SUMMARY REPORT ON OSHA INSPECTIONS CONDUCTED AT SUPERFUND INCINERATOR SITES

Occupational Safety and Health Administration
Directorate of Compliance Programs
200 Constitution Avenue, N.W.
Washington, D.C. 20210

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I. INTRODUCTION

The Occupational Safety and Health Administration (OSHA) and the Environmental Protection Agency's (EPA's) Office of Emergency and Remedial Response (OERR) recently entered into an interagency agreement to participate jointly in activities that will ensure vigorous occupational safety and health oversight of Superfund Thermal Destruction Facilities (TDFs). These efforts are being coordinated by a joint EPA-Labor Superfund Safety and Health Task Force. As part of this initiative, OSHA is conducting a number of in-depth safety and health evaluations of Superfund incinerator facilities; this report summarizes the findings of five such inspections conducted between 1992 and 1993.

Although a major objective of these inspections was to assess compliance with OSHA's Hazardous Waste Operations and Emergency Response Standard (29 CFR 1910.120), the investigations were also designed to evaluate the overall adequacy of each facility's safety and health program, as implemented by the contractors operating at each site, and to identify any factors that were contributing to reduced program effectiveness. Emphasis was placed on evaluating each employer's safety and health standard operating procedures (SOP's) and the adequacy of task- and operation-specific hazard analyses and emergency response programs. However, because of the focus on safety and health program design and implementation, the investigations went beyond the assessment of compliance with these specific OSHA requirements and included such areas as the effectiveness of strategies to mitigate heat stress, confined space programs and the use of process safety management approaches in the operation of the TDF.

Inspections were conducted over a three- or four-day period by teams of from four to six OSHA personnel. Activities undertaken by the inspection team included the conduct of interviews with employees, safety and health personnel, union representatives, and site management personnel to evaluate the effectiveness of safety and health program implementation; a number of walkthrough inspections to observe and document site conditions, operations, and safety and health program deficiencies; the collection of wipe

samples of work surfaces in clean areas and employees' skin; and a detailed review of each site's written safety and health plan (SAHP), emergency response plan, operation-specific hazard analyses, and other relevant written safety and health programs and records.

The remainder of this report is presented in four sections. The overview of incineration technology and associated occupational hazards is presented in Section II. Section III provides a general description of Superfund TDF sites of the type inspected, as well as brief descriptions of the five sites visited. Findings from each of the inspections are presented in Section IV. Section V presents an overall summary of our findings.

II. GENERAL OVERVIEW ON INCINERATION TECHNOLOGY AND ASSOCIATED OCCUPATIONAL HAZARDS

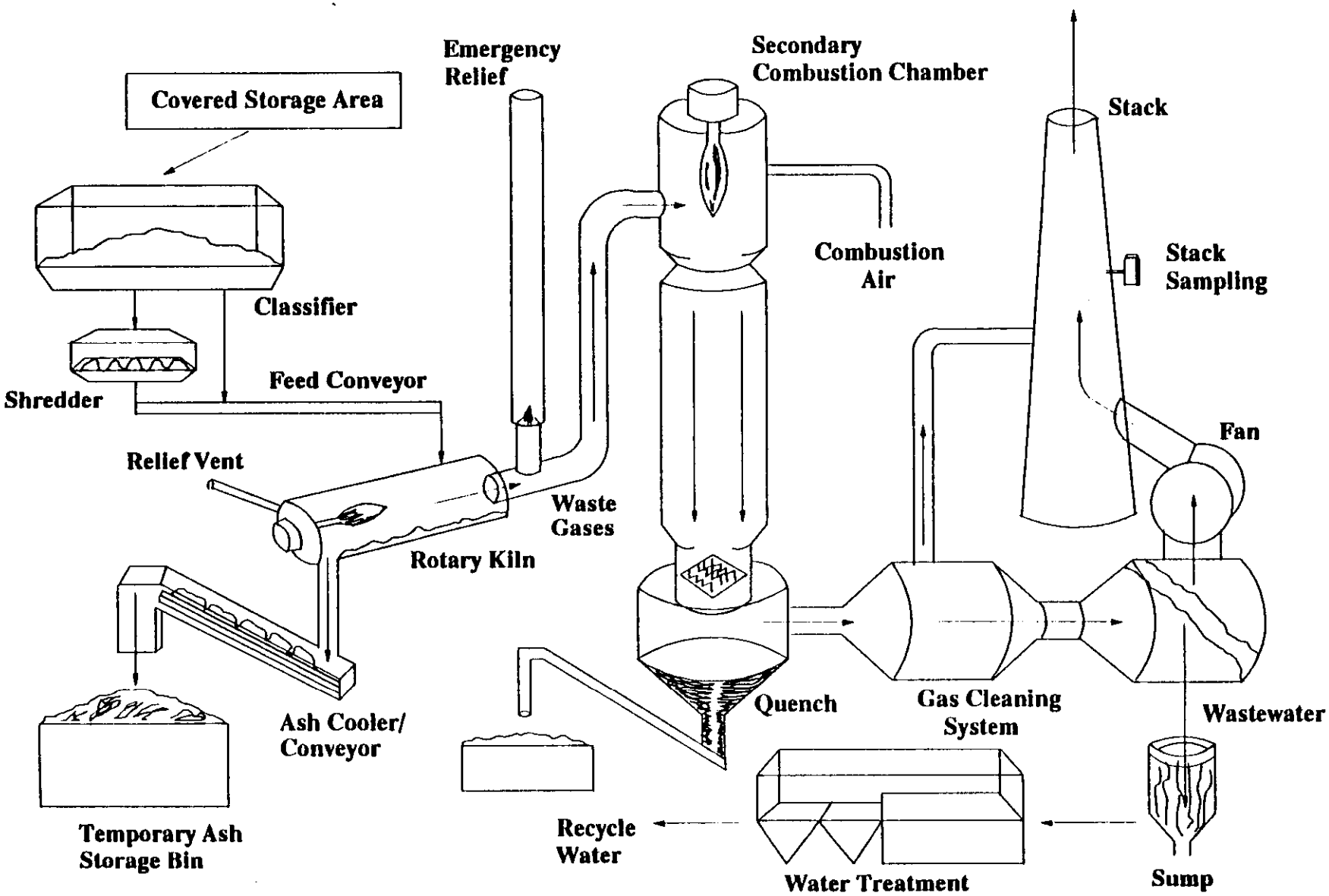
Incineration of hazardous waste involves the use of controlled flame combustion to thermally destroy hazardous wastes; this method is one of the most frequently selected technologies for treating hazardous contaminants at Superfund sites. Incineration has been found to be suitable for the destruction of most organic materials (volatile and non-volatile), pesticides, and cyanides found in sludges, soils, and liquids having a high organic content. An on-site incineration system is comprised of several subsystems, including:

- Waste pretreatment (solids sizing, mixing, grinding);
- Waste feed (conveyors, augers, hoppers, chutes, pumps, ram feeders);
- Primary and secondary combustion units;
- Air pollution control equipment (secondary burners, scrubbers, precipitators, quench systems, filters, spray towers); and
- Residue handling and disposal (solidification, stabilization of ash, use of ash as backfill material, filtration, clarification, and neutralization of waste liquids).

Figure 1 is a diagram of these subsystems that shows the flow of waste feed, ash, and waste gases through the system. Residues that are generated in the operation of the incinerator include fly ash, bottom ash, and scrubbing and quenching liquids.

