and injuries resulting from adverse conditions such as hot or cold weather, sharp objects, uneven surfaces, pits, explosive environments, *etc.* A *written* safety plan should be developed for each site. The plan should identify key personnel and cover all phases of work. Procedures for both normal work and emergency actions should be specified.

In order to protect workers during hazardous waste cleanup operations, a site specific safety plan should be developed and implemented. The foundation of this plan is reliable information. Sufficient amounts of accurate data need to be obtained so that potential hazards at the site can be identified. Information gathering and evaluation continues through all phases of the operation; however, it is especially important to gather as much data as possible during the preparation phase before cleanup action begins. The site records such as waste inventories, manifests and disposal records can be very useful if available. Other sources of information, such as previous investigation reports by other individuals, adjacent property owner complaints, local newspaper reports and sanitation and public health complaints can add valuable information. Displaying the pieces of information on a map or aerial photo of the area is an excellent way to organize the information for decision making and future progress reporting.

A visual examination of the site from vantage points that are upwind but near enough to identify access routes and problem areas can be very useful before entering the site. The information obtained, in addition to the information from the records and background sources, will be used initially to define what types of:

- Screening and sampling procedures should be used on-site.
- Safety procedures and levels of protective equipment will be needed for the initial site entry.

The site should be examined for the following items, (their presence and any details observed should be recorded in notes and/or on the site map):

1. Location and conditions of drums, tanks, barrels, ponds, trenches, buildings and physical features.
2. Biological indicators such as dead or stressed vegetation, dead animals, fish, and insects.
3. Signs of possible physical and chemical reactions such as changes in waste color/state/condition, odors, and bulging drums.

The initial site survey is generally made to accomplish the following objectives:

1. Confirm the existence of a suspected hazardous situation.
2. Verify existing information about the site.
3. Characterize the hazards.
4. Determine mitigation actions.
5. Refine the safety requirements for personnel.
6. Determine types of sampling and analytical methods.

During the initial site-survey, chemical screening is the most common procedure performed at hazardous waste sites. Screening tests often utilize fairly inexpensive and reasonably available instrumentation (such as combustible gas meters, OVA, H-Nu, and detector tubes) which the state or local personnel have adequate training to operate. The primary purpose of chemical screening is to gather sufficient data to determine: 1) if a potential hazard exists, 2) if further testing is required, 3) the types of additional tests needed and 4) personal protective equipment needs for additional site work.

During the initial site survey, team members should be sure to complete the following tasks:

1. Identify conditions that are immediately dangerous to life or health (IDLH). IDLH conditions include: 1) explosive environments, 2) presence of Class A poisons, 3) oxygen deficient environments, and 4) percutaneous agents.
2. Gather data to select personal protective equipment for the cleanup workers and contamination monitoring schemes for the cleanup operations. These include:
   - Ambient air samples to determine types and levels of contaminants present.
   - Samples of wastes or substances found on-site in order to select appropriate personal protective equipment, work practices and engineering safeguards for workers.
   - Identification of areas of high contamination — "Hot Spots."
   - Identification of areas free of contamination — "Clean Areas."
   - Identification of natural wind barriers (*e.g.* hills, tanks, and buildings).
3. Identify and monitor changes in physical agents which include: 1) hot/cold conditions, 2) noise levels, and 3) radiation.
4. Identify and monitor changes in safety hazards such as:
   - Explosive and flammable environments.
   - Electrical hazards, *e.g.*, overhead power lines and buried cables.
   - General hazardous conditions which can result in falls, cuts, and injuries.
5. Identify and monitor changes in biological hazards such as:
   - Biological wastes (bacterial, fungal or viral agents).
   - Hospital wastes.
   - Wastes from research facilities (contaminated animal wastes).

Prepare a Sampling and Monitoring Plan

The purpose of the plan is to obtain the information necessary to perform a comprehensive site assessment. The plan should define the problem, state the objective to be accomplished, describe the sampling and monitoring procedures, define quality control and describe the reporting procedure.

After the contaminants and their concentrations have been identified, the information is interpreted to establish safety procedures and select personal protective equipment. The application of the information obtained from sampling and monitoring to the health and safety aspects of the cleanup action is a complex issue. Thus, experienced occupational safety and health professionals should be consulted.

