Lessons From Superfund and RCRA | 2

The United States has had nearly 20 years' experience with hazardous waste operations at Resource Conservation and Recovery Act (RCRA) and Superfund sites, Much of this work has involved site characterization efforts: attempts to identify the nature of site pollutants and to map their locations, concentrations, and environmental transport routes. In addition, emergency removals of contaminants have been carried out at about one-third of all (non-Federal) sites on the National Priorities List (NPL).[12] permanent cleanup activities and construction projects that usually involve more complex and lengthy remediation actions are just getting underway at most sites. Nonetheless, the RCRA-Superfund experience offers important lessons about protecting the health and safety of workers engaged in environmental remediation—lessons that are directly applicable to cleanup of the Nuclear Weapons Complex.

The RCRA - Superfund experience offers important lessons about protecting worker health & safety

WORKER PROTECTION ISSUES WITHIN THE REGULATORY PROCESS

Competition Between Worker Protection and Other Cleanup Priorities

The environmental laws and regulations that drive the goals and schedules of most environmental cleanup operations do not assign worker health and safety a high priority. Superfund and RCRA regulations and procedures are complicated, and are intended to guide employers through the multitude of technical uncertainties and necessary assumptions that are inevitably part of environmental remediation.[3-5] *Amid the* complexities and controversies surrounding site characterization, remedial design,

and cleanup, the information and programs needed to ensure the safety and health of cleanup workers and emergency responders can be overshadowed or neglected.

In setting cleanup priorities, site owners, managers, and regulators must contend with a range of issues and goals, such as the concerns and priorities of local communities, technical obstacles to meeting target levels of residual contamination, legally binding agreements on cleanup schedules or project "milestones," and cleanup costs. The importance of worker health and safety protection may become lost in this welter of competing issues, especially when the workforce is unorganized, transient, and inexperienced—as is the case for a large proportion of cleanup workers[6]—and when work-related illnesses are not clearly linked to specific work hazards or appear only years after initial exposure.

The Agency for Toxic Substances and Disease Registry (ATSDR) is responsible for determining the potential human health impacts of toxic materials released into the environment. ATSDR has broad statutory authority to evaluate the human health implications of environmental toxicants, and has occasionally intervened to protect the health of cleanup workers.[7] ATSDR officials are rarely present during cleanup operations however, and the Agency's work focuses mostly on possible off-site health effects of Superfund and RCRA pollution.

In some circumstances, efforts to mitigate risks to off-site populations may increase the health and safety hazards faced by cleanup workers. For example, at one Superfund site, contractors proposed construction of a structure to prevent air releases of volatile organic compounds (VOCs) that were being pumped from contaminated groundwater. However, workers operating within this structure would have been exposed to VOC levels that were up to half the concentration believed immediately dangerous to life and health,[8] OSHA and EPA recently agreed to make investigations of worker protection issues associated with "enclosures" at hazardous waste sites a high priority.[9]

Weak Oversight of Occupational Health and Safety Rules by Regulators

The Occupational Safety and Health Act holds all employers responsible for providing workers with "safe and healthful working conditions."[10] The Occupational Safety and Health Administration (OSHA) standard for Hazardous Waste Operations and Emergency Response (HAZWOPER), enacted to protect cleanup worker health and safety, mandates a structured, but nonspecific, performance-based approach to worker protection during hazardous waste operations and emergency response.[11] Under this standard, crucial and complex decisions about how to identify and mitigate cleanup worker health risks are left to the judgment of individual employers.

The quality and the comprehensiveness of health and safety programs implemented under HAZWOPER at Superfund and RCRA sites are reported to vary widely.[12] 13 These inconsistencies stem from several sources, including of information gaps and uncertainties about necessary levels of worker protection; differences in the rigorousness with which different employers pursue worker safety and health protection; OSHA's failure to issue detailed guidance documents that would help employers to interpret and apply the broadly worded HAZWOPER regulation; and a weak OSHA enforcement effort.

OSHA and EPA cooperatively developed an OSHA inspection protocol for incinerators at Superfund sites.[14] In general, however, OSHA enforcement of HAZWOPER has been weak.[15] OSHA has about 1,000 inspectors (including supervisors and trainers) to enforce health and safety standards for almost 3.6 million employers and 55 million workers.[16] Aside from the handful of planned Superfund incinerator inspections, OSHA has not targeted the more than 4,000 RCRA sites that may require or have undergone

remediation, or the 1,354 sites on Superfund's NPL[17,18] as high priorities for OSHA inspections.

EPA is the Federal agency with the most expertise in hazardous waste operations. However, EPA staff are not well prepared to assess or oversee worker health and safety during cleanup. Few of EPA's regional staff or project managers have occupational health and safety backgrounds. Currently, EPA maintains that it does not have the authority to enforce OSHA's HAZWOPER requirements .19

EPA has, at times, neglected to consider worker risks when selecting cleanup options.[20,21] Although EPA officials have acknowledged the need to weigh worker health risks against the benefits of particular remediation measures, they have developed a formal means of doing so only in the past few months, and the effectiveness of the proposed changes in EPA's risk assessment approach has yet to be tested.[22]

EPA's principal goals, which are largely a response to public and congressional pressures, are to reduce the time needed to complete the RCRA and Superfund processes, and to accomplish cleanup more cheaply. A recent proposal for a "new Superfund paradigm" is designed to speed up site assessments and initiate activities early on in the cleanup process to reduce "immediate risks."[23] It is not clear how this new paradigm will affect cleanup worker health and safety. Some contend that these "faster, cheaper" priorities are at odds with worker protection needs, which might in certain cases dictate a "go-slow" approach to unusually hazardous situations or when implementing innovative remedies.[24]

Neither the assessment of cleanup worker health and safety risks nor the evaluation of proposed and implemented worker protection programs has high priority for the regulatory agencies most involved with the implementation of Superfund and RCRA. The OSHA regulatory officials who are most knowledgeable about worker protection issues generally are not familiar with environmental cleanup work and are rarely present during cleanup operations. The EPA regulators who are most familiar with hazardous waste work know little about OSH matters and refuse to enforce OSHA standards. The net result is that interpretation and implementation of cleanup worker OSH standards are highly variable and are left, essentially, to the voluntary efforts of employers.[25-27]

EPA-Labor Health and Safety Task Force

The EPA Office of Solid Waste and Emergency Response (OSWER) has established the EPA-Labor Health and Safety Task Force, consisting of employees from EPA, OS HA, the National Institute of Occupational Safety and Health (NIOSH), the Army Corps of Engineers (ACE), and representatives of labor unions whose members frequently conduct cleanup work. Regular meetings of the Task Force have provided a collegial, nonbureaucratic setting in which participants can discuss problems associated with the interpretation and enforcement of HAZWOPER from a technical and professional perspective, [28] outside the policymaking process.

The Task Force is situated in the EPA office that has line control over remedial action programs. Task Force members believe this organizational position gives it greater authority and persuasive powers with contractors and construction managers than if it were located in a health and safety oversight unit.

The Task Force has facilitated the clarification and integration of EPA, OSHA, and ACE policies, and has been constructive in identifying some of the more pressing and pervasive worker protection problems at RCRA and Superfund sites. One major accomplishment of the group is the preparation of "fact sheets," or simplified guidance documents, on topics that have been problematic at Superfund sites.[29-34] **Other ac-**complishments that have been stimulated by needs identified by the Task Force include a Memoranda of Understanding between OSHA

and EPA that provide EPA funding to train OSHA personnel and develop a protocol for OSH inspections of hazardous waste incinerator operations.[35,36]

The Task Force represents a multidisciplinary, interagency, cooperative effort that has proved extremely useful in developing viable approaches to worker health and safety protection in the environmental cleanup industry. EPA's OSWER deserves credit for initiating and supporting the Task Force. Yet despite such progress, the Task Force appears to enjoy only limited support among EPA and OSHA policymakers. EPA has not hired any health or safety professionals to replace the two industrial hygienists who formerly staffed OSWER's Design and Construction Management Branch. OSHA, too, was initially reluctant to participate in the incinerator inspection project.

Some evidence suggests that EPA staff perceive Task Force suggestions and findings as potential impediments to the achievement of other agency goals, such as the speedy completion of cleanup.[37-39] There is some *justificatiion* for such concern. One issue that the Task Force has raised repeatedly is the inadequacy of site characterization data with respect to the identification of potential safety hazards and worker health risks.[40-42] provisions that would allow revision of or additions to the regional site characterization so as to better support HASPS might delay cleanup schedules.

The Task Force has also focused attention on the inadequacy of emergency response plans at some Superfund sites. Lack of appropriate training and equipment on the part of municipal firefighters who might be called on to respond to emergencies during the cleanup operation is of particular concern.[43-45] Remedying these problems may be time consuming and costly.

Since EPA is under considerable pressure to demonstrate rapid progress in moving waste sites through to closure, delays are of concern to OSWER staff. However, avoiding delays in future cleanup schedules might best be accomplished by ensuring that worker risks area specific focus of initial characterization efforts, requiring management to take proper heed of site hazards, and instituting appropriate emergency response plans. Such actions could improve community acceptance of cleanup plans and thereby expedite the remediation process.