Exposure to hazardous contaminants present on an incinerator site can occur both within the area being remediated and near the waste pretreatment and incinerator feed area.

Figure 1. Schematic Diagram of a Typical Superfund Incineration Facility



Potential exposure to site contaminants or to their incomplete combustion products can occur in the vicinity of the incinerator if it is not operating according to design parameters. Deficient operating conditions may include:

- Short residence time;
- Low oxygen to fuel- or waste-ratio;
- Low-temperature operation;
- Soil/ash fallout creating steam pressure buildup in the combustion chamber;
- Incinerator slag buildup;
- Waste surges;
- Poor gas mixing in the combustion chamber due to low turbulence within the chamber; and
- High halogen content of the waste feed.

In addition, poorly designed or malfunctioning air pollution control equipment will increase particulate emissions, which often carry incomplete combustion products adsorbed onto the particle's surface.

Other occupational hazards commonly found on Superfund incinerator sites include those associated with thermal stress, the use of heavy construction equipment, work in confined spaces, excavation and trenching operations, storage and handling of flammable materials such as motor fuels, walking and working surfaces, noise, hot or cold environments, or marine operations.

III. DESCRIPTION OF SUPERFUND TDF SITES

All of the sites inspected utilized a transportable rotary kiln incinerator to destroy hazardous materials at the site of contamination. In addition, contractors at each of the sites also engaged in excavation activities designed to move contaminated soils and lagoon sediments to the waste pretreatment area. All excavation, waste pretreatment, and waste feed operations were conducted within a demarcated exclusion zone, entry into which required the

use of Level C or Level B personal protective equipment (PPE). With one exception, the incinerator unit itself and associated pollution control equipment were located outside the exclusion zone. Figure 2 shows the general layout common to each site visited.

In instances where EPA is unable to identify the responsible party, or where EPA cannot reach an agreement with the responsible party, EPA conducts any necessary remedial design and remedial action (RD/RA). When EPA takes the lead to conduct RD/RA, the Agency can choose between two contracting mechanisms; EPA may provide direct oversight of a RD/RA contractor under the Alternative Remedial Contracting Strategy, or EPA may request that RD/RA be administered and implemented by the U.S. Army Corps of Engineers (USACE) or Bureau of Reclamation (BUREC) under Interagency Agreements (IAG) with EPA. In some instances, a State agency will assume responsibility for RD/RA, in which case it will use any of its own contracting mechanisms. In any event, the Agency that issues the competitively bid contract provides oversight of the clean-up activities being conducted under the contract. The prime contractor is responsible for implementing cleanup procedures in accordance with the terms of the contract and is responsible for developing and implementing a safety and health program for the site. The prime contractor may procure the services of a number of subcontractors that specialize in various aspects of the cleanup activity; frequently, a subcontractor is hired to operate the TDF.

Table 1 identifies the locations of the sites investigated, the prime contractor, the subcontractor responsible for incinerator operation, and the state or Federal government agency responsible for remediation oversight. All sites were inspected between May of 1992 and April of 1993. For the remainder of this report, the identities of the sites are masked and are referred to by a randomly assigned letter designation (Sites A through E).

IV. INSPECTION RESULTS

OSHA found several deficiencies in the design, management, and implementation of safety and health plans at each site. These deficiencies fell into 10 functional areas, listed in Table 2. With few exceptions, deficiencies in these 10 functional areas were common to all 5 sites; discussion of the findings specific to each functional area follows.

Figure 2. Layout of a Typical Hazardous Waste Incinerator Site

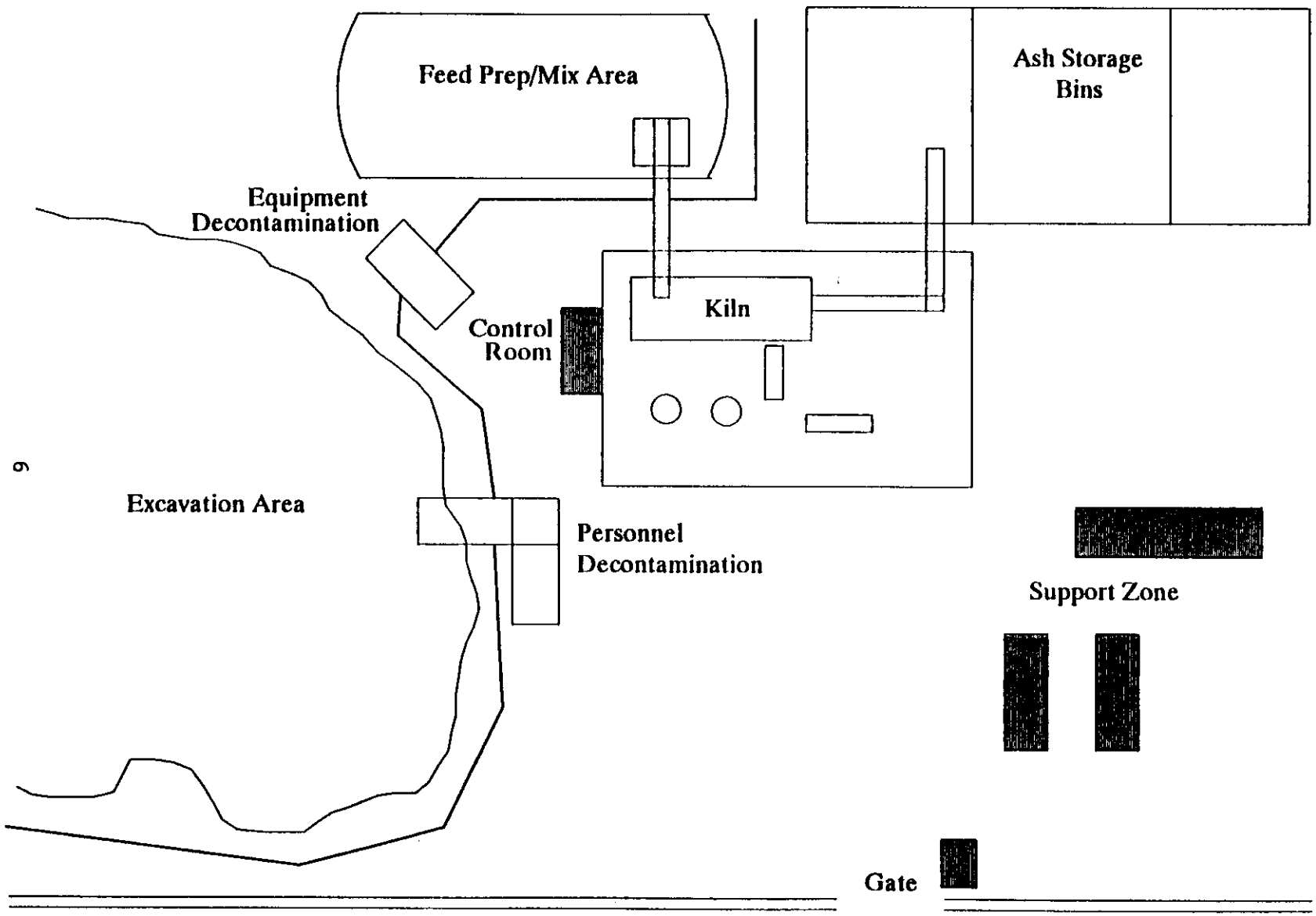


TABLE 1. DESCRIPTION OF SUPERFUND INCINERATOR SITES INSPECTED BY OSHA (1992-1993)