Evaluation, Interpretation and Assessment

The chemical composition may vary from point to point at hazardous waste sites. The National Research Council has recommended that, "Until more specific information becomes available, it seems that the most productive course to follow to determine the limits for multiple exposures is to assume additivity and follow the guidelines for mixtures as recommended by the American Conference of Governmental Industrial Hygienists." After thoroughly screening the site, identifying what contaminants are present and in what levels they are found, an extrapolation should be made to estimate the worst possible case of exposure that could occur. Although some degree of uncertainty will always remain, it is still important to assess a Worst-Case Scenario based on the information available.

In estimating hazards to workers, each individual job should be evaluated for potential exposure factors such as: level of site activity; atmospheric dispersion characteristics; physical and chemical properties of agents; proximity to zones of contamination; accident/major release potential;

job function; potential routes of exposure; frequency of exposure; and duration of exposure. Special consideration should also be made for chronic (long-term) exposure of hazardous waste workers. This evaluation is often called a *job hazard analysis.*

All levels of protective equipment are chosen conservatively, and there could be considerable overlap between levels. The decision criteria for choosing levels of protection are flexible; they are only guidelines. The final decision will be made by the Safety Officer based on site-specific knowledge and experience.

Health and Safety Team

Upper levels of management are responsible for providing the necessary facilities, equipment, and support to on-site personnel in order to carry out an effective health and safety program.

Most hazardous waste site remedial actions require a multidisciplinary approach. The technical specialties often needed on-site include chemistry, industrial hygiene, geology, hydrology, engineering and life sciences. The field team categories should be filled by personnel with expertise specifically relevant to the individual site. Health and safety personnel are required to use professional judgment in assessing risks to workers and selecting protection methods; therefore, they must be fully qualified.

Personnel should be assigned to specific work teams with designated supervisors. Each team member should be trained to recognize potential hazards and be familiar with procedures, engineering controls, and personal protective equipment. On-site team members should assume responsibility for alerting other team members when they observe practices or conditions which may create additional hazards or unnecessary exposures. In an emergency situation, the team should evacuate as a group to insure that all team members are evacuated.

Inspection and Safety Plan Evaluation

The safety officer should frequently conduct audits or inspections of conditions, facilities, and work practices to insure that the safety plan is being followed. Factors can interact to create drastic changes in the degree-of-hazard to the worker. These include: work being done; weather conditions; equipment maintenance requirements; progressive degradation of containers and containment structures; and actions of authorized and unauthorized persons.

The safety plan must be reevaluated regularly to determine its adequacy. The use of a checklist to provide guidance and reminders of items that should be inspected can be most helpful. The frequency of inspections will vary with the activity being inspected.

Sample site safety checklists are often organized around the following topics:

1. Hazard recognition.
   - Audit of information sources.
   - Initial site inspection.
   - Environmental sampling.
2. Hazard evaluation.
   - Chemical hazards.
   - Physical and safety hazards.
   - Biological hazards.
3. Hazard control and worker protection
   - Administrative controls.
   - Engineering controls.
   - Personal protective equipment.
   - Work practices.
   - Training.

Develop a Work Plan

An important part of the preliminary work in organizing safe site activities is the development of a work plan. A typical work plan has the following basic elements:

1. Background review.
2. Statement of objectives and goals.
3. Methods of accomplishing the objectives — sampling plan, inventory, disposal.
4. Personnel requirements.
5. Equipment requirements.
6. Safety plan.
7. Special equipment or services requirements — subcontract of drilling equipment or heavy equipment and operators.
8. Outline of decontamination procedures and control of contaminated materials.
9. Safety briefing schedule for team members — includes any special safety training needed.
10. Description of the safety requirements for any special tasks — container sampling, excavation of buried drums.
11. Defining the activites in each zone.

Sites are commonly divided into the following zones:

- Exclusion Zone (contaminated area) (hot zone).
- Contamination Reduction Zone (area where decontamination takes place.
- Support Zone (clean area).

Control Entry onto the Site

Unauthorized personnel should be excluded from the site to prevent exposure of unprotected persons and avoid interference with safe and effective working procedures.

- Traffic routes for personnel and vehicles should be clearly identified (*e.g.* signs, painted lines, ropes, *etc.*).
- Zones should be clearly marked.
- An identification system should be established to identify authorized persons and any limitations to their approved activites.
- Establish enforcement authority for entry and exit requirements.

During working hours, site security is maintained at the support zone, and secondly at the access control points of the contamination reductions zone. If there is no fence around the site, patrols and signs may be needed.

Communications

An internal communication network is needed among the designated work zones. The purpose of the internal communication network is to: alert the team to emergencies, pass along safety information, relay changes in work scope, and maintain site control.