Worker Protection Needs and Site Characterization

Site characterization activities are especially important to efforts to protect cleanup workers. Characterization data obtained during the Remedial Investigation/Feasibility Study (RI/FS) process in Superfund cleanups and during RCRA Facility Investigation (RFI) efforts are supposed to provide information about the presence, location, and concentration of hazardous contaminants so that appropriate engineering responses to the pollution can be devised.[46]

EPA requires that potential remediation alternatives at Superfund sites[47] be assessed against nine criteria that include overall protection of human health and the short-term effectiveness of different cleanup technologies-thus implying the obligation to consider risks to cleanup workers.[48] Practitioners and health professionals consulted by the Office of Technology Assessment (OTA) maintain, however, that in practice, other criteria—particularly "implementability" and cost—weigh more heavily than protection of cleanup worker health and safety. In practice, possible threats to cleanup workers are seldom considered at the outset of site characterization efforts, and such issues are rarely factored into decisions about environmental sampling strategies.[49-51] Consequently, RI/FS and RFI data frequently fail to provide the information needed to determine the nature or seriousness of the health and safety hazards that cleanup workers might encounter and do not always translate into useful information about potential worker exposures, health risks, or necessary protection levels.[52]

RI/FS and RFI data are the foundation on which site-specific worker health and safety plans are formulated. Health and safety plans (HASPS) are legally mandated documents intended to identify specific hazards workers might face and provide a blueprint of worker protection programs and safe work practices to be followed

PHOTO CREDIT: THE WORKPLACE HEALTH FUND

PPE is needed to prevent worker exposure to contamination when the nature and extent of toxic pollutants is uncertain, These workers wear protective clothing and respirators while drilling sampling wells.

during cleanup activities. HASPS are a key element of OSHA's HAZWOPER standard, the major Federal regulation governing the occupational health and safety of cleanup workers. If site hazards are not recognized in characterization studies, HASPS are likely to be flawed.

The failure of RI/FS and RFI data to provide sufficient information to support sound and efficient worker protection programs reflects a pervasive lack of focus in site characterization studies.[53,54] Decisions about what substances to look for at contaminated sites, what instruments to use, how long or often to carry out monitoring, etc., are very site specific, require considerable professional judgment, and are not readily prescribed by regulations (see box 2-A).[55]

OSHA standards for some toxic substances (e.g., lead, benzene) mandate specific monitoring methods to ensure accurate determinations of worker exposure.[56] Most standards do not include monitoring requirements, however, and in any case, many of the substances found at waste sites are not addressed by OSHA regulations.[57]

Careful consideration of sampling strategies, measurement methods, and quality assurance (QA) programs is essential if environmental monitoring data are to be successfully applied to worker protection programs, The National Academy of Sciences, in its recently published report on monitoring exposure to airborne pollutants, has estimated that 15 to 25 percent of the total monitoring budget should be expended on *QA*.[58]

Attempts to organize environmental monitoring programs for cleanup workers are constrained by the technical limitations of available monitoring equipment; real-time instruments suitable for field use are especially needed. (See box 2-B.) The logistic complexities of assaying worker exposures under the changeable conditions of many hazardous waste operations and most emergency response scenarios are also problematic. Finally, the costs associated with robust worker monitoring programs can be considerable, and such investments are not always recognized as high priorities in contract negotiations.[59,60]

EPA recognizes that environmental sampling strategies used in Superfund and RCRA cleanup are often poorly conceptualized, and has emphasized the need to link environmental monitoring data to specific information needs and to involve risk assessors and other health professionals early on in data collection strategies.[61] EPA has recently issued interim guidelines for risk assessment at Superfund sites that aim to streamline environmental sampling and to address directly the potential worker risks associated with implementing selected cleanup remedies.[62,63] This new approach may prove useful if it truly does direct more attention toward characterizing risks to cleanup workers. There is some danger, however, that EPA's eagerness to make site evaluations shorter and less expensive could counteract the

Box 2-A—Environmental Monitoring and Worker Protection at Hazardous Waste Sites: How Much Is Enough?

The purpose of environmental monitoring at hazadous waste sites is to identify the type and quantity of site contaminants, and to map envviromnmental transport pathways, current boundaries, and probable future migration patterns of the contamination. The appropriateness and efficiency of the traditional approach to environmental monitoring at hazardous waste sites have been controversial Some experts are frustrated with the delays and costs associated with laborious efforts to "study a site to death," whereas others complain that hasty and possibly ineffective cleanup remedies are being imposed before the nature of the contamination is understood.

At many Superfund sites, enormous amounts of data are collected to no purpose because monitoring programs not integrated with the information requirements of proposed remediation tasks, risk assessment activities, or worker protection programs. For example, at a Superfund site in EPA Region II, large numbers of environmental samples were collected and analyzed during incineration of lagoon sludge containing polychlorinated biphenyls (PCBs) and other toxic materials. The results of these analyses were not routinely reviewed by health and safety professionals, nor were they used to confirm or improve the effectiveness of ongoing occupational safety and health (OSH) procedures.[12]

Decisions about what substances to look for contaminated sites, what instruments to use, how long or often to carry out monitoring, etc., are very site specific, require considerable professional judgment, and cannot be readily prescribed by regulations. Although the Occupational Safety and Health Administration (OSHA) standard on Hazardous Waste Operations and Emergency Response (HAZWOPER) requires environmental monitoring at toxic waste sites, it does not specify that the highest exposures to most hazardous materials be monitored. OSHA standards for some toxic substances (e.g., lead, benzene) mandate specific monitoring methods to ensure accurate determinations of worker exposure.[3] Most standards do not include monitoring requirements, however, and in any case, many of the substances found at waste sites are not addressed by OSHA regulations.

[1] Joseph Cocalis, Co-chair, U.S. Environmental Protection Agency-Labor Health and Safety Task Force, personal communication to T. O'Toole, Aug. 19, 1992

[2] R. Curtis, Director, Occupational Safety and Health Administration's Health Response Team, U.S. Department of Labor, letter to J. Roche, Resident Engineer, U.S. Army Corps of Engineers, Aug. 17, 1992.

[3] U.S. Congress, General Accounting Office, *Occupational Safety and Health: Options for Improving Health and Safety in the Workplace*, GAO/HRD-90-66BR (August 1990).

benefits of an increased focus on cleanup worker health and safety.

PROBLEMS WITH CONTRACTING PRACTICES

A multilayered managerial structure encompassing a large number and variety of employers is an important feature of most cleanup operations.[64,65] Waste sites undergoing cleanup resemble more routine construction sites, with many tasks proceeding simultaneously and with workers employed by multiple contractors or subcontractors coming and going as their skills are required. A typical cleanup operation will include officials of State and Federal regulatory agencies; managers of contracting firms and subcontractors; and an array of organized and unorganized laborers, skilled workers, technicians, scientists, and engineers.[66] The sprawling, complicated structure of such a work force generates significant management challenges to protecting cleanup worker safety and health.

Contractual agreements among site owners, prime contractors, and subcontractors are the principal mechanisms for establishing the occupational health and safety programs that will be

Box 2-A—Continued

Unusual or episodic exposures like those that occur during accidents may represent some of the most serious health threats at waste sites, but such exposures would not be noted during routine monitoring. Thus, inhalational exposures that occur during unusual wind conditions, or dermal exposures that occur when a drum is pierced accidentally or when personal protective equipment fails, are not easily anticipated or documented by routine environmental monitoring. Also, monitoring data may reflect only average exposures when biological effects are determined by peak concentrations. Monitoring that measures ambient conditions may fail to reflect the actual exposure of particular individuals.

Disputes over the accuracy and adequacy of characterization data, and how these data inform interpretations of worker health risks, have caused delays in cleanup schedules at Superfund sites and Resource Conservation and Recover Act (RCRA) facilities. At a Superfund site in Massachusetts, for example, the prime contractor was unable to produce characterization data justifying the designated boundaries of supposedly uncontaminated areas. Work was halted for several months while the prime contractor, labor representatives, and regional Environmental Protection Agency and OSHA officials attempted to resolve the controversy. Additional environmental sampling was eventually necessary.[4,5] Phase I contract costs increased by $1.3 million as a result of response actions associated with safety and health issues.[6] The regarding the adequacy of site characterization data spilled over into local communities, led citizens to question the wisdom of the entire cleanup plan, and contributed to additional delays in cleanup schedules.[7]

At the Nyanza Superfund site in New England, characterization data failed to identify important site contaminants, and the HASP resulting from this inaccurate picture of site hazards proved inadequate to protect workers.[8] Employees working without protective gear, in a supposedly "clean" area of the site, uncovered drums containing unidentified materials. Six workers became ill; one was hospitalized. At this same site, it was discovered-after cleanup work had begun-that no methods existed for detecting potentially dangerous levels of methylmercury found on-site.[9] Cleanup had to be halted for several months while monitoring procedures and safe work practices were devised.

[4] L. Murphy, "Crisis in the Fire Service," Conference Proceedings of the First Environmental Protection Agency Design and Construction Issues at Hazardous Waste Sites Conference, Dallas, TX, May 1-3,1991, EPA 540/8-91/012, p. 828.

[5] P. Gratin, Area Director, U.S. Department of *Labor, Occupational Safety* and Health, letter to J. Merloni, Jr., President, Massachusetts Laborers' District Council, Oct. 13, 1989.