NAME OF SITE	LOCATION	GOVERNMENT OVERSIGHT AGENCY	PRIME CONTRACTOR	SUBCONTRACTOR FOR INCINERATOR OPERATION	TONNAGE TO BE INCINERATED
Bridgeport Rental and Oil Services (BROS)	Bridgeport, NJ	EPA/U.S. Army Corps of Engineers	EBASCO	ENSCO	100,000
Old Midland Products	Ola, Arkansas	Arkansas Dept. of Pollution Control and Ecology	Chemical Waste Management	None	less than 25,000
Rose Township Demode Road	Oakland County, MI	EPA Region V/ARCS	Perland Environmental Technologies, Inc.	OHM Remediation Services Corp.	less than 25,000
Sikes Disposal Pits	Crosby, TX	Texas State Water Commission	IT-DAVY (Joint Venture)	None	300,000
Big D Campground	Kingsville, Ohio	Ohio-EPA/ARCS	Fluor Daniel Inc.	Containment Treatment Inc.	30,093 (As of 4/93)

A. SAFETY AND HEALTH SUPERVISORS AT THE SITE MUST BE GIVEN THE AUTHORITY TO EXERCISE THEIR JUDGEMENT IN MATTERS OF EMPLOYEE SAFETY AND HEALTH. MANAGEMENT DECISIONS RELATED TO SAFETY AND HEALTH MUST REFLECT THE JUDGEMENT OF SUCH INDIVIDUALS.

Perhaps the most essential component of the safety and health program at a hazardous waste site is the development, management, and implementation of the program by a competent site safety and health supervisor who has the authority to make decisions that affect employee safety and health. Because worksite conditions that affect employee safety and health can change rapidly, the safety and health supervisor needs to have sufficient authority to make decisions in a timely manner to respond to dynamic conditions. In addition, for an effective program, the safety and health supervisor must have the flexibility to conduct any investigation deemed necessary to fully characterize the hazardous exposures of employees and to ensure that the various elements of the safety and health program are effective in mitigating these hazards. The need to grant appropriate authority to the site safety and health supervisor is addressed in paragraph (b)(2)(i)(B) of 29 CFR 1910.120 (HAZWOPER).

At Site B, interviews with safety and health management personnel indicated that some decisions regarding employee safety and health were made without input from safety and health professionals. In addition, industrial hygiene personnel from the oversight agency were not readily available to evaluate the recommendations made by the contractor's safety and health personnel. Furthermore, the contractor was bound by contract provisions that dictated specific procedures for employee exposure monitoring and the selection of PPE, regardless of conditions occurring on site. For example, although the contractor was free to upgrade the level of PPE when site conditions so warranted, downgrading the level of PPE required the submission of a written justification to the Contracting Officer and the receipt of written approval before a downgrade could be implemented. The time required to obtain permission to downgrade PPE may place employees at unnecessary risk of heat stress and other hazards associated with the use of PPE, such as restricted vision, impaired communication, and increased fatigue. Contractor safety and health personnel concurred

TABLE 2. SUMMARY OF FUNCTIONAL AREAS IN WHICH SAFETY AND HEALTH PROGRAM DEFICIENCIES WERE FOUND AT SUPERFUND INCINERATOR SITES

A.	Safety and health supervisors at the site must be given the authority to exercise their judgement in matters of employee safety and health. Management decisions related to safety and health must reflect the judgement of such individuals.
B.	The site specific safety and health plan (SAHP) must include procedures for the implementation and enforcement of safety and health rules for all persons on site, including employers, employees, outside contractors, and visitors.
C.	The safety and health program must be effective in ensuring that ongoing task-specific hazard analyses were conducted so that the selection of appropriate personal protective equipment (PPE) could be made and modified as conditions warrant.
D.	Task-specific hazard analyses must lead to the development of written standard operating procedures (SOPs) that specified the controls necessary to safely perform each task.
E.	Emergency response elements of the safety and health program must be fully implemented as described in the program.
F.	All site control elements of the safety and health program must be fully implemented as described in the program.
G.	The safety and health program must include procedures for monitoring the effectiveness of PPE, decontamination procedures, or housekeeping programs.
H.	Self-audit site inspection and abatement tracking programs must be formalized and effectively implemented.
I.	Process safety management procedures for the incinerator facility need to be improved.
J.	Procedures to monitor for and reduce heat stress need to be effective.

with this conclusion, and cited an example where employees engaged in installing a new pug mill were required to wear Level C PPE, despite a low potential for exposure to contaminants on the site.

Therefore, OSHA concludes that the on-site presence of a competent safety and health professional from the oversight agency, coupled with the use of more flexible contractual safety and health provisions, would lead to better and more responsive safety and health decision making in the face of changing site conditions.

At the remaining four sites inspected, contractor safety and health personnel appeared to have more latitude to make and implement changes to their respective SAHPs to respond to changes in site conditions. However, a deficiency in this area was noted at Site D, where no site safety and health supervisor had been designated for a period of about five months; as a result, some aspects of the SAHP, in particular the monitoring program, had not been fully implemented at this site.

B. THE SITE-SPECIFIC SAHP MUST INCLUDE PROCEDURES FOR THE IMPLEMENTATION AND ENFORCEMENT OF SAFETY AND HEALTH RULES FOR ALL PERSONS ON-SITE, INCLUDING EMPLOYERS, EMPLOYEES, OUTSIDE CONTRACTORS, AND VISITORS.

This functional area is closely related to the first deficiency described above, because it also involves the authority of the site's safety and health supervisor. To maintain adequate site control, the site safety and health supervisor must have the authority to enforce the SAHP's rules on any individual present at the site, whether employee or outside contractor. At Site B, the safety and health supervisor felt that, because of the contractor/client relationship between the contractor and the oversight agency, he had little authority over the safety and health activities of oversight agency personnel. However, when shown the deficiencies identified by OSHA, personnel form the oversight agency emphasized that they expected the site safety and health supervisor to exercise authority over any person present on site, including their own personnel, if necessary.

The authority of the safety and health supervisor was most at issue at Site A. At this site, two of the contractors issued their own SAHPs, each with distinct safety and health requirements. Interviews with safety and health personnel at these sites indicated that no

single site safety and health supervisor who had overall responsibility for the enforcement of safety and health requirements for all personnel on site had been designated. Although it may be appropriate for each contractor to develop its own SAHP, OSHA considered it essential that both plans be integrated and enforced consistently to ensure uniformity and clear understanding of expectations by on-site personnel, and particularly to ensure clear lines of authority and an understanding of response actions during an emergency situation. At this site, the emergency alerting schemes of the prime and subcontractor varied considerably, a situation that could easily lead to confusion in crisis (See Section E below). Another result of having two safety and health supervisors enforcing separate plans for their own employees was that PPE requirements frequently varied for prime and subcontractor employees. For example, some employees of one contractor expressed concern and were confused about a requirement that they wear Level C protection in an area where employees of the other contractor were permitted to wear Level D PPE. Allowing a situation of this type to continue clearly undermines any effort to convey to employees the need to take appropriate protective measures to guard against exposure to hazardous conditions.

C. THE SAFETY AND HEALTH PROGRAM MUST BE EFFECTIVE IN ENSURING THAT ONGOING TASK-SPECIFIC HAZARD ANALYSES WERE CONDUCTED SO THAT THE SELECTION OF APPROPRIATE PPE COULD BE MADE AND MODIFIED AS CONDITIONS WARRANT.