Establish an emergency communication signal to be used for emergency *ONLY*. Examples of emergency signals are: hand signal — hand clutching throat to indicate personal distress; radio communication — established code words; audible signal — three short blasts, pause, repeat.

An external communication (site to off-site) should be established for emergency response, to obtain additional resources and to report to management results, changes or problems associated with site work.

Personal Protective Equipment

Personal protective equipment (PPE) includes the special clothing, respirators and other safety equipment worn by workers in potentially hazardous situations. PPE protects workers from the chemical, physical and biological hazards which cannot be controlled or eliminated through engineering safeguards, safety procedures, or selection of alternative remedial actions designed to minimize risks to worker health and safety. In this light, PPE is the last line of defense to prevent exposure if all other controls have failed.

Personal protective clothing and equipment can be placed into the following general protection categories:

1. Respiratory protection.
2. Skin and body protection.
3. Face and eye protection.
4. Foot protection.
5. Head protection.
6. Hearing protection.
7. Entry and fall protection.

Results of the intensive sampling during the investigation phase will be used to determine the kinds of PPE to be worn by various workers during the hazardous waste cleanup activity.

Prior to beginning cleanup operations, a personal protective equipment program should be well established. The program should ensure not only proper selection but also proper use and maintenence of personal protective clothing and equipment. Such a program should include:

1. Written standard operating procedures.
2. Management and administration of the program under the direction of a qualified health and safety professional.
3. Medical screening for determining the physiological and psychological limitations of workers to perform their work using the personal protective clothing and equipment.
4. Use of approved equipment.
5. Selection of clothing and equipment based on several factors which determine protection requirements.
6. Personnel training covering equipment capabilities and limitations, proper techniques for wearing and removing clothing and equipment, its decontamination and cleaning, maintenence and repair, and proper storage.
7. Proper fitting of equipment and clothing assigned to workers (*e.g.*, fit testing of respirators and properly-sized gloves).
8. Restriction of personal habits or hygiene practices which interfere with design functions of clothing and equipment (*e.g.*, wearing of excessive facial hair which prevents proper respirator fit, gum chewing or not having or wearing dentures).
9. Assignment of one qualified individual, or under the direct supervision of a qualified health and safety professional, to issue appropriate clothing and equipment to workers for the hazards identified.
10. Routine inspection of clothing and equipment prior to each use and at least once per month while in storage to ensure that good operating condition is maintained.
11. Inspection and monitoring of worker practices to ensure proper use of clothing and equipment.
12. Routine monitoring and assessment of hazard conditions to identify changes which may warrant modifications of clothing and equipment selections.
13. Medical monitoring designed by a physician to evaluate the effectiveness of the exposure prevention program.
14. Regular maintenence of equipment to ensure good operating condition.
15. Review of procedures and rationale for selection, use, maintenence, cleaning, and storage established by the program on a regular basis to identify problems and ensure accommodation of the most current guidance available.

Use of appropriate personal protective equipment is required by OSHA regulations in 29 CFR 1910. These requirements are reinforced by regulation 40 CFR 300.71 which requires all private contractors working on Superfund sites to conform to applicable OSHA provisions and any other safety requirements deemed necessary by the lead agency overseeing the activities.

Personal protection levels are established on the basis of an exhaustive review of site conditions and operational requirements. There will be situations, however, in which protection levels should be upgraded or downgraded from their original levels. Modifying the level of protection should only be approved after consultation with the site safety officer and supervisors.

Heat Stress

Selection and use of PPE must take into account the problem of heat stress and the variability of individual susceptibility to heat stress. Heat stress is the most common problem while working in personal protection equipment (PPE) on a hazardous waste site, especially when temperatures exceed 26° C (80° F).

Wearing partially or completely vapor and liquid impermeable protective clothing will drastically reduce heat exchange through the normal mechanisms; this in turn will limit effective work time, increase the risk of heat-induced illnesses and increase the chance of accidents.

Heat stress can be manifested in the following ways: 1) heat stroke, 2) fainting, 3) heat exhaustion, 4) heat rash, 5) heat cramps, and 6) transient heat fatigue.

Individuals vary in their susceptibility to heat stress. Some of the predisposing factors for heat stress include: 1) lack of physical fitness, 2) lack of acclimatization 3) age, 4) dehydration, and 5) obesity.