[6] J. Cocalis, Co-Chair, EPA-Labor Health and Safety Task Force, personal communication to T. O'Toole, U.S. Congress, Office of Technology Assessment, Aug. 19, 1992.

[7] J. Moran, Co-Chair, EPA-Labor Health and Safety Task Force, personal communication to T. O'Toole, U.S. Congress, Office of Technology Assessment, June 23, 1992.

[8] Ibid.

[9] James Merloni, Jr., Administrator, New England Laborers' Training and Trust Fund, letter to Congressman Joseph D. Early, U.S. House of Representatives, July 13, 1989.

followed during cleanup operations. From the perspective of occupational safety and health, cleanup contracts must ensure that site HASPS adequately address site hazards and worker risks, and that employers are held accountable for implementing such plans. Contracts must also be sufficiently flexible to allow individual contractors or subcontractors to negotiate changes in the original HASPS as work progresses so that the evolving understanding of site hazards is matched to appropriate worker protection strategies.

Unless occupational health and safety programs included in contract bids are critically reviewed and the health and safety records of competing bidders are taken into account, companies offering cheaper, less stringent worker protection programs may have an unwarranted advantage over firms whose bids include more rigorous OSH plans. Contract proposals that incorporate

Box 2-B-Environmental Monitoring: Technical Limitations

Environmental monitoring methods can be divided into measurements obtained via direct-reading instruments and those obtained by sample collection with laboratory analysis of results. Direct-reading field instruments provide instantaneous readings, albeit of a somewhat general nature, for some groups of contaminants. Laboratory analysis of environmental samples can provide more specific information about the types and concentrations of contaminants, and is usually required for purposes of legal documentation, but time (hours, days, weeks, or months) is needed to obtain the results.

Direct-reading monitoring instruments are becoming increasingly available and have several advantages.[1] Immediate availability of contaminant measures is obviously useful, eliminating both the time and the costs required for laboratory analyses. Direct-reading instruments are invaluable for certain aspects of cleanup, such as the early stages of site investigation, or during confined entry procedures when means of detecting very high levels of contaminants that might pose immediate danger to life or health are required. Direct-reading equipment is available to detect flammable or explosive atmospheres, oxygen deficiency, the presence or absence of organic vapors, some contaminants in soil or groundwater, and surface contamination by radionuclides.[2]

Direct-reading instruments are also useful for identifying changing conditions at a site to alert personnel that additional caution may be warranted. For example, direct-reading instrumentation can be used to monitor drilling or drum-packing operations. If an area of highly concentrated chemicals is penetrated or a drum leak occurs, abruptly high direct readings of contaminant concentration could prompt an immediate reevaluation of the health and safety procedures in effect and possibly prevent worker exposure.

Significant limitations attend the use of most direct reading field instruments, however.[3] Low concentrations of contaminants are not easily detected by direct-reading equipment, and often only classes of contaminants, not specific chemicals, can be identified Some contaminants cannot be detected by such equipment, and most direct-reading instruments are not sensitive enough to detect low levels of contamination that may be of concern. Most instruments cannot detect airborne concentrations of less than 1 part per million. In some cases, subsequent laboratory analysis of samples is necessary to verify results of such direct-reading instruments, particularly when monitoring results are being used for litigation or regulatory purposes.

Direct-reading instruments require careful calibration and must be operated by skilled personnel who understand their limitations and idiosyncrasies. The interpretation of values given by direct-reading equipment is not necessarily straightforward[4] There is potential interference by other contaminants, and appropriate sampling protocols for use of this equipment have not been well established. Direct-reading equipment is essential for many worker protection monitoring programs, but as the National Academy of Sciences noted, there are major research and development needs in this areas

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[1] W. Chudyk, "Field Screening of Hazardous Waste Sites," *Environmental Science &Technology,* vol. *23, No. 5, 1989,* pp. 504-507.

[2] Us. Environmental Protection *Agency,* Office of Emergency and Remedial Response, "Establishing Work Zones at Uncontro lled Hazardous Waste Sites," Publication 9285.2-06FS, April 1991.

[3] ~&

[4] *Office* of Technology Assessment Workshop on DOE Cleanup Workers, op. cit.

[5] National Academy of Sciences, *Human Exposure Assessment for Airborne Pollutants* (Washington, DC: *National* Academy Press), 1991.

vague or boilerplate HASPS may militate against firms that insist on more rigorous or comprehensive occupational health and safety programs or that wish to include in their contract bids the costs of additional investigations into potential site hazards.[67]

It is important that contract bids and awards be reviewed by persons who are informed about ac-

tual site conditions, who recognize the limitations of available characterization data, and who have sufficient technical background to evaluate occupational health and safety needs.[68] Otherwise, the programs required to protect cleanup workers may be negotiated out of contract agreements.

Negotiators who lack professional training in occupational health and safety, or are unfamiliar with the great uncertainties about site hazards and worker risk that pervade hazardous waste operations, may fail to recognize the need for prudent, proactive approaches to worker protection.[69] Some OSH professionals have complained to OTA that the lack of occupational health and safety expertise among Federal contract negotiators has made it difficult to ensure adequate levels of worker protection during cleanup operations.[70]

EFFECTIVENESS OF CLEANUP WORKER HEALTH AND SAFETY REGULATIONS

Overview of OSHA's Hazardous Waste Operations and Emergency Response (HAZWOPER) Standard

Congress has recognized that workers engaged in hazardous waste and emergency response operations face special health risks .[71] The Superfund Amendments and Reauthorization Act of 1986[72] required OSHA and EPA to establish regulations to protect such workers. Accordingly, EPA and OSHA promulgated identical regulations,[73] the so-called HAZWOPER standard, to protect workers engaged in hazardous waste operations and emergency response.[74]

Many different laws and regulations, promulgated by both Federal and State authorities, can affect cleanup worker health and safety. However, HAZWOPER targets workers engaged in hazardous waste operations and emergency response, and is the most comprehensive and specific regulation governing occupational safety and health programs or procedures applicable to environmental cleanup activities.

HAZWOPER is a complex regulation of many parts (see figure 2-1).[75] The standard requires employers to consider systematically the potential hazards to cleanup workers at specific waste sites, and to develop procedures to explicitly gauge and avoid, or mitigate such hazards. HAZWOPER acknowledges the uncertainty inherent in hazardous waste operations and mandates several strategies for dealing with this uncertainty,

Figure 2-l—Elements of Site-Specific Health and Safety Plans Required by HAZWOPER (29 CFR 1910.120(a)-(o))

a. **Scope, application, and definitions**
b. **Safety and health program**
c. **Site characterization and analysis**
d. **Site control**
e. **Training**
f. **Medical surveillance**
g. **Engineering controls, work practices, and personal protective equipment** for employee protection
h. Monitoring
i. **Informational programs**
j. **Handling drums and containers**
k. **Decontamination**
l. **Emergency response by employees at uncontrolled hazardous waste sites**
m. **Illumination**
n. **Sanitation at temporary workplaces**
o. **New technology programs**

SOURCE: U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, "Hazardous Waste Operations and Emergency Response," April 1991.

including requirements for task-specific hazard or risk analyses to assess the possible dangers of particular jobs; ongoing environmental monitoring to evaluate worker exposure during cleanup; medical surveillance programs for certain categories of workers; worker health and safety training to equip individual workers to respond appropriately to health threats they might face in the course of their jobs; and written, "regularly rehearsed," emergency response plans to handle "anticipated emergencies."

HAZWOPER LACKS DETAILED GUIDANCE

HAZWOPER is a performance-based standard. It describes broad goals that the law aims to achieve, but does not include detailed instructions on how employers should reach these goals.[76] The diversity of hazards, setttings, and work tasks encompassed by environmental cleanup operations, and the "uncontrolled" nature of the pollutants at issue, generally preclude the use of explicitly prescribed engineering and mechanical controls to eliminate site safety and health hazards or to prevent exposure to such hazards.[77-79] The lack of scientific understanding of the health impacts of environmental toxicants further complicates attempts to dictate specific worker protective measures.

The rigor with which elements of HAZWOPER are implemented varies greatly, in part because key components of the regulation are worded vaguely and subject to different interpretations.[80-82] Most Federal regulations are accompanied by preambles, guidance documents, and other materials that describe the history, intent, and appropriate application of the regulation. EPA, for example, has issued many guidance documents pertinent to aspects of Superfund cleanups. OSHA also typically publishes guidance documents to inform employers and its own inspectors about how specific regulations should be applied and to ensure that regulations are enforced in a consistent manner.

Hazardous Waste Action Contractors (HWAC), a major trade association of engineering and science firms engaged in hazardous waste management, notes that the technological uncertainties of hazardous waste work incur "enormous business risks" and "create many opportunities for large legal liability exposures."[83] HWAC notes that regulatory guidance documents provide important clues to interpreting hazardous waste statutes and regulations-and hence are a crucial hedge against future liability.

