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Project Summary

Drum Handling Practices at Hazardous Waste Sites

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The overall goal of this research was to provide technical guidance for planning and implementing safe and cost-effective response actions at hazardous waste sites containing drums. A manual has been prepared on methods, procedures, and equipment suitable for handling drummed waste. Detailed information is presented on locating buried drums; excavating and transferring drums onsite; staging, opening, and sampling drums; consolidating wastes; storing drums; and transporting drums offsite. Each of these operations is discussed in terms of equipment and procecdures used in carrying out specific activities, field health and safety procedures used in carrying out specif-environment and public welfare, and factors affecting costs. Information is also included on the applications and limitations of the following remedial actions for controlling or containing migration of wastes from drums: surface capping, surface water controls, ground-water pumping, subsurface drains, slurry walls, and *in-situ* treatment techniques. This manual will be useful to On-Scene Coordinators; Federal, state, and local officials; and private firms that plan and implement response actions at sites containing drums.

This Project Summary was developed by EPA's Hazardous Waste Engineering Research Laboratory, Cincinnati, OH, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) establishes a nationwide program for the cleanup of uncontrolled hazardous waste sites. This program is implemented through the provisions of the National Contingency Plan (NCP), 40 CFR Part 300, which sets forth the process by which response actions will be selected, evaluated, and implemented. All CERCLA response actions must meet the need for protection of public health, welfare, and the environment in the most cost-effective manner. The objective of this Summary is to provide the technical guidance necessary to select and implement cost-effective response actions at hazardous waste sites with drums. Past experience in cleaning up these sites indicates that there are a number of health, safety, and environmental hazards unique to drum handling operations. As a result, specific procedures, protocols, and equipment types have been developed but have not necessarily been made generally available to the user community. The experience gained from these activities and presented in this manual will be invaluable for future response actions.

The manual describes and evaluates equipment, procedures, and methods for planning and implementing cost-effective response actions applicable to drum problems requiring one or more of the three broad response categories outlined in the NCP: removal, surface cleanup, and subsurface remedial action. The major focus of the document, however, is to provide guidance on procedures and

methods specific to removal of buried or surface drums containing hazardous wastes. Activities such as locating, excavating, staging and opening drums, and consolidating, storing, and transporting wastes from drums are presented in detail because there has been no previous guidance published in these areas. Also, information on the use of source control measures (e.g., pumping, slurry walls, drains) to contain or control the migration of wastes from drums is presented in the form of summary tables with lists of references since considerable guidance is already available on the design and implementation of these technologies.

Results and Discussion

The manual identifies, describes, and evaluates equipment and procedures for activities related to drum handling, including:

- Locating buried drums
- Excavation and onsite handling of drums
- Drum staging and opening
- Waste consolidation and recontainerization
- Interim storage/transport
- Source controls.

Locating Buried Drums

Locating and detecting buried drums at a hazardous waste site involves the use of historic and background data on the site, aerial photography, geophysical surveying, and sampling. Background data should be examined extensively since it can focus remedial investigation activities and thereby minimize the cost and maximize the level of safety associated with the drum handling operations.

Aerial photography invovles the use of historic aerial photographs to show changes in the site over time such as filled in trenches or mounding; and current aerial imagery (usually color or infrared) to show spills, seepage, or changes in vegetation that may indicate the presence of drums.

Geophysical survey methods include metal detection, magnetometry, electromagnetics, electrical resistivity, ground-penetrating radar, and seismic refraction. Geophysical surveys can be used to locate buried drums; define the boundaries of trenches containing drums; approximate the number of drums present; determine plume boundaries, concentration gradients, and direction of ground-water flow; and determine subsurface conditions. Applicability, reliability, and cost-effectiveness of these methods are highly site-specific. Magnetometry is generally the most useful survey tool for detecting drums. Metal detectors may be adequate if drums are close to the surface. Ground-penetrating radar can be used in plume delineation and for locating and approximating the number of buried drums; this method is extremely sensitive but is subject to several interferences. Electromagnetics and electrical resistivity are often used together to determine the boundaries of leachate plumes rather than the location of drums, although electromagnetics has been used for this purpose. Use of seismic refraction at hazardous waste sites has been limited to determining depth and thickness of geologic strata. Results of geophysical surveying should be verified by sampling.

Where drums have been stored aboveground, a drum inventory is generally prepared as part of the remedial investigation. This generally involves estimating or counting the drums and randomly sampling them to allow a gross categorization of the types of wastes onsite. This information is then used to prepare bid documents and cost estimates for clean-up.