The OSHA standard (29 CFR 1910.120) mandates that site safety and health programs require task- and operation-specific hazard analyses to be conducted at the site; these analyses are intended to ensure a comprehensive and systematic approach to hazard anticipation, recognition, and evaluation at hazardous waste sites. Because work operations and site conditions change as the remediation process progresses, hazard analyses must be conducted on an ongoing basis; that is, the potential hazards associated with each operation must be reevaluated periodically as conditions change to ensure that employees are being afforded appropriate protection. For example, as work progresses, all information and data on employee exposures obtained to date should be incorporated into the analysis to enhance and refine the evaluation; the results of air monitoring are an important source of site-specific information used for hazard analysis. The requirement to conduct task- and

operation-specific hazard analyses and to incorporate the results of such analyses into the site-specific SAHP is contained in paragraph (b)(4)(ii)(A) of the HAZWOPER standard. Paragraph (h) of the standard also requires that the exposures of employees be monitored to ensure adequate characterization of their exposures; the results of all exposure monitoring should feed back into the hazard analysis process to ensure continuing improvement in site planning and procedures.

Program deficiencies were identified in two related areas: the development of operation-specific hazard analyses and conduct of monitoring programs designed to characterize employee exposures to hazardous materials. These deficiencies are discussed in more detail below.

Written Operation-Specific Hazard Analyses: Three of the five sites inspected lacked written hazard analyses for some tasks and operations that were being conducted on site. In addition, some of the written analyses examined failed to include an appropriate level of detail in describing the nature of the hazards or the protective measures to be taken in performing the task or operation.

At Site B, for example, written hazard analyses were not available for two tasks: cleaning the filter presses and charging chemicals into the aqueous waste treatment system. Operation of the filter press cleaning operation, which involves spraying filter presses with a stream of water, revealed that the employee engaged in the operation was exposed to splashes of contaminated liquids on the back of his head and neck because the protective clothing he was using was inadequate. OSHA believes that a hazard analysis of this operation would have indicated the need for protective clothing of a different design. Also at this site, it was noted that substantial overspray from an equipment decontamination operation was carried into areas where Level D PPE was permitted, thus potentially exposing unprotected personnel to contaminated aerosols. The written hazard analysis for this operation did not identify this potential hazard, which was readily apparent to OSHA inspectors on direct visual observation.

Site E lacked written hazard analyses for tasks and operations frequently performed by employees; examples of these operations include working on or near moving equipment such as conveyors, operating heavy equipment, relighting the pilot of the secondary

combustion chamber, and conducting air monitoring and surveying in the excavation area. For example, although safety and health management personnel believed that industrial hygiene technicians were among the most highly exposed individuals on the site because they spent so much time in the exclusion zone, no formal analysis of the hazards associated with air monitoring in the exclusion zone had been conducted.

At Site A, written hazard analyses were not available for several operations, including:

- Cleaning filter presses;
- Changing mix tanks with caustic and acid from 55-gallon drums;
- Changing and cleaning sand filters, which may be contaminated with lead and other heavy metals;
- Procedures for incinerator operation/shutdown in emergency situations, especially with respect to the use of emergency respiratory protection; and
- Decontamination of heavy equipment, especially with respect to containing overspray to prevent contamination of the personnel decontamination trailer.

In contrast, hazard analyses were available for all tasks and operations at Site D. The site's approach to hazard analysis was unique in that it asked the employees who performed each operation to conduct the analysis. The employee performing each task or operation completed a standard form, and the information was reviewed and supplemented where necessary by the safety and health supervisor. This approach minimized the potential for operations to be overlooked during the hazard analysis and ensured that all important hazards would be identified.

Employee Exposure Monitoring: As discussed above, the results obtained from a site's exposure monitoring program should be used to continually improve and refine the ongoing process of operation-specific hazard analysis, which is designed, in turn, to identify the appropriate kind and level of employee protection needed. Each of the sites inspected relied primarily on the results of real-time monitoring for organic vapor and dusts to characterize employee exposures. Selection of the appropriate level of PPE on these sites is generally based on action level concentrations determined from real-time air sampling; for example, Level C PPE is indicated when dust concentrations exceed 1 mg/m^3 or organic

vapor concentrations exceed 1 ppm. This approach which is commonly used on hazardous waste sites, was recommended by EPA's Standard Operating Guides (1984). Relying on real-time sampling results to guide PPE selection is certainly appropriate during the initial site entry and characterization phases, where the nature and the extent of the hazards on the site are largely unknown; however, by the time the sites are engaged in active remediation, a considerable amount of data has been compiled that enables fuller and more accurate characterization of employee exposures and therefore provides a sounder basis for the selection of PPE. Four of the five sites inspected collected personal air samples for various contaminants known to be present on site; the contaminants selected for monitoring represented the principal contaminants identified in the preliminary Remedial Investigation/Feasibility Studies (RI/FS) conducted before work began at the sites. However, no site actually used these monitoring data to make decisions about the PPE to be worn by employees or to determine whether employees were being exposed to other air contaminants. As a result, OSHA concluded that employee exposures were not being characterized sufficiently to permit the selection of the most appropriate level of protection.

Specifically, at Site A, no personal sampling for air contaminants had been conducted, despite potential employee exposures to PCBs, arsenic, lead, organic solvents, diesel exhaust, and carbon monoxide. The level of PPE assigned to employees was based primarily on the location of the operation rather than on the concentration of the contaminants to which employees were exposed. The safety and health supervisor at this site used a miniram real-time dust analyzer to determine exposures to lead and PCBs but did not appear to factor the results of this monitoring into the PPE selection process. In addition, the monitoring equipment being used was not always properly calibrated to manufacturer's specifications.

Similarly, the monitoring program implemented at Site C did not adequately characterize the health risks associated with each site task or operation. No personal monitoring had been performed to determine employee time-weighted-average exposures for any work tasks conducted on this site. Specifically, the site did not have a program in place to identify, evaluate, or monitor employee exposure to specific air contaminants that were identified in the original site investigation such as lead, vinyl chloride, or specific organic solvents. The only environmental monitoring conducted had been area sampling using a

photoionization detector for total organic chemical vapors, a direct reading meter for toluene diisocyanate (TDI), and a combustible gas meter.

Consequently, the PPE usage at Site C appeared to be more related to corporate policy rather than on a site-specific evaluation of site hazards. The use of unnecessarily high levels of PPE in itself may create a hazard due to restricted vision and mobility, and increased potential for heat stress. Although Level B protection would always be necessary during excavation and drum characterization operations, OSHA believes that certain areas of the site in which Level B was being used, such as the feed hopper, can be sufficiently characterized so as to permit the use of half-mask or no respirators most of the time. To this end, direct reading instrumentation can be used on an on-going basis to determine the appropriate level of respiratory protection after employee exposure has been adequately characterized through the use of personal samples.

At Site E, personal air samples were routinely taken for benzene and vinyl chloride, as mandated by the contract with the oversight agency; however, no program was in place at this site to identify and quantify airborne levels of other hazardous substances present. This deficiency was particularly important at this site because a number of employees reported experiencing signs of respirator cartridge breakthrough or facepiece leakage, despite personal sampling results indicating that exposures to benzene and vinyl chloride were low. In other words, these employees were being exposed to concentrations of unknown contaminants while working in the exclusion zone. In addition, management at Site E paid inadequate attention to the monitoring program, as evidenced by the late submission of samples for laboratory analysis.