Two years have passed since the final HAZWOPER rule was published, but OSHA has not yet issued guidance on how critical parts of the regulation should be interpreted or put into practice. The lack of specificity of many HAZWOPER provisions, combined with the absence of comprehensive compliance guidance from OSHA, has made it difficult for employers and regulators to apply the standard in particular situations. Consequently, HAZWOPER has been variously interpreted by employers and Federal officials in different OSHA and EPA regions.[84]85

For example, for some toxic substances, OSHA standards specify workplace air concentrations that constitute "action levels."[86] When monitoring indicates that action levels have been attained, OSHA mandates that particular responses be triggered, such as the initiation of medical surveillance and the use of personal protective equipment.[87 88] Many of the contaminants found at hazardous waste sites are not addressed by OSHA regulations, however. Employers are thus left to determine what concentrations of contaminants in different media should be considered action levels and what actions should be triggered. Different employers at the same cleanup site may use different action levels.[89]

Some of the variability in implementing HAZWOPER is due to "information vacuums"-a virtual absence of toxicological data, exposure monitoring technology, or both. For example, there is no toxicological information regarding the cancer-causing potential of 75 to 85 percent of all chemicals in commercial use.90 The data base on noncancer health effects due to exposure to environmental toxicants (e.g., neurological,

immunological, or reproductive effects) is severely limited in nearly all cases.[91-93]

The lack of clear regulatory guidance has caused the HAZWOPER standard to be implemented in ways that are inconsistent, inefficient, and in some cases ineffective.[94] There is a need to establish uniform, validated methods for calculating probable worker exposure from given levels of pollutants in certain media. There is also a need for regulatory guidance on how to assign action levels for some common site contaminants and what worker protection measures should be triggered when action levels are reached.


INTERNATIONAL ASSN. OF FIREFIGHTERS

Workers moving drums of hazardous waste.

EMPLOYER RESPONSIBILITY UNDER HAZWOPER

Although all employers are responsible for providing "safe and healthful working conditions,"[95] employer responsibility for the health and safety of cleanup workers is especially burdensome because of the unpredictable and variable nature of cleanup work, the performance-based structure of HAZWOPER, and the lack of interpretive guidance from OSHA, Under HAZWOPER, employers must determine whether a particular job is hazardous, assess the degree of risk involved, and design the appropriate protection strategies to be followed. These decisions are usually made under conditions of great uncertainty and with little-or contradictory-scientific evidence in support of a given course of action.

Under HAZWOPER:

- employers assess the adequacy of environmental characterization data for identifying site hazards;
- employers interpret these data and determine whether and which potential risks are important;
- employers decide how risks to worker will be mitigated, what level of protective gear is needed, and what levels of worker exposure to potentially hazardous-and sometimes unregulated-materials are acceptable;
- employers determine what doctors are competent to design and manage medical surveillance programs; and
- employers are the final arbiters of whether and how to alter worker protection strategies based on the results of medical surveillance or environmental monitoring.

EPA has made it clear that prime contractors will be held responsible for inadequate health and safety plans submitted by subcontractors.[96] The U.S. Court of Appeals for the Eleventh Circuit ruled recently that the U.S. Army Corps of Engineers is responsible for failing to enforce its own health and safety plan, and is liable for a subcontractor's failure to follow ACE safety procedures.[97]

OSHA has indicated that employers are responsible for conducting site characterization studies that accurately portray potential worker hazards. In a number of instances, OSHA has issued citations to both prime contractors and subcontractors for failure to identify site hazards,[98-100] Employers have challenged such citations on the grounds that the lack of comprehensive compliance guidance for HAZWOPER makes it impossible to know whether characterization data accurately portray site hazards, what level of detail must be included in site health and safety plans, or what specific occupational safety and health strategies should be implemented to protect workers against uncertain risks.[101,102]

These objections are undercut by HAZWOPER's clear directive that in the event worker risks or exposures are unknown or unquantified, workers should be fully protected.[103] It is not practicable, however, to outfit workers in full protective gear whenever indeterminate exposures to uncertain risks are encountered or anticipated: such uncertainties are simply too pervasive in cleanup work. Regulatory guidance providing rational, consistent approaches to some of the major, common questions regarding interpretation and implementation of HAZWOPER could aid employers and simplify OSHA's enforcement efforts.

Problems With Specific HAZWOPER Elements

Most OSHA health standards mandate the use of specific engineering and mechanical controls designed to limit worker exposure to potentially dangerous materials.[104] The diversity of hazards, settings, and work tasks encompassed by environmental cleanup operations—and the "uncontrolled" nature of the environmental contaminants at issue—render this approach impractical for many hazardous waste operations, however. Instead, HAZWOPER provides a framework for anticipating and responding to potential health and safety risks encountered during environmental restoration activities, and specifies a number of elements that must be included in cleanup worker protection strategies.

Some of the most critical elements of the HAZWOPER approach are subject to disparate interpretations.[105] The performance-based language of the standard has allowed employers to implement aspects of HAZWOPER in widely differing ways, and the validity and appropriateness of these various approaches have been hotly disputed.[106] The design and enforcement of site-specific health and safety plans, the designation of work zones, and the development of medical surveillance programs have proved especially contentious and are discussed below.

HEALTH AND SAFETY PLANS

HAZWOPER requires that a detailed health and safety plan be in place before any characterization or cleanup work begins. The site-specific HASP is intended to establish comprehensive health and safety principles and practices to be followed by all employees working on-site during normal operations or during emergencies. The HASP is the essential starting point of an adequate occupational health and safety program at cleanup sites.

According to HAZWOPER, the HASP must identify all the safety and health hazards that a site is believed to harbor. An understanding of site hazards must then be linked to planned work tasks. Potential worker health and safety threats associated with particular jobs must be anticipated via hazard analyses, risk assessments, or other disciplined methods of scrutiny. Strategies for worker protection must be devised, such as the use of environmental and worker monitoring, medical surveillance, emergency response plans, worker health and safety training and the use of personal protective gear. The organizational structure of the cleanup operation must be described and provisions made for the protection of off-site populations during cleanup activities. A written HASP must be in place before any characterization or mediation work begins, and it must be updated annually or whenever additional information about the site is acquired and work plans change.

Experience at Superfund sites and RCRA facilities has revealed a number of problems associated with HAZWOPER-mandated HASPS. HASPS formulated on the basis of erroneous or incomplete information about site conditions or cleanup plans may promote inappropriate health and safety practices. As noted earlier, characterization data available when HASPS are written may fail to identify significant site hazards. Important potential worker risks may therefore be missed or inaccurately assessed. Alternatively, if insufficient information is available about a po-

tential exposure hazard, the HASP may recommend an unnecessarily stringent approach to worker protection. Fully encapsulated clothing and respirators decrease a worker's ability to communicate and impose risks of heat stress, reduced peripheral vision, and physical clumsiness on workers. These may be important factors in hot climates or in situations where agility or the ability to make a rapid exit is necessary.

Experience at cleanup sites indicates that in some cases the written provisions of the HASP, although adequate, are not enforced by either the prime contractor or regulators, and do not reflect actual site conditions or work practices.[107 108] This was reportedly the case at two Superfund sites in New Bedford, Massachusetts, where mandated emergency response plans exist only on paper. At the New Bedford Harbor site, where plans call for polychlorinated biphenyl (PCB) contaminated sediment to be dredged from the harbor and incinerated, the water supply available in the event of a fire is only 25 percent of that called for in the written HASP.[109 110] The New Bedford Fire Chief has publicly stated that his department lacks the training and equipment needed to respond to emergencies at either of the two local Superfund sites, and has prohibited members of his department from entering either of these sites.[111 112]

Another problem with many HASPS is the tendency to concentrate on potential worker *health* threats (e.g., long-term cancer risks) while paying little attention to more immediate site *safety risks.* [113] *problems* encountered at **hazardous** waste incinerators illustrate the seriousness of safety risks and the need for detailed analyses of potential hazards and ongoing vigilance in evaluating risks and altering worker protection strategies as cleanup proceeds and site operations change.