Decontamination

Decontamination procedures must be in place before anyone enters a site, and modified (as necessary) throughout the entire site operation.

Decontamination involves physically removing contaminants and/or converting them into innocuous substances. The intent is to pass through stages of contamination reduction, removing contaminated clothing and equipment in decreasing order of the degree of contamination and need for protection during decontamination (*e.g.*, use of the respirator until potential contamination in the breathing zone is at acceptable levels.)

Decontamination procedures should prevent: 1) cross-contamination of clean areas, 2) exposures to workers when removing contaminated clothing, and 3) introduction of contaminants to areas off-site, including the homes and cars of workers. The decontamination plan is based on the assumption that all personnel and equipment leaving the Exclusion Zone (area of potential contamination) are grossly contaminated.

Once decontamination procedures have been established, all personnel requiring decontamination must be given precise instructions (and practice if necessary). Compliance with procedures must be frequently checked.

Medical emergency decontamination procedures should be established as a part of the emergency or contingency plan. In a medical emergency, immediate treatment may be necessary to save a life. If decontamination can be done without interfering with essential first aid and life-saving techniquies such as CPR, then it should be done. If decontamination is not possible: the individual should be wrapped in a blanket or suitable material to prevent contamination of ambulance and emergency personnel.

In addition to decontamination, all reuse respirators, protective clothing and personal articles must be sanitized before they are used again.

Medical Program

A medical program for hazardous waste workers can be very complex. These workers could be exposed to many toxic substances, often in situations where identification or quantification of these exposures is not possible. At the present time, very little quantitative data exist on the occupational exposures and hazards these workers encounter. Available industrial hygiene data indicate that these workers have low-level exposures to multiple chemicals and the possibility of short-term, high-level exposures to multiple chemicals.

The medical program for these workers must provide a baseline of pre-employment and periodic screening yet remain adaptable to the exposures at specific sites. Most importantly, this program must be integrated with the personal protective equipment program and the safety plan.

Information obtained by the pre-employment health screening and on-going health monitoring will be used to: 1) determine if workers are fit for strenuous work in PPE and 2) establish a baseline medical status for each worker.

After considering the individual's physical fitness, work history, and physical examination results, further testing may be needed. The medical screening provides baseline data on the individual to better evaluate and treat the worker if an exposure occurs.

The frequency and content of periodic screening of hazardous waste workers will depend on the nature of their work. In general, these examinations should include an interval history and physical examination. The medical history should focus on changes in health status, illnesses, and possible work-related symptoms occurring since the last screening examination.

Provisions for acute or episodic medical care must be developed for each hazardous waste site. This involves: 1) training personnel in first aid; 2) having appropriate equipment on-site; and 3) consulting with off-site emergency personnel

Record-keeping is an important part of any medical surveillance program. For hazardous waste workers, this may be difficult due to multiple locations where they may work for short periods of time. OSHA regulations require that:

- Medical records for all workers be preserved and maintained for at least the duration of employment plus thirty years after they leave employment.
- The results of medical testing and a copy of full medical records must also be available without cost to the workers or their representatives, and to OSHA.
- Occupational accident and illness records must be maintained and reported yearly to OSHA.

Maintenance and review of such records is important. Each accident or illness should be promptly evaluated to determine the cause of the incident and to implement appropriate changes in health and safety procedures for the site.

Training

On a hazardous waste site, workers must understand and recognize the potential hazards involved. They must be knowledgeable of programs and procedures established in the site safety plan to protect their health and safety. They should be trained in the applications and limitations of the tools, instruments, and personal protective clothing and equipment they will be required to use. Workers should understand how their tasks relate to and impact on all other

tasks on site. No one should be allowed on site who is not trained in job performance and safety precautions.

Supervisors and other site management personnel should receive training to enhance their abilities to provide guidance and make decisions. Training for supervisory personnel and especially the health and safety personnel should include the general topics previously described. The depth to which each topic is covered will depend on the workers' responsibilities and the tasks to be performed.

Summary

This has been an overview of the key occupational safety and health guidelines that NIOSH is developing in cooperation with EPA, USCG, and OSHA. The guidelines stress the development of a site safety plan with continual information gathering and updating so that workers are protected throughout the hazardous waste site cleanup operation. The need for experienced health and safety personnel to assess the complex nature of hazardous waste sites is emphasized. Employee training, good supervision, adequate equipment and time along with a well thought-out safety plan can help assure that the Superfund activites can be accomplished without inflicting new health problems on hazardous waste workers.

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