The SAHP for Site D contained provisions for real-time sampling for organic vapors and dusts, personal air sampling for pentachlorophenol and polynuclear aromatic hydrocarbons, and detector tube measurements for benzene, toluene, xylenes, and vinyl chloride; however, only the real time organic vapor measurements were used to select the appropriate level of PPE. Furthermore, the sampling program specified in the SAHP was inconsistently implemented by safety and health personnel; direct-reading measurements were not taken in accordance with the schedule outlined in the SAHP, and no personal air samples for pentachlorophenol had been taken in a period of more than two months. Most of these

difficulties were attributable to the absence of a designated site safety and health officer until just prior to the inspection.

The exposure monitoring program at Site B was the most complex of the programs at all sites inspected. This program called for frequent real-time measurements of organic vapor and dust levels and personal air sampling for several indicator substances, including PCBs, toluene, naphthalene, phenols, and trichloroethylene. Several personal air samples for these materials were taken daily; however, not all were subject to analysis. According to the contract between the oversight agency and the contractor, air samples were selected for analysis only if real-time measurements indicated the potential for relatively high exposure or the samples were selected for analysis by the oversight agency's contracting officer. These sample selection procedures were not described in the SAHP, nor were employees routinely notified that air samples were not submitted for analysis, according to discussions with Laborer's representative. Instead, employees were interpreting the fact that they were not being notified of the results of the sampling to mean that they were not being significantly exposed, when in fact employees were not being notified because the samples had never been analyzed.

OSHA performed a detailed analysis of the sampling results obtained by Site B personnel for a 1-month period prior to the inspection. During this month, industrial hygiene personnel collected 79 air samples; of these, 30 were submitted for analysis. About half of these were designated as area, rather than personal samples. The vast majority of samples taken and analyzed represented exposures in two areas, the pug mill and an area in which the lagoon was being dredged. Only 4 of the 30 samples analyzed were taken on employees working in the feed preparation area or in the vicinity of the incinerator, and none were taken in the ash handling area. Thus, despite the dedication of considerable time and resources to sampling, OSHA concludes that employee exposures were not being adequately characterized on an ongoing basis.

The situation at Site B reflects the fact that the site safety and health supervisor had not been given adequate authority to design a sampling strategy that reflected changing work or site conditions. For example, the company was concerned about potential lead exposures to personnel operating at newly installed pug mill and ordered that personal samples be

taken; however, because lead had not been specifically identified during the RI/FS stage, no requirements for such sampling had been incorporated into the SAHP. As a consequence, these samples were taken at the contractor's expense, which means that a disincentive had been built into the system to discourage the contractor from exercising its judgment as on-site conditions changed. Another example concerns the maintenance operation conducted about once per week at the site that requires employees to enter the secondary kiln to chip away slag that accumulates on the inner walls. Employees are provided with air-purifying respiratory protection to conduct this operation. Despite the potential for exposure to silica, personal samples for this substance have not been taken and are not required by contract, and thus there is no confirmation that air-purifying respirators are appropriate.

D. TASK-SPECIFIC HAZARD ANALYSES MUST LEAD TO THE DEVELOPMENT OF WRITTEN STANDARD OPERATING PROCEDURES (SOPs) THAT SPECIFIED THE CONTROLS NECESSARY TO SAFELY PERFORM EACH TASK.

Detailed hazard analyses conducted for each site task and operation provide the basis for developing standard operating procedures to protect employees from safety and health hazards. Written safety and health SOPs provide a mechanism for keeping employees aware of procedures that ensure their safety and for management to ensure that hazard control procedures are enforced. Requirements for written safety and health SOPs are included in paragraphs (b)(4)(i) of the HAZWOPER standard. In general, the inspection team found that written SOPs either lacks sufficient detail to be useful to employees and safety and health personnel, or were not available for several important operations.

For example, the SAHP developed for Site B did not include written safety and health procedures and protective measures to be used for the emergency shutdown of the incinerator. Safety and health hazards may be present during automatic waste feed shutoff (AWFSO), which can occur from a variety of causes, such as elevated stack temperature, low furnace vacuum, low oxygen levels, failure of the furnace pilot light, failure of the brick lining, low water pressure to the scrubber, or inappropriate flow of waste feed. Although the site maintained written procedures for incinerator operation during AWFSO events, these

procedures did not include the safety and health measures required to address the hazards associated with each type of shutdown.

Many of the SOPs at Site B contained only broad and general statements such as "use appropriate protective clothing". Thus, the SOPs did not convey specific information on protective measures to be taken to address the types of hazards associated with each operation or task. In addition, the inspection team felt that the site's SAHP and SOPs had not been made readily available to employees; employee interviews indicated that some employees were unaware of the existence and availability of these documents. To be maximally useful, both documents should be available in the control zone where employees can refer to them as needed.

The SOPs in Site B's SAHP did not always address the specific PPE requirements of each task or operation, as required by paragraph 1910.120(b)(4)(ii)(C). For example, the site implemented a PPE program that separately identified the level of respiratory and dermal protection required for each area of the site, although this requirement was not described in the written SAHP. Despite the fact that this requirement reflected an improvement in the site's PPE program, it was not included in the most recent versions of the SAHP or in other written safety and health procedures. The root cause of this deficiency derives from contractual provisions requiring that any change to the SAHP be accompanied by the issuance of a new edition of the SAHP; since issuance of a new edition is a major undertaking, there is considerable reluctance to modify the SAHP as events on the site unfold. As a consequence, changes in safety and health procedures are not being incorporated into the SAHP. This practice has since changed at the site, and SAHP revisions may now be issued in the form of change notices; although these notices still require approval by the oversight agency's contracting officer, they are more quickly effected than was the case formerly.

Deficiencies noted in the SAHP for Site C included the absence of addressing the safety and health risk or hazard analysis for potentially hazardous operations, such as incinerator operation, feeding waste to the incinerator, or cleaning of labels on excavated barrels.

The SAHP developed for Site D did not include written site-specific safety and health SOPs for the following operations: line breaking, hot work, confined space work, repairing the primary valve on the caustic tank, and evaluating the thermal status of employees working in the exclusion zone. The SAHP did incorporate, by reference, a series of corporate SOPs covering certain of these topics, such as hot work and confined space entry work, although these SOPs had not been revised as necessary to address site-specific factors, despite a requirement in the corporate SOPs to do so. For example, the SOP for confined space entry work did not identify the specific locations of confined spaces on site.

The SAHP used at this site also did not reflect the site's practice of permitting employees to wear Level C protection when performing tasks of short duration (i.e., less than 15 minutes) in the closed waste feed preparation area (an area that normally requires Level B PPE). This exception to the normal requirement to wear Level B PPE should be discussed in the SAHP, along with the supporting reasons that justify relaxing the PPE requirement for short-duration tasks conducted in this area.

At Site A, the written SOPs for confined space entry lack detail. For example, the SOP did not identify the specific locations of the confined spaces at the site. In addition, the SOP did not explicitly require that the air quality be tested in confined spaces when air-supplied respirators were being used, nor did it require the use of forced ventilation during the conduct of hot work in confined spaces. In both cases, however, the safety and health supervisor at the site expected both of these practices to be carried out.

Safety and health SOPs in the SAHP at Site A did not address the selection of PPE for employees working in the excavation area. In addition, the site's SOPs did not specify the procedures to be used by employees to decontaminate or dispose of PPE. Furthermore, the SAHP contained no SOPs for the conduct of regular inspections/audits of the safety and health program at the site or for delegating the authority to do so.