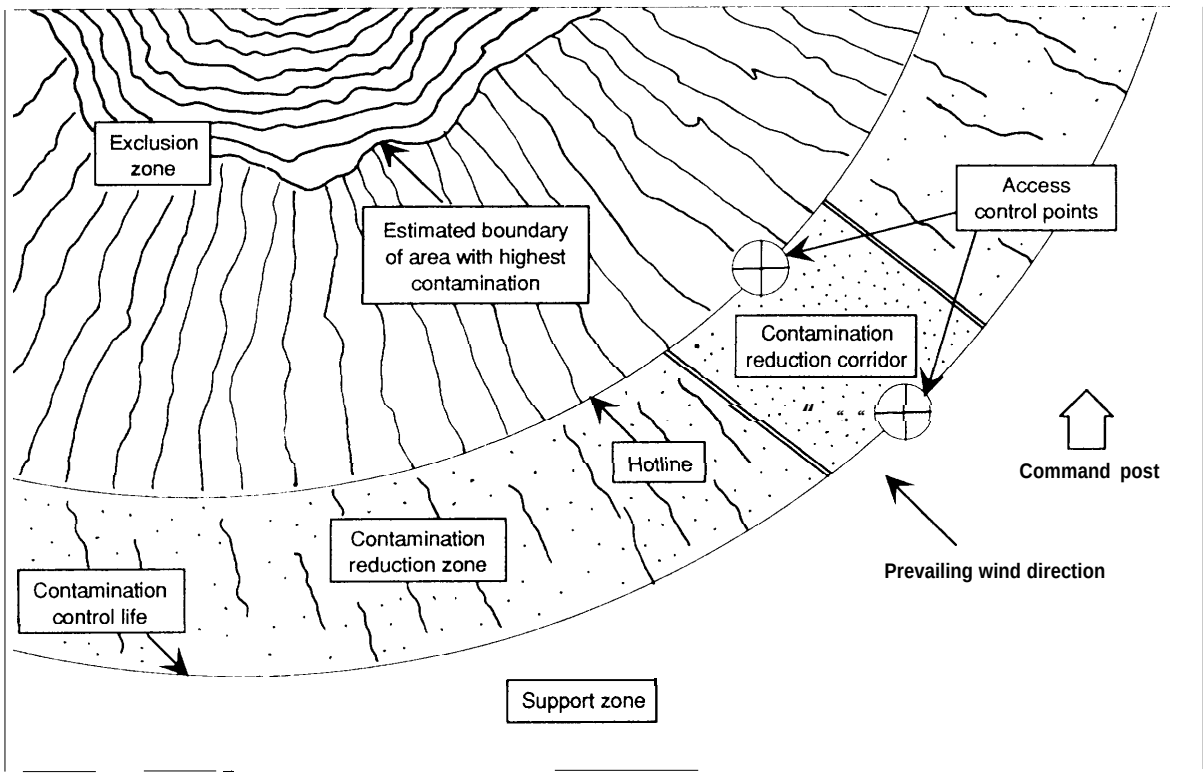
At one site, while soils contaminated with explosives were being incinerated, an explosion resulted in more than $200,000 in property damage and more than $1 million in costs for research, incinerator redesign, and lost production. One employee received first- and second-degree burns over 40 percent of his body. The ACE investigation team that reviewed the incident noted that fatalities would have been a near certainty if other workers had been in the area,[114] This accident occurred after more than 12,000 tons of contaminated soil had been incinerated successfully. Changes in the composition of the soil being treated significantly affected the behavior of the incinerator and eventually led to the massive overpressure that resulted in explosion. Smaller explosions had occurred prior to the accident, causing temporary and automatic shutdown of the plant, but they were not fully investigated or allowed to interrupt production.[115]

Another incinerator accident resulted in the hospitalization of three workers. Once again, failure to persistently scrutinize potential worker risks resulted in injuries. In this case, slag and soil deposits were known to collect in the incinerator quench tank during burns of contaminated soil, and workers had to remove this material manually between burns. On at least two occasions, workers refused to enter the tank for fear of being hit by falling pieces of hot slag, but managers failed to inspect the burner chamber for slag buildup to determine the danger to workers operating in the tank below. On the day of the accident, two workers were inside the quench tank, shoveling slag onto the tank portal, when approximately 3 cubic yards of slag/soil fell from the burner. These workers received second- and third-degree burns over 30 percent and 75 percent of their bodies. Five other workers who had joined in the rescue effort were taken to the hospital for evaluation of lung irritation from breathing the fine dust particles released when the slag fell. One of these workers was hospitalized with pulmonary edema.[116]

WORK ZONES

OSHA has determined that wastes sites may be divided into zones, according to the "potential" for worker exposure to hazardous materials

Figure 2-2—illustration of Typical Work Zones at Hazardous Waste Sites



SOURCE: U S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, "Establishing Work Zones at Uncontrolled Hazardous Waste Sites," April 1991.

(see figure **2-2).** Exclusion or "hot" zones should include all areas where workers are "potentially" exposed to contaminants in excess of OSHA's published Permissible Exposure Limits (PELs). Access to such areas should be restricted to those who have received certain levels of health and safety training and who are equipped with appropriate personal protective gear. Decontamination procedures must be followed when people or items of equipment leave such exclusion zones.[117] [118]

On the periphery of hot zones are contamination reduction zones (CRZS), where decontamination procedures take place. Beyond the CRZs are support zones, which should be free from contamination or exposure hazards. According to HAZWOPER, workers in the support zone need no special protective equipment or training beyond instruction in the proper evacuation procedures in case of emergency.[119]

Limiting the hot zone confers logistic and economic advantages because outside this zone, applicable HAZWOPER training provisions are less rigorous, decontamination procedures need not be followed, workers do not have to use special protective gear, and work can generally proceed in a less rigid and more rapid fashion. Yet OSHA offers little guidance on how employers should determine if workers are "potentially exposed" to hazardous materials, other than to note that such exposures include "accidental or possible exposure."[120] [121] OSHA provides no suggestions about what to do if a site contains contaminants that are not regulated or have no "published levels,''[122] nor does it suggest how employers


PHOTO CREDIT: THE WORKPLACE HEALTH FUND

Decontamination procedures must be carried out when workers leave "hot zones" for uncontaminated or "clean" areas of the site.

should gauge risks to workers exposed to mixtures of hazardous materials (see box 2-C).

OSHA's published PELS refer to allowable air levels, but many environmental contaminants encountered at waste sites are found in soil, sediment, vegetation, and water, There is no scientific consensus about, or validation of, what methods should be used to convert the amount of a toxic substance that is legally permissible in ambient air into the allowable concentration of that substance in soil or other media. Determining the degree of hazard or risk associated with a particular worker exposure, and the level of worker protection required, depends on a number of assumptions and estimates. In the absence of validated or government-sanctioned methods for estimating exposures and risks, different employers make use of different assumptions, which result in differing estimates of allowable exposure levels.[123]

MEDICAL SURVEILLANCE

Medical surveillance in the workplace refers to the periodic and systematic collection and analysis of data about workers' health and workplace conditions, with the aim of detecting "illnesses or health trends that indicate a possible adverse effect of workplace exposures" before serious disease has become evident or the worker would normally seek medical advice,[124]

In addition to indicating the effectiveness of worker protection from hazards and providing early recognition of work-related health effects, medical surveillance programs may also:

- contribute valuable information to studies of long-term health impacts of occupational exposures among groups of workers, and
- allow evaluation of an individual worker's "fitness" to carry out particular job tasks or to cope with physical stresses such as wearing respirators or encapsulated clothing. [125]

The information collected in medical surveillance programs may take the form of questionnaires, physical exams, medical tests such as x rays or blood analyses, or environmental monitoring and industrial hygiene data. To be useful, such information must be gathered and analyzed in a systematic way: there must be some coherent rationale directing the types of data that are collected and the questions that are analyzed. The most important purpose of medical surveillance activities is the translation of analytic results into actions that forestall or reduce further exposure to materials shown to be hazardous.

When surveillance data are analyzed over populations or whole groups of workers, it is possible to practice "primary prevention." In such cases, medical surveillance reveals that some exposure or situation is causing adverse health effects or abnormalities that might lead to future

Box 2-C-Cleanup Workers and Allowable Limits of Exposure to Environmental Toxicants

Among the most difficult issues surrounding protection of cleanup worker safety and health is the question of what "levels of exposure" to particular toxic substances are reasonable and legal. Many toxic substances encountered at hazardous waste sites are not covered by existing regulations. The 620 substances for which the Occupational Safety and Health Administration (OSHA) has published Permissible Exposure Limits (PELs) were chosen for their relevance to general industry and exclude many of the substances found at Superfund and Resource Conservation and Recovery Act (RCRA) sites. The Environmental Protection Agency (EPA) publishes allowable exposure limits for some materials, but many of EPA's regulations are media specific. It is not clear that standards designed to regulate allowable concentrations of toxic substances in groundwater can or should be translated into occupational limits for a particular toxic contaminant in soils, for example. Mixtures of hazardous contaminants have not been satisfactorily addressed by any regulatory agency.

The scientific basis for setting particular exposure limits is often scanty. Approximately 60,000 chemicals are used commercially; human data are available on the cancer-causing potential of about 60 substances. Animal and in vitro studies of carcinogenicity have been conducted on a somewhat larger number of substances, but no information whatsoever is available on the cancer-causing potential of 75 to 85 percent of all chemicals in commercial use today.[1] Even less is known about the nonacute, noncarcinogenic effects of chemical exposure. Scientists have become increasingly attentive to noncancer biological end points, such as the impact of environmental toxicants on the neurological, immunological, and reproductive systems.

Most worker exposure standards focus on ambient air contaminants, and almost all regulatory standards and recommended exposure levels (PELs, Threshold Limit Values, etc.) are based on air monitoring measurements. This historical focus on airborne contaminants in occupational settings does not accurately capture many potentially toxic exposures encountered during hazardous waste operations, such as the ingestion of contaminated soil or skin absorption of toxins. It is often unclear how to translate measurements of contaminants in ambient air into dosages received by individual workers via ingestion or absorption through the skin.

Furthermore, many OSHA standards are outdated, and the scientific basis for many PELs has been challenged.[2,3,4] The U.S. Court of Appeals for the Eleventh Circuit recently vacated more than 400 OSHA PELs established in 1989, thereby in effect making the worker exposure limits established in 1971 the law of the land.[5]

The difficulty of accurately measuring cleanup worker exposure to toxic materials is increased by the variety of particular cleanup tasks and associated worker exposures, which may differ from one day to the next. Episodic worker exposures to hazardous materials, such as releases that occur during accidents, are especially difficult to monitor. The transiency of much of the hazardous waste work force makes it difficult

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[1] U.S. Congress, Office of Technology Assessment, *Complex Cleanup-the Environmental Legacy of Nuclear Weapons Production (Washington DC:* U.S. Government Printing Office, February 1991).