A drum inventory may be prepared for buried drums as well. Where buried drums are involved, ground water and soil sampling may be required together with geophysical surveying to locate drums, approximate their number, and obtain a general idea of the types of waste present. Air monitoring equipment (e.g., combustible gas, radiation, and toxic gas meters) should be used to ensure the safety of field personnel when working near drums.

Excavation and Onsite Handling of Drums

Buried drum excavation is generally accomplished by using a combination of conventional excavation, lifting, and loading equipment such as backhoes, front-end loaders, and bobcats, but with special equipment modifications or accessories adapted to hazardous waste site applications. The most valuable piece of equipment for handling drums is the barrel grappler, a modified crawler-mounted backhoe with a rotating grapple head. The grapple attachment can rotate 360 degrees along a given plane and is hydraulically self-adjusting in grip radius so that it can grab and lift various sized containers, including containers that are slightly dented or bent. Another valuable piece of equipment is the industrial vacuum loader. This high-strength vacuum can convey either solids or liquids from distances up to 150 meters (500 feet) and is particularly useful for removing soil around drums and cleaning up spills from ruptured or leaking drums. Other attachments include nonsparking bucket teeth to prevent explosions, morman bars to cover the teeth of backhoes to avoid puncturing drums, plexiglas safety shields for vehicle cabs, and drum lifting attachments such as nylon yokes and metal hoists.

Equipment used in the excavation and staging of drums must be suitable for digging, grabbing, lifting, loading, and manipulating drums. Complete management of a drum-related problem usually requires a combination of equipment, particularly where the grappler is not available.

There are a number of safe handling practices that should be followed during excavation and onsite handling of drums. Unless buried drums are being handled remotely using a grappler, it will generally be necessary to determine drum integrity prior to drum excavation. This may be accomplished through a visual inspection of the drum surface for corrosion, leaks, swelling, or missing bungs. Field personnel should rely on air monitoring equipment (e.g., oxygen meters, combustible gas detectors, gas/vapor analyzers) to provide an indication of unsafe conditions in the immediate vicinity of drums. Where certain highly hazardous or toxic materials are suspected, additional precautions may be required. These precautions include:

- Immediate overpacking and isolation of radioactive materials
- Minimal contact, prompt isolation, and preferably remote handling of explosive or shock-sensitive materials
- Barricading overpressurized drums until the pressure can be relieved remotely
- Cautious handling of gas cylinders to avoid dragging or striking them.

Where drums are found to be leaking or structurally unsound, the drums should be overpacked or the contents transferred to a new container promptly in order to avoid spills or releases that could jeopardize worker safety.

Drum Staging and Opening

The next activity involves staging and opening the drums. This generally re-

quires that all drums be sampled in order to determine potential treatment and disposal options. The procedures used for staging and opening depend upon the number of drums onsite, their relative hazard, and the space available for performing these activities. It is recommended that drums be staged according to their physical contents (i.e., liquids, solids, gas cylinders, lab packs) since procedures for opening and sampling these containers are unique. Preferably, the drum staging and opening areas should be physically separated to minimize the risk of a chain reaction in the event of fire or explosion during drum opening. The drum opening area should be diked and lined. A combined staging and opening area may be required at sites where the work space is too confined or where the logistics of marshalling thousands of drums from a staging area to a drum opening area is cost-prohibitive. Using this combined approach, drums should be staged in rows of two or in groups of four with sufficient distance between rows or groups to allow easy access of remotely operated drum opening equipment.

There are a variety of tools available for opening drums. Nonsparking wrenches and manually operated deheaders should be used only for drums with good integrity and where the contents are not suspected of being explosive. Remotely operated equipment types include debungers, plungers, and backhoe-attached spikes. Further protection should be provided during drum opening by conducting the operation from behind a plexiglas shield. Finally, during drum opening, measures should be taken to contain and mitigate spills that may occur. In general, remote drum opening is recommended where drum integrity is poor or the wastes are highly toxic. However, these methods are time consuming and may add considerable cost to a drum removal operation.

Waste Consolidation and Recontainerization

The specific activities conducted during the consolidation and recontainerization phase of the drum handling operation are intended to prepare the wastes for final treatment and disposal. The initial step is to conduct compatibility testing on all drums. This involves the use of simple, rapid, and cost-effective testing procedures in order to segregate wastes into broad categories (e.g., radioactives, oxidizers, water reactives, etc.) so that wastes can be bulked and an appropriate treatment/disposal option can be identified. Once compatible waste types have been identified, composite samples are generally subjected to more rigorous testing before bulking to make certain they meet specific requirements of the treatment/disposal facilities. Treatment and disposal options that are available include incineration, aqueous treatment, resource recovery, secure landfilling, and solidification/stabilization.