E. EMERGENCY RESPONSE ELEMENTS OF THE SAFETY AND HEALTH PROGRAM MUST BE FULLY IMPLEMENTED AS DESCRIBED IN THE PROGRAM.

The emergency response plan for a hazardous waste site is one of the key components of a site's SAHP. Major elements of the emergency response plan include coordination with

local organizations that provide emergency response services (i.e., fire department, health care facility, and local emergency response center), training employees in emergency response alerting and evacuation procedures, and conducting drills to determine the effectiveness of the emergency response plan. Requirements for developing and implementing emergency response plans are contained in paragraph (l) of the HAZWOPER standard.

All SAHPs of the incinerator sites that were inspected were deficient in the emergency response training provided to employees. In addition the SAHPs of these same sites had incomplete or outdated written emergency plans.

Inspection of Site B revealed a number of areas in which emergency planning needed to be improved. In particular, the employees responsible for implementing the emergency procedures associated with shutdown of the incinerator did not have direct access to or training in the use of the PPE that might be necessary during shutdown, nor was emergency SCBA or other respiratory protection available to employees in the incinerator control room. In addition, the safety and health officer for the subcontractor charged with operating the incinerator at Site B had difficulty locating the written emergency shutdown procedures when OSHA requested them to do so.

At the time of the inspection, OSHA understood from employee and management interviews that only one evacuation drill had been conducted at Site B, and that this drill had not been very successful. In their response to OSHA's findings, however, the prime contractor reported that three drills had been concluded prior to the inspection and that two of these had been deemed to be successful; the third was not considered adequate due to missed communication among the parties regarding the execution of the drill. In no case have the emergency drills at Site B involved other than on-site employees; according to management personnel at Site B, this was due to difficulties encountered when attempting to coordinate arrangements with community organizations through the oversight agency.

An OSHA inspector contacted several of the local emergency response organizations in the area of Site B, and neither the county Emergency Response Center nor the local hospital were able to locate copies of the site's written emergency response plan. A hospital

representative did report that procedures had been developed for tracking potentially contaminated patients, however.

Site B's Spill Control and Response Plan was not current, as evidenced by the organization chart, which identified as responsible individuals, persons who were no longer employed at the site. In addition, the written Spill Response Plan contained procedures for conducting monthly meetings, drills, and periodic spill containment inspections; none of these procedures were being implemented at the site. OSHA recommended that the program be reevaluated to ensure that it addressed specific hazards at the site, including those locations around the aqueous waste treatment area where hazardous materials were being stored.

Interviews with employees at Site B indicated that some were not familiar with the meaning of the emergency signals identified in the SAHP, indicating the need to provide more frequent training and practice drills. The site relied heavily on the use of small air horns located strategically throughout the site to provide notification of emergency situations; however, access to some of these horns was blocked by drums and equipment. In addition, the main siren located at the site had not been tested periodically because of concerns about alarming the surrounding community.

As was the case with Site B, employees at Site D were not familiar with all emergency signals and procedures specified in the SAHP. In addition, the SAHP did not specifically address procedures to be followed in the event of fire; it was the company's policy that employees not fight fires beyond the incipient stage.

At Site A, OSHA found that the emergency alerting procedures of the two on-site contractors were inconsistent and were not clearly understood by site employees. The SAHP for each contractor specified the use of air horns for emergency alerting, but personnel from the subcontractor at the site indicated that they would actually rely on radio communication in an emergency. Additionally, the two contractors had different alarm signals; for example, one contractor planned to signal site evacuation using one long blast followed by one short blast, while the other contractor's plan mandated the use of continuous 30-second blast. Both contractors also used different radio frequencies, which creates the potential for miscommunication during an emergency.

Other deficiencies in the emergency plan at Site A included the following:

- There was no emergency SCBA in the incinerator control room, despite the potential for emergency conditions that may dictate the use of such equipment;

- The emergency response plan did not identify specifically where employees were to assemble during an emergency evacuation. In addition, maps were not readily available that showed the evacuation routes to pre-designated assembly areas;

- The emergency response plan was not rehearsed regularly, according to interviews with employees; and

- Emergency air horns and spares were not kept in the decontamination trailer, as required by the SAHP.

The SAHP developed for Site E did not address all anticipated emergencies, including procedures to be followed in the event of natural gas line rupture or fires. In addition, alternate evacuation routes should have been established for employees working in the exclusion zone; only one evacuation route was indicated in the SAHP. During the inspection, the site had an evacuation drill that made it apparent that site personnel were aware of evacuation routes; however, the emergency alarm siren could not be heard inside the control zone trailer where inspection team members were reviewing records, and personnel in this trailer had to be verbally instructed to evacuate. Thus, the emergency alerting procedures did not conform to the requirements of 1910.120(l)(3)(vi) or 1910.165 regarding the use of emergency alarms.

The emergency response plan for Site C did not accurately describe the training requirements for members of the on-site emergency response team. Additionally, the deficiencies included team member names not being identified, as well as the level of involvement the team is expected to have in an emergency response. Further, the SAHP for this site failed to address the emergency response plan for chemicals brought onto the site such as fuel or wastewater treatment plant chemicals, although the emergency response plan did address spills of the identified landfill contaminants.

F. ALL SITE CONTROL ELEMENTS OF THE SAFETY AND HEALTH PROGRAM MUST BE FULLY IMPLEMENTED AS DESCRIBED IN THE PROGRAM.

Inspection team members found that certain elements of each facility's site control program were not being rigorously implemented. In particular, this included the use of the buddy system, which is required by paragraph (d)(3) of HAZWOPER. The purpose of these requirements is to ensure that only properly trained and authorized individuals enter those areas of the site where potential hazards are present, and that, in the event of an emergency, rapid assistance can be rendered to employees working in the exclusion zone.

At four of the sites inspected, use of the buddy system for employees entering the exclusion zone was required in the SAHP, but the systems were generally informal and, as a result, were inconsistently implemented. For example, it was not evident from Site C's SAHP that the buddy system would be in place during all activities conducted in areas requiring Level B PPE (these activities included trailer placement, surface soil sampling, groundwater well installation, groundwater sampling, and surface water sampling).

In general, employees at these sites were instructed to watch for each other in the exclusion zone, but no formal assignment of partners was made prior to entry into the exclusion zone. Evidence of this deficiency could be seen in the exclusion zone entry/exit logs, which contained numerous entries by single individuals who were not paired with a buddy. Furthermore, employees wearing respiratory protection equipment were observed to be working without the benefit of direct observation by a designated buddy.

Therefore, the health personnel on these sites need to reevaluate their criteria for determining where the buddy system is necessary, and to formalize the use of the buddy system in those areas so that employees have a clear understanding of the importance of adhering to the buddy requirement.

Demarcation of different work zones on hazardous waste sites is another crucial feature of the site control program. In general, the various work zones were clearly identified and demarcated at Sites A, C, D, and E. Entry and egress of personnel and equipment through the exclusion zone were accomplished on these sites via well-established decontamination facilities. However, at Site B, demarcation of the various work areas was less clear, due in large part to the movement of barricades by equipment.

G. THE SAFETY AND HEALTH PROGRAMS MUST INCLUDE PROCEDURES FOR MONITORING THE EFFECTIVENESS OF PPE, DECONTAMINATION PROCEDURES, OR HOUSEKEEPING PROGRAMS.