[2] S. Roach and S. Rappaport, "But They Are Not Thresholds: A Critical Analysis of the Documentation of Threshold Limit Values," *American Journal of Industrial* Medicine, vol. 17, pp. 727-753, 1990.

[3] B. Castleman and G. Ziem "Corporate Influences on Threshold Limit Values," *American Journal of industrial Medicine,* vol. 13, pp. 531-554, 1988.

[4] M. Pitcher, "Standard Setting: A Political Process," *American Journal of Industrial Medicine,* vol. 17, No. 2, pp. 255-259, 1990.

[5] *Occupational Safety and Health Reporter,* "Labor Department Asks Eleventh Circuit To Reconsider Core on OSHA Exposure Limits" (Washington, DC: The Bureau of National Affairs, Inc.) Sept. 9,1992, pp. 515-516.

Box 2-C-Continued

to determine workers' past exposures or to ascertain an individual's cumulative exposure burdens. There are no regulations requiring that a worker's cumulative exposure be tracked over time. In some situations, peak levels of exposure bear most heavily on health outcomes; interpretation of monitoring data that record only average exposures may therefore be problematic.

In the absence of occupational standards, the allowable exposure levels for hazardous waste workers are unclear. Some argue that EPA standards, developed to protect community health and based on lifetime risks (24-hour exposures for 70 years) and a consideration of sensitive individuals such as the elderly and young children, should be applied. Others believe this approach is overly conservative.

Many legal exposure standards in fact represent compromises between health considerations and other concerns such as cost, feasibility, and the potential benefits of a chemical.[6,7] In many cases, there is no pragmatic alternative to such compromises. Different stakeholders have competing interests in the establishment of exposure standards, and regulators must act on the basis of the limited toxicologic information available. It is important to keep in mind, however, that legal standards and recommended exposure guidelines are not always well validated by scientific evidence.

Appropriately designed medical surveillance programs might, over time, eliminate much of the uncertainty about what level of worker protection is needed in different exposure situations, but medical surveillance of cleanup workers is itself hampered by limited science, vague regulations, potentially high costs, and poor oversight by managers.

What is certain is that controversies over the adequacy of worker monitoring, and wide variations in the costs and efficacy of such programs, will continue to occur.

[6] Michael Pitcher, "Standard Setting: A Political Process," American *Journal of Industrial Medicine,* vol. 17, No. 2, 1990, p. 255.

[7] National Research Council, *Risk Assessment in the Federal Government: Managing the Process (Washington,* DC: National Academy Press 1983) pp. 44-47.

health problems in some portion of the work force. This recognition provides the impetus to alter work conditions so that additional exposures are reduced or eliminated. The ability to use medical surveillance data in support of primary preventive strategies depends on how the data are organized and assessed, the way results are communicated to workers and decision makers, and the manner in which managers respond to the results.[126-128]

The identification of health problems in particular individuals-with prompt intervention in the form of removal from harmful work situations and medical treatment if necessary-is called "secondary prevention." With secondary prevention, the individual has experienced a harmful exposure and some adverse biological effect has already occurred.

Medical surveillance is especially important in hazardous waste work.[129] Traditional industries rely on industrial hygiene monitoring to detect worker exposure to dangerous substances. This information guides the use of appropriate engineering controls, personal protective equipment, safe work practices, etc. At hazardous waste sites, however, the usefulness of environmental monitoring to detect worker exposures is limited (see box 2-B). The failure to identify or accurately map site contaminants; the episodic nature of many worker exposures, especially during accidental releases of toxic materials and other emergencies; and the lack of reliable, real-time field instruments to detect contaminants in all media mean that, in many situations, medical surveillance is the *only* way to recognize worker exposure to toxic substances.[130]

In addition, many of the engineering controls and work practices used in traditional industrial settings to prevent worker exposure to hazardous substances are impractical at hazardous **waste sites,** Instead, less reliable methods of worker protection must be used, such as personal protective equipment (PPE) or work practice techniques (e. g., exclusion of untrained workers without appropriate PPE from contaminated areas of the site).[131] Finally, given the many scientific uncertainties about the biological consequences of exposure to environmental toxicants, prudence demands that the health status of cleanup workers be reviewed periodically to ensure that adverse exposures and health effects are not occurring.

The medical surveillance provisions of HAZWOPER are a tacit admission of the difficulty of reliably protecting cleanup workers from potentially hazardous exposure. The HAZWOPER standard does not mandate medical surveillance for all workers at hazardous waste sites, however. Only those employees "who are or may be exposed" at or above OSHA's PELs for 30 or more days a year, who wear a respirator for 30 or more days a year, who become sick due to overexposure during a release incident, and who are members of emergency response teams must be offered medical surveillance.[132] Under HAZWOPER, workers who do not meet OSHA's "30-day trigger" are not eligible for periodic medical surveillance evaluations and are not required to undergo medical assessment at the termination of employment.

Determining which workers "may be" exposed to high levels of toxic materials is as problematic in designating eligibility for medical surveillance coverage as it is in delineating the boundaries of work zones. Some consider the 30-day trigger an invitation to hire short-term workers to perform the dirtiest and most dangerous jobs, without burdening employers with the costs of providing medical supervision or adequate training for these workers.[133] [134] On the other hand, representatives from some national environmental firms told OTA that they believe failure to include *all* employees working on a hazardous waste site in surveillance programs amounts to negligence and is an invitation to litigation in the event of worker injury or illness.[135] [136]

In any case, there is no scientific basis for HAZWOPER'S 30-day demarcation for medical surveillance coverage.[137] Guidelines for medical surveillance programs covering EPA employees acknowledge that brief, high-dose exposure to toxic materials may carry as much, and sometimes greater, risk than longer but lower dose exposures. Likewise, some exposures, work tasks, and work conditions may be more hazardous than others.[138] HAZWOPER does not link mandated medical surveillance to such considerations, however.

The OSHA standard includes requirements pertaining to what written information about medical surveillance results must be given to individual workers and to employers, as well as employer record-keeping requirements. The medical surveillance provisions do not stipulate that physicians in charge of medical surveillance programs be trained or have experience in occupational or environmental medicine; doctors need only be "licensed physicians" according to HAZWOPER, The standard also fails to specify the content of medical exams or testing programs (see box 2-D). HAZWOPER does not require that information gathered for medical surveillance purposes be analyzed by qualified health professionals or that the results be reported to health authorities, even if adverse health impacts are detected or conventional protection programs are discovered to be inadequate.

The absence of any requirement to report the results of medical surveillance of cleanup workers to health authorities is a serious shortcoming of HAZWOPER. Indeed, there is no requirement to *analyze* collected data: employers may comply with the law even if surveillance results are never reviewed. The absence of a reporting requirement increases the difficulty of developing truly worth-

Box 2-D—Design of Medical Surveillance Programs for Cleanup Workers

The National Institute of Occupational Safety and Health defines medical or health surveillance as "the periodic medicophysiological examinations of exposed workers with the objective of protecting health and preventing disease."[1] Surveillance tests may detect evidence of *exposure* to a potentially harmful substance-so that appropriate action can be taken to prevent additional exposure; or a test may signal a biological *efffect* of toxic exposure-hopefully an effect that occurs early in the course of illness, when removal from additional toxic insults or the initiation of appropriate medical treatment can forestall the development of serious disease.

Even in traditional industries there is little agreement about what constitutes appropriate medical surveillance for a broad range of exposures and work processes. Anecdotal reports suggest that surveillance involving general industrial workers may at times be excessively elaborate and expensive, that large amounts of data may be gathered to little purpose, or that collected data may be inappropriately reviewed and analyzed. On the other hand, the hazardous waste industry is relatively new; no prospective studies of hazardous waste workers have been done; and the long-term health risks to these workers remain largely uninvestigated.

There is no consensus on what particular medical exams or diagnostic tests should be included in a medical surveillance program for hazardous waste workers. One study of more than 400 such workers found that laboratory tests typically used in medical settings were incapable of distinguishing "exposed" (i.e., employees whose job titles and descriptions placed them at potential risk of coming in contact with hazardous chemicals) from "unexposed" employees.[2]

The number and usefulness of tests that aim to detect the effects of toxic exposure are seriously limited by a lack of information about the biological consequences of exposure to particular chemicals. Many diagnostic medical tests, designed to evaluate people who are already ill, are too insensitive to serve as indicators of the early abnormalities one would like to detect in surveillance programs. Other tests are nonspecific and prone to register an "abnormal" reading even when actual diseases or the effects one is attempting to measure do not exist. When administered to large populations of healthy individuals, a test inability to distinguish the truly abnormal from apparently abnormal (i.e., its tendency to produce "false-positive" readings) can result in a large number of abnormal readings. Such results may then be repeated to check their accuracy or may lead to more elaborate medical testing, which can cause significant anxiety and expense.

[1] S. Hemberg, "The Validation of Biological Monitoring: An Introduction," *Occupational and Environmental Chemical Hazards*, V. Foa et al., eds. (New York, NY: John Wiley& Sons, 1987).