Compatible liquid wastes are generally consolidated onsite in vacuum tanker trucks. Some pretreatment (e.g., acid-base neutralization, oxidation of cyanide and sulfide) may be required for some waste types before they can be bulked. Such reactions should be carried out under carefully controlled conditions in a reaction tank or compatibility chamber.

Under certain circumstances, it is more economical or acceptable to transport liquid wastes in drums or overpacks rather than to bulk them. This is the case when the number of drums containing compatible waste types is too few to make use of vacuum trucks economical, or when there are a few drums containing highly toxic or incompatible wastes that cannot be bulked with other wastes without contaminating the load.

As is the case with liquid wastes, it is most cost-effective to consolidate compatible solid waste types. This can be done using an industrial vacuum loader if the wastes are sufficiently low in viscosity or a bulk solids dump trailer. Contaminated soils can be bulked with solid wastes. This not only provides a cost-effective means of disposal but also stabilizes the solid wastes. Fly ash, sawdust, and commercial sorbents can also be used to remove any free liquids in the waste. Drums are a suitable means for containerizing small volumes of solid wastes or contaminated soils.

Available procedures for treatment of gas cylinders include venting of nontoxic, nonflammable gases; neutralization of acidic or basic gases; and controlled detonation of flammable gases. Care should be taken to avoid dragging or striking gas cylinders and to protect them from temperature extremes.

Procedures for handling lab packs involve manually separating the individual bottles and segregating them into waste types. Chemically compatible wastes other than explosives and shock-sensitive wastes can then be repackaged in conformance with Department of Transportation (DOT) regulations. Explosives and shock-sensitive components of lab packs must be handled with extreme caution. Typically, these waste types are either detonated or incinerated under closely controlled conditions.

Interim Storage/Transport

Conditions at hazardous waste sites frequently require that drums be stored temporarily onsite until additional funds become available to transport them offsite or until a suitable site is located for their final disposal. Standards for Resource Conservation and Recovery Act (RCRA) permitted storage facilities (40 CFR Part 264) should be followed to the extent practicable. DOT regulations (49 CFR Parts 171-179) govern the packaging and transport of hazardous wastes.

Source Controls

Where buried drums are present, use of source control options to prevent the migration of wastes may be preferred over excavation and removal. Such measures are often less costly and minimize the exposure of field personnel to toxic and hazardous wastes. Source control measures for containing and controlling waste migration include: capping, surface water controls, groundwater pumping, subsurface drains, slurry walls, and *in-situ* treatment methods. A full feasibility study is required under CERCLA for selecting the most cost-effective remedial action for controlling or containing waste migration.

Conclusions and Recommendations

A variety of procedures, protocols, and equipment types has been utilized for handling drums containing hazardous wastes. However, safe and cost-effective drum removal operations should follow certain general principles. Operations should promote the use of remote drum handling equipment (e.g., drum grappler, plexiglas safety shield, drum opening equipment) and should be designed to provide a means for segregating incompatible wastes and isolating highly hazardous wastes (e.g., explosives, radioactive materials). Equally important, compatible waste types should be consolidated to develop sufficient quantities for more cost-effective treatment/disposal of waste materials.

Measures should also be taken to minimize secondary contamination of the environment. These include prompt cleanup of spills and provisions for secondary containment of spills within different operating areas (e.g., drum opening area,

equipment decontamination area, interim storage area).

Field personnel should be provided with the appropriate monitoring equipment to enable detection of any hazards during drum removal operations. This commonly includes meters for measuring explosive levels, toxic materials, radioactivity, and oxygen levels.

The removal operation should be designed and conducted to adhere to all safety and environmental regulations and standards including Occupational Safety and Health Administration and state safety regulations for personnel protection and reporting; DOT regulations for offsite transport of hazardous wastes; and RCRA standards for storage, transport, treatment, and disposal of hazardous wastes.

At some hazardous waste sites with buried drums, the most cost-effective response action will require that the drums be left onsite with long-term remedial actions (source control measures) being implemented to control and/or contain hazardous waste migration (e.g., pumping, slurry wall, capping).

Regardless of whether the most cost-effective remedial action involves removal or source containment measures, the response action should be designed based on a full consideration of the following criteria;

- Engineering feasibility of the method/equipment types
- Protection of health and safety of field personnel
- Protection of the environment and public welfare
- Costs

These criteria are consistent with response action requirements under the National Contingency Plan.

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The complete report, entitled "Drum Handling Practices at Hazardous Waste Sites," (Order No. PB 86-165 362/AS; Cost: $16.95, subject to change) will be available only from:

National Technical Information Service
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