Safety and health supervisors at hazardous waste sites need to evaluate the effectiveness of their safety and health programs on an ongoing basis to ensure that SOPs are warranted. Monitoring the effectiveness of the program is required under paragraph (b)(4)(iv) of the HAZWOPER standard. In general, inspections uncovered the fact that safety and health personnel have not established objective procedures for monitoring the effectiveness of certain elements of their programs, in particular the use of PPE, decontamination procedures, and housekeeping procedures. The effectiveness of these program elements can be assessed in a variety of ways, such as by taking wipe samples on decontaminated equipment and surfaces in clean areas, analyzing the final decontamination rinse water for the presence of contaminants, or visual inspection of PPE for signs of leakage or failure. During these inspections, wipe samples of work surfaces in clean areas, as well as skin wipes and hand washes, were collected to examine the effectiveness of PPE and procedures for preventing contamination of clean areas. None of the sites inspected employed methods such as these to evaluate the effectiveness of their programs.

At Site B, PCB surface contamination was found in the incinerator control room and in a portable laboratory located in a Level D PPE area near the incinerator kiln. Also at this site, inspection team members observed that overspray from the equipment decontamination area presented a potential exposure hazard to personnel in an adjacent Level D PPE area; thus, although the procedures used to decontaminate equipment at this site may have been effective, the methods employed created another potential exposure hazard that was readily apparent even on direct visual observation. Other sites avoided this problem by using curtains to contain any overspray.

During the inspection at Site D, team members observed a number of employees doffing potentially contaminated PPE in a manner inconsistent with the site's SOPs; for example, some employees were observed removing their inner gloves before removing their potentially contaminated outer clothing. In addition, it was observed that cotton coveralls worn under Tyvek protective clothing showed visible signs of contamination after employees had finished using a high-pressure water wash to decontaminate large excavated items; this

suggests that a more impervious type of protective clothing (such as double-seamed Tyvek) should be used during this operation. Thus, the ineffectiveness of the protective clothing worn during this operation was readily apparent, again by direct visual observation.

At Site C, workers in the materials preparation building and feed hopper areas were required to wear Saranex coated Tyvek and level B respiratory protection. However, the rationale for this level of protection was not stated in the SAHP. Because these workers handled contaminated soil, it appeared unlikely that there was a potential for serious skin exposure to liquid chemicals. Uncoated Tyvek clothing would have most likely provided adequate skin protection for these workers. The use of the Saranex coated Tyvek greatly increased the potential for heat stress among these workers.

H. SELF-AUDIT SITE INSPECTION AND ABATEMENT TRACKING PROGRAMS MUST BE FORMALIZED AND EFFECTIVELY IMPLEMENTED.

The overall effectiveness of the safety and health program must be evaluated, in part, by conducting regular inspections and audits to ensure that the program is being properly implemented. In addition, there should be a mechanism to follow-up on corrective actions recommended by the site safety and health officer during safety inspections. All hazard abatement action identified by the site safety and health officer should be tracked to ensure that the corrective actions have been implemented and the hazard(s) have been eliminated. The program should designate individuals to periodically inspect work areas and ensure that hazard abatement has been accomplished. Paragraph (b)(4)(iv) of the HAZWOPER standard contains the requirement that the site safety and health supervisor, or a knowledgeable designee, perform periodic inspections to evaluate the effectiveness of the program.

Some of the program deficiencies discussed above point to the need for more rigorous and formalized inspection and abatement tracking procedures on the sites inspected. Examples demonstrating this include the instance at Site D where improper PPE doffing procedures were being used, the inaccessibility of some of the emergency air horns at Site B, and the lack of a system at Site C for ensuring that safety and health problems are corrected in a timely manner. Documented instances in which safety and health standards were not

being complied with point to the need to strengthen self-inspection and abatement tracking at these sites. These findings are summarized in Table 3.

I. PROCESS SAFETY MANAGEMENT PROCEDURES FOR THE INCINERATOR FACILITY NEED TO BE IMPROVED.

Hazardous waste incineration is a complex process in which a number of upset conditions can result in potential hazards to employees; these hazards are typically presented when the upset condition causes a sudden increase in system pressure or a bypass of the pollution control equipment. Transportable incinerators are equipped with several safety interlock systems that trigger automatic equipment shutdown or interruption of waste feed when operating parameters fall outside the normal range. However, safe operation of incinerator equipment still relies heavily on the attention of the operator and the implementation of proper maintenance and repair procedures that optimize the safety and reliability of the incinerator and its associated equipment. Although the incinerator sites inspected in this study do not generally fall within the scope of OSHA's process safety management standard (29 CFR 1910.119), the inspection team applied many of the principles that formed the basis of that standard to evaluate each site's management procedures for ensuring the safe operation of the incinerator. Some of these principles include maintaining accurate Piping and Instrumentation Diagrams (P&IDs), developing and implementing written programs for regularly scheduled equipment maintenance, ensuring that safety equipment such as pressure relief devices are properly installed and operating, and keeping accurate records of repairs and modifications made to the system.

At three of the sites, production operations had been initiated only a few weeks prior to the inspection; few repairs or process modifications had been undertaken. Each of these sites had procedures in place to maintain accurate records of such activities. The inspection team believed that, should there be any change in the supervisory personnel responsible for incinerator operation, adequate information regarding system design and operation would be available for their use. At Site B, however, only daily visual inspection and maintenance logs were kept. No routine procedures were in place to ensure that records of process modifications were maintained or that P&IDs were updated. Responsibility for incinerator

TABLE 3. SUMMARY OF SAFETY AND HEALTH VIOLATIONS IDENTIFIED ON HAZARDOUS WASTE INCINERATOR SITES

Name of Site	Description of Violation	Citation
Site A	Natural gas line was not protected from impact.	1910.120(g)
	Certification of lockout/tagout inspections not provided.	1910.147(c)(6)(ii)
	Alloy chain slings were not properly identified by label.	1910.184(e)(1)
	Wire rope sling with broken wires was not removed from service.	1910.184(f)(5)(i)
	Bench grinder did not meet specifications for clearance and guarding.	1910.215(a),(b)
	Barrier guards were not provided to protect employees from rotating machine parts.	1910.219(c)(2)(i)
	Belts and pulleys on compressor were unguarded.	1910.219(d),(e)
	Chain and sprocket wheels were not enclosed.	1910.219(f)
	Open-sided floor platforms were guarded.	1910.23(c)(i)
	Employees were not protected from incidental welding rays.	1910.252(b)(2)
	Flexible cords were used in lieu of permanent wiring.	1910.305(g)(i)
	High-voltage boxes were not properly secured or labeled.	1910.305(b),(g)
	Moving equipment had non-operating backup alarm.	1926.602(a)
	Employee was within swing radius of backhoe.	1910.651(e)
Site B (Continued on next page)	Signs designating work zones have been moved by equipment and not replaced on a timely basis.	1910.120(d)(3)
	Employees were not provided with separate clean and dirty change areas.	1910.120(n)(7)(2)
	Building had unguarded plat form on three sides.	1910.23(c)
	Workers were on elevated platform without benefit of guardrail or safety belt.	1910.23(c)
	Unguarded floor opening was located more than 6 feet from ground.	1910.23(a)(8)

TABLE 3. SUMMARY OF SAFETY AND HEALTH VIOLATIONS IDENTIFIED ON HAZARDOUS WASTE INCINERATOR SITES (Continued)