[2] E. Favata and M. Gochfeld, "Medical Surveillance of Hazardous Waste Workers: Ability of Laboratory Tests to Discriminate Exposure," *American Journal of Industrial Medicine*, vol. 15, 1989, pp. 255-265.

(continued on next page)

while programs because data from different surveillance programs may be variously analyzed or interpreted, cannot easily be pooled, and are unavailable to researchers seeking to identify trends or reliable indicators of exposure or health effects. Small companies may be unable to design medical surveillance programs with enough statistical power to detect important adverse worker health impacts.

Finally, because the precise hazards and nature of possible worker health impacts associated with hazardous waste operations are poorly understood, it is important to use medical surveillance results to take advantage of every opportunity to practice primary prevention. Unless medical surveillance data are translated into improved work site health and safety practices, "screening and monitoring . . . become sound and

Box 2-D-Continued

Thousands of possible medical tests could be included in a medical surveillance program for hazardous waste workers; it is important that such tests be chosen judiciously. If the medical surveillance program is not designed to include appropriate tests of exposure to or effects of the toxic materials present at a work site, then reliance on seemingly "normal" medical surveillance results could induce a false sense of security. On the other hand, pursuit of a large "grab bag" of test components is also unwise. Meaningful analyses of large amounts of data may be impractical, and a larger number of tests increases the likelihood of false-positive results.

Medical surveillance programs should not be limited to periodic monitoring of the health of individual workers without reference to previous findings. They should include analyses of changes in individual workers over time, as well as cross-sectional "snapshot" analyses of group data. Although a slight decrement in lung function in a single individual might not be cause for concern, progressive loss of function in a single person or a similar loss of lung function among a group of workers who share job tasks or exposures should, at the least, prompt a work site evaluation and a search for the cause of such findings.

Determining the components of a medical surveillance program is a matter of clinical judgment. It is not possible to compile a cookbook of recipes to dictate the ingredients of medical surveillance programs that are appropriate for all cleanup sites. As much as possible, medical surveillance programs should be designed on a site-specific basis. Although the Occupational Safety and Health Administration's Hazardous Waste Operations and Emergency Response standard requires only that medical surveillance for hazardous waste workers be conducted by "licensed physicians," effective and efficient programs must be designed by health professionals who have knowledge of the toxic substances a site is suspected or known to harbor, who understand what medical tests can effectively detect such exposures or their effects, and who recognize the capabilities and limitations of the tests selected.

fury, preventing nothing.'' [139] HAZWOPER, however, contains no requirement that managers take medical surveillance results into account when reviewing the adequacy of existing health and safety practices or planning new approaches.

Problems With Health and Safety Training Under HAZWOPER

Cleanup workers' health and safety depends to a great degree on the use of personal protective equipment and on workers' abilities to recognize and respond appropriately to unanticipated hazards. The safety of local communities also depends on cleanup workers' performance and judgment, because improper management of contaminants could lead to off-site dispersion of hazardous materials. [140] The uncertainties of site characterization and the continuously changing nature of sites undergoing cleanup mean that worker recognition of the presence of hazardous materials may be the frost warning that contamination exists in a particular area or that a release of toxic materials has occurred.

The Superfund Amendments and Reauthorization Act (SARA) specifically requires that hazardous waste workers, managers, supervisors, and emergency response personnel receive health and safety training, and directs OSHA to issue regulations specifying training standards and certification requirements.[141] The HAZWOPER standard sets forth the general "elements" that should be covered in training courses for cleanup workers and specifies the number of training hours required for different categories of workers.

OSHA has also proposed the Hazardous Waste Operations Training Accreditation Standard,[142] which stipulates course content, training hours, accreditation review processes, and other issues in greater detail. The proposed regulation is cur-

rently under review; it is expected to be finalized in early 1993.

HAZWOPER stipulates that hazardous waste workers must receive health and safety training that meets certain minimum requirements before engaging in operations that could expose them to toxic materials or to safety or health hazards. Initial or "generic" training must include certain topics, such as the basic principles of hazard identification, the use of PPE, and review of the site HASP and of medical surveillance programs. Additional training is to be furnished to workers exposed to "unique or special hazards ." [143] Programs must include both classroom instruction and supervised, site-specific field training.

HAZWOPER also specifies the minimum number of training hours that workers must log. The amount of training required is supposedly keyed to a worker's potential for being exposed to hazardous materials above permissible exposure limits:

- "General site workers (such as equipment operators, general laborers and supervisory personnel)" must receive a minimum of 40 hours of off-site instruction and at least 3 days of supervised field experience.
- On-site managers and supervisors "directly responsible for or who supervise" cleanup workers must receive an additional 8 hours of specialized training.
- In addition, general site workers and supervisors must receive at least 8 hours of "refresher training" annually.
- "Occasional" workers who are on-site for only "a specific, limited task . . . and who are unlikely to be exposed over permissible exposure limits and published exposure limits" must undergo a minimum of 24 hours of off-site instruction and at least 1 day of supervised field training.
- Another category of workers, who are regularly on-site but work in areas that have been monitored and "fully characterized indicating that exposures are under permissible exposure limits where respirators are not necessary, and the characterization indicates that there are no health hazards or the possibility of an emergency developing" must also receive 24 hours of off-site instruction and one day of field experience.[144]

Because OSHA fails to specify any criteria for distinguishing between general site workers and those occasional workers who are "unlikely" to be exposed to hazardous materials above published PELs, the responsibility for determining which workers receive the more extensive training is placed on employers. In practice, some complain that there is a trend to "train to the lowest minimum level, which is 24 hours .''[145-147]

The OSHA training categories have been criticized for the same reasons that the designation of work zone boundaries and worker eligibility for medical surveillance has provoked criticism: there is no scientific basis for determining an individual worker's "potential for exposure" to hazardous materials during cleanup work. A 1990 workshop held by the National Institute of Environmental Health Sciences was unable to determine what criteria could be used to distinguish between general site workers and "occasional" workers or to determine the applicability of the 24-hour training for "occasional workers.''[148]

Another contentious aspect of HAZWOPER's proposed training rule is the grandfather clause that allows some workers to be exempted from the initial, generic training requirements.[149] Employers who can "document or certify" that a worker's experience or past training has resulted in training "equivalent to" that required by HAZWOPER are not required to provide initial training. OSHA does not specify what type or amount of past experience qualifies a worker for "equivalent training." Thus, the employer determines which workers are in need of instruction in an accredited program. Critics contend that this provision violates SARA's intent that cleanup workers receive appropriate training in accredited programs.[150] [151]

Some union representatives with extensive experience in hazardous waste operations and environmental remediation claim that even 40 hours of instruction—the maximum required under OSHA's proposed accreditation standard-is insufficient to teach individuals the rudiments necessary to perform cleanup work safely. Several unions have created cleanup worker training programs that are more rigorous than HAZWOPER requires, and some have developed 80-hour "generic" courses.[152] [153] The International Association of Firefighters (IAFF) argues that firefighters and emergency responders need far more extensive and rigorous training than either HAZWOPER or the proposed accreditation standard mandates.[154]

In the absence of a current regulatory standard governing the content and quality of the training curricula for hazardous waste workers, many different programs have emerged to meet the HAZWOPER requirements that cleanup workers obtain certain minimum hours of health and safety training. Both the content and the quality of existing courses appear to vary widely.[155] Some courses are reportedly entirely didactic and involve no hands-on training in the use of PPE, etc.[156] Because HAZWOPER includes no specific requirements for course content or format, employers accept as "trained" any worker who can provide certification that he or she has received the requisite number of hours of instruction.[157]

The target audience should be a factor in directing the focus and the content of training programs. Some labor unions have developed training courses that assume students will be skilled crafts people who have a basic knowledge of trade-specific safe work practices. EPA offers courses geared primarily to Federal Superfund site managers and to State and local government officials.[158] Some vendors of health and safety programs, however, do not differentiate among the needs of different groups, and train laborers, skilled crafts people, and scientists with advanced degrees in the same classes, using the same materials.[159] [160]

OSHA's proposed accreditation standard would not impose specific, detailed requirements on the content of health and safety training courses. The proposed rule includes no minimum standards or training requirements for instructors, does not incorporate peer review or on-site inspection of proposed programs, and does not require that annual refresher courses be reviewed and accredited.[161]

A grants program for the training and education of workers engaged in hazardous waste operations and emergency response was established by the 1986 Superfund amendments.[162] [163] Nonprofit organizations with demonstrated access to appropriate populations of cleanup workers are eligible to apply for aid in developing, implementing, and operating worker health and safety training and education programs.[164] The overall program is administered by the National Institute of Environmental Health Sciences (NIEHS) and currently supports 16 training grants involving a total of 60 individual institutions.[165] [166]

NIEHS adopted a National Institutes of Health-type peer-review process to review initial grant applications and to oversee grant management activities and program administration. Stringent review criteria require applicants to demonstrate access to the target population; to provide an experienced, qualified program director; and to offer hands-on training with appropriate facilities and equipment. Protocols for on-site peer review of field programs are being developed.[167]

Initial efforts of NIEHS grantees were directed toward developing suitable curricula for hazardous waste work training and establishing appropriate field training facilities. The widely varying audiences that the grantees targeted necessitated a range of teaching materials and classroom exercises.[168] NIEHS subsequently established a national clearinghouse for training materials and course curricula developed by its grantees that makes such technical information and curricula available to the general public.[169]

Emergency Response

Emergencies arising at hazardous waste operations differ from other health and safety issues associated with environmental cleanup work. Site accidents, equipment failures, weather damage, or other emergency situations are likely to require the assistance of individuals beyond those who work on-site or are directly involved in cleanup. Emergency responders might include police officers, firefighters, medical personnel, and possibly local civil defense, transportation, and government officials. Releases of site contaminants may also pose a public health threat to off-site populations.