Site B (Continued)	There was no means of safe egress from a second level platform.	1910.36(b)(1)
	Caution signs were not provided near high-voltage electrical sources.	1910.304(d)(2)
	Acid and caustic charging areas were not provided with emergency eyewash or shower.	1910.151(c)
	Feed conveyor was unguarded, exposing employees to nip-point hazard.	1910.212(a)
	Ground plug was missing from electrical power tools.	1926.300(a)
	Front-end loader had cracked front and side windshields.	1926.601(b)(5)
	Flexible electrical wire was used in lieu of fixed wiring.	1910.305(g)(1)(iii)
Site C (Continued on next page)	MSDSs were not routinely checked for completeness and accuracy;	1910.1200(g)(8)
	Labels on several containers including the caustic and acid tanks in the water treatment plant had no hazard warnings; other containers, such as fuel cans, had no labels at all.	1910.1200(f)(5)(ii)
	There were no methods to deal with the hazards of non-routine tasks and no method for informing employees of contents of unlabeled pipes.	1910.1200(e)(1)(ii)
	There were no methods of informing employees of the hazards associated with foreseeable emergencies.	1910.1200(e)(2)(ii)
	The water treatment building had improperly guarded platforms on two 13-foot storage tanks.	1910.23(c)
	The elevated platform on a hopper near the baghouse had a broken guardrail on the west side. The guardrail on the truck into which the baghouse fines are loaded had broken guardrails on all sides.	1910.23(c)
	An unguarded floor opening was located about 4 feet from the ground on the platform near the baghouse.	1910.23(a)(8)
	The step-up inspection platform on the drum crusher was not adequately guarded.	1910.212(a)(3),(4)

TABLE 3. SUMMARY OF SAFETY AND HEALTH VIOLATIONS IDENTIFIED ON HAZARDOUS WASTE INCINERATOR SITES (Continued)

Site C (Continued)	A live electrical box on the east end of the lunch room trailer was not properly guarded from vehicle traffic.	1910.303(g)(2)(ii)
	The battery charging area located in the compressor shed was not provided with an acceptable emergency eyewash.	1910.151(c)
	The handle for the main natural gas shut-off was removed from the valve stem.	1910.120(l)(i)
Site D	Electrical extension cord lacked ground plug.	1926.300(a)
	Drums used to transfer flammable liquids were not grounded or bonded.	1910.106
	No fire watch was present during a welding operation.	1910.252(d)(2)(ii)
	HAZCOM program was deficient in that MSDS's were missing and no hazard warning labels were used on caustic tanks.	1910.1200
	Issuance, enforcement, and review of hot work and confined space entry permits were not effectively performed during welding operation.	1910.146(c)(1&2), (f)
Site E	Standard operating procedures for decontamination and PPE were not being adhered to.	1910.120(c)(5), (k)
	Confined space entry permit did not address possible hazards.	1910.146(c)(5)(C)
	Record of fire extinguisher inspection was not available.	1910.157(e)

maintenance was delegated to a single person (the lead engineer), who was familiar with process maintenance and modifications that had been conducted up to that time, but maintained no accurate historical record of these changes. Thus, the inspection team believed that there was a need at this site to implement formal and systematic recordkeeping procedures to ensure safe operation of the incinerator in the event of a personnel change.

At four of the sites inspected, the inspection team noted a lack of any capability to manually separate or disconnect the natural gas feed line from the incinerator in the event of an emergency. Each site possessed the capability of stopping gas flow to the incinerator through the use of electrically operated relays; however, it would not be possible to isolate the natural gas supply from the TDF at the source. At Site A, the main shutoff valve of the natural gas line was located just outside the main gate of the plant; this valve lacked either a computer-controlled interlock or manually operated valve. The guard was instructed to manually close the main gas valve in the event of an emergency, but no wrench or other device was readily available to enable him to do so. At Sites B and C the main gas valve lacked a handle that would enable an employee to isolate the TDF from the gas supply. The main gas valve at Site D was located 300 feet from the site entrance and also lacked a handle.

J. PROCEDURES TO MONITOR FOR AND REDUCE HEAT STRESS NEED TO BE EFFECTIVE.

Perhaps the greatest health hazard facing hazardous waste site workers is that of heat stress, which is exacerbated by the use of impermeable chemical protective clothing. Ideally, a comprehensive heat stress program will include several elements, including environmental and medical monitoring (i.e., measurements of pulse rate, oral temperature, and/or weight loss), issuance of heat alerts, implementation of work-rest regimens when site conditions warrant, provision for fluid intake and shaded rest areas in the exclusion zone, and regular training of employees in recognizing the signs and symptoms of heat stress in themselves and others. The inspection team found that heat stress programs varied considerably among the sites inspected, and in no instance were all elements of a comprehensive heat stress program present.

Safety and health personnel at Site B conducted periodic environmental monitoring to measure wet-bulb-globe-temperature (WBGT) conditions; these were used to trigger work-rest regiments in accordance with the site's SAHP. In addition, pre- and post- shift body weights were taken on employees assigned to work in the exclusion zone. No other medical monitoring was routinely conducted, but the contractor was experimenting with the use of remote pulse sensors at the time of the inspection. During the inspection, two workers entered the decontamination trailer with signs of heat exhaustion; two health and safety technicians were present at the time, but did not know what actions to take. Employees interviewed during the inspection stated that they had complained of lack of shaded rest areas in the exclusion zone, but none had been provided.

Safety and health personnel at Site D issued verbal warnings of potential heat stress hazards when temperatures exceeded 70°F. Workers were trained to recognize signs and symptoms on site, but there was no provision for medical or environmental monitoring of heat stress condition. Employees stated during interviews that they believed their training adequately protected them from heat stress.

Site E was the only one inspected that implemented routine medical monitoring for heat stress. Pulse rates were determined after workers exited the exclusion zone, and these rates were required to fall to predetermined levels before the workers were allowed to re-enter. No heat stress program was described in the SAHP for Site A; the written program included only an appendix containing information publications. Similarly, the SAHP for the Site C did not provide for taking environmental measurements or otherwise characterizing the potential for heat stress to determine when engineering controls, work practices, or other control measures are to be instituted.

V. SUMMARY

The primary findings of this project to date point the need for a change in culture at these sites. Despite the fact that these safety and health programs were generally comprehensive in scope and were oriented toward compliance with HAZWOPER and other applicable standards, our inspections revealed consistent deficiencies attributable to the failure

to apply professional judgment appropriately and to pay attention to meaningful details. These problems were evidenced in several ways:

- Hazard analyses failed to consider all of the available data describing the safety and health conditions at each site;
- Objective measures to evaluate the effectiveness of the site's safety and health program, particularly for PPE use, decontamination procedures, and heat stress programs were lacking; and
- Exposure monitoring programs were targeted toward compliance rather than toward the characterization of employee exposures.

In addition, these inspections identified several disincentives and obstacles that would interfere with efforts to alter the safety and health culture at these sites. For example, contractors are often not free to exercise independent judgment because contractual provisions lock them into predetermined activities that do not permit them to respond to changes in site conditions or to new information. Another obstacle that operates against improved hazard recognition and evaluation skills is the training currently provided to safety and health personnel. At present, most of the technicians at these sites are inadequately trained to do more than follow "cookbook" instructions. In summary, OSHA believes that nothing short of rigorous program of on-going self-assessment, improved training in hazard recognition and evaluation, enhanced management commitment, and sustained employee involvement in the program will achieve the change in culture needed to move these sites toward excellence in occupational safety and health.