Two sections of SARA are relevant to emergency response at Superfund sites. SARA Title I directs EPA and OSHA to establish specific regulations to protect the health and safety of workers engaged in hazardous waste operations and emergency response. These are the HAZWOPER regulations that OSHA issued in 29 CFR 1910.120. EPA promulgated identical regulations in 40 CFR 311. HAZWOPER requires that emergency response plans be included in all site HASPS and details the necessary components of these plans.[170] HAZWOPER also requires that the emergency response plan be "rehearsed regularly" as part of the overall site training program and reviewed periodically and amended, as needed.[171]

SARA Title III, "The Emergency Planning and Community Right-to-Know Act of 1986," requires municipalities to take steps to ensure the safety of communities from environmental releases of toxic substances.[172] The statute mandates the preparation and testing of a comprehensive emergency response plan that would go into effect in the event of significant environmental release of hazardous substances. Title III thus pertains to most hazardous waste operations and most industrial facilities that use or store hazardous materials, not just to Superfund or RCRA sites. The plan is required to include the involvement of a variety of State and local officials, including organizations such as fire and police departments; local environmental, hospital, and transportation personnel; community groups; and site owners.[173]

Together, SARA Title I and Title III are designed to provide communities with a comprehensive, integrated capacity to respond to emergencies arising from environmental release of hazardous chemicals. The intent was to create a basic emergency response infrastructure (via Title 111) and to deal with emergencies that might result from operations at uncontrolled waste sites by requiring site-specific emergency response plans and hazardous materials training for designated emergency responders (via Title I/HAZWOPER).

A number of recent incidents have revealed significant flaws in the implementation of Title 111 provisions as well as serious problems with the emergency response plans and capabilities at Superfund sites.[174-182] Emergency response plans at some Superfund sites appear to be "paper programs" that exist in written form but remain largely unimplemented.[183 184] Also, local communities may be unable or unwilling to invest the resources necessary to train and equip fire departments or others to comply with legal mandates pursuant to SARA Title III.

In the course of reviewing the HASP at the Baird-McGuire Superfund site, it was discovered that the local fire department lacked the resources to provide either the equipment or the mandated training needed to prepare firefighters to respond to an emergency at Baird-McGuire. Although EPA believed that the local fire department had agreed to provide support to the site, none of the local firefighters or emergency medical technicians had received even the minimal 8-hour "awareness" training required of first responders.[185] This situation violated the EPA's audit guidelines for the evaluation of local community response capabilities as well as HAZWOPER regulations.[186] The situatiion was corrected after EPA provided training of local firefighters through an Interagency Agreement with IAFF.[187]

In December 1991, the Fall River, Massachusetts fire department responded to a hazardous materials incident at a local manufacturing facility, where a worker had fallen into a container of chemicals. A firefighter-who had not received legally mandated hazardous materials training—entered the container, fell, and was himself submerged in chemicals. Two ambulances and their crews were subsequently contaminated in the rescue effort. The response of the local hospital was also less than optimal.[188] The shower designated for decontamination was not usable, and a long delay occurred before either man was washed clean of the chemical (dimethyl diisocyanate). One of these contamination victims subsequently developed liver failure.[189]

A review of this incident conducted by EPA's Emergency Response Team in conjunction with the EPA-Labor Task Force determined that in a fire department with more than 200 professionals, serving a population of 100,000, only 6 firefighters had received hazardous materials response training equivalent to OSHA's operations level; 2 firefighters had been trained to specialist level. No one in the department had been trained as an incident commander.[190]

In New Bedford, Massachusetts, the fire department has publicly stated that it is not prepared for and will not respond to an emergency at the New Bedford Harbor and Sullivan's Ledge Superfund sites, *9* where plans call for contaminated sediments to be dredged from the harbor and incinerated within city limits. Although a written emergency response plan has been developed for the lower risk preliminary phases of this site, the present plan, if applied to the planned incineration phase of the cleanup, will be unacceptable with regard to personnel roles, lines of authority, communication, safe distance zones and places of refuge, civilian evacuation plans, emergency care for responders, and use of personnel equipment.[192193] If prompt action is not taken to address emergency response activities and related training issues, lead time may not be sufficient to prevent costly project delays. EPA is investigating programmatic remedies for these issues.[194]

The emergency responder provisions of HAZWOPER and the proposed training accreditation standard have generated intense criticism from many quarters including EPA,[195] the International Association of Firefighters,[196] and other labor organizations.[197] OSHA's failure to require certification of training for emergency response workers has been especially controversial. OSHA contends that it lacks both the personnel and the resources needed to review and accredit training programs for the many emergency responders (including professional and volunteer firefighters) who might be called on to assist in an emergency during hazardous waste operations or during an accidental release of toxic materials.[198]

HAZWOPER does not stipulate any minimal training requirements for emergency responders. The standard notes only that "employees who are engaged in responding to hazardous situations at . . . cleanup sites that may expose them to hazardous substances shall be trained in how to respond to such expected emergencies.''[199] The standard designates five tiers of emergency response workers and links training requirements to the responsibilities an individual is likely to exercise during an emergency. OSHA offers no justification for why emergency responders in successively lower ranked tiers should be afforded less protection in the form of less extensive hours of health and safety training. No minimum number of hours of training is required of the first, lowest tier of emergency responders, "who are likely to witness or discover a hazardous substance release.''[200] Only 24 hours of safety and health training is required of even the highest category of emergency responders, which includes "on scene incident commanders." In addition, training courses for emergency responders are explicitly exempted from accreditation requirements under OSHA's proposed rule.[201]

The IAFF found in 1991 that 79 percent of the nation's firefighters considered themselves inad-

equately trained to deal with hazardous materials emergencies, and 82 percent felt they were not adequately equipped.[202] The IAFF is concerned that fire departments responding to emergencies at cleanup sites might be unprepared to provide the assistance required by the situation in a manner that affords adequate protection to firefighters and others. *There* is particular concern about the absence or inadequacy of preincident planning. IAFF argues that provisions must be made in advance for communication and coordination of activities, as well as for transfer of command to the fire department "in pre-identified areas ."[203]

In crafting HAZWOPER requirements for emergency response training, OSHA may have presumed that firefighters' proficiency in fire suppression affords expertise in handling hazardous materials. However, traditional firefighting tasks do not require a knowledge of basic chemistry, the reactive properties of chemicals, the characteristics of hazardous materials, or radiation protection—all of which are skills needed to conduct effective emergency response operations at hazardous waste sites.[204] OSHA and EPA also apparently assume that fire departments will have the benefit of the health and safety training required under Title III provisions of SARA. Recent experience at Superfund sites suggests that such an assumption may be unwarranted. Many towns and cities have apparently not yet complied with the emergency response preparedness provisions of Superfund and lack the resources to do so in the near future.[205] [206]

CHAPTER 2 ENDNOTES

[1] William Reilly, Administrator, U.S. Environmental Protection Agency, "Statement Before the Subcommittee on Investigations and Oversight Committee on Public Works and Transportation, U.S. House of Representatives," Oct. 3, 1992,

[2] Under the Superfund Amendments and Reauthorization Act (SARA), the Environmental protection Agency has the authority to order emergency removal of environmental contamination at uncontrolled hazardous waste sites when the contamination is believed to represent an acute or immediate threat to human health. An example of a such action was the removal of thousands of highly radioactive metal "needles," 200 lab reagent chemicals, deteriorating shock-sensitive ether cans from a Superfund site in Ncw York.

[3] 42 U.S.C. 9601 et. seg.

[4] National Oil and Hazardous Substances Pollution Contingency Plan, 40 CFR 300 et. seq.

[5] C. Zamuda, "Superfund Risk Assessments: The Process and Past Experience at Uncontrolled Hazardous Waste Sites" *The Risk Assessment of Environmental and Human Health Hazards: A Textbook of Case Studies* , D.J. Paustenbach (cd.) (New York, NY: J. Wiley& Sons) 1989.

[6] M. Gochfeld, V. Campbell, P. Landsbergis, "Demography of the Hazardous Waste Industry," *Occupational Medicine: State of the Art Reviews, vol. 5, No.* 1, January-March 1990, pp. 9-23.

[7] Mark Bashor, Asst. Administrator for Federal Facilities, Agency for Toxic Substances and Disease Registry, personal communication to T. O'Toole, Nov. 24, 1992.

[8] J. Cocalis, National Institute of Occupational Safety and Health, Environmental Investigation Branch, personal communication to T. O'Toole, Aug. 19, 1992.

[9] M. Garrahan, Senior Industrial Hygienist, Occupational Safety and Health Administration, personal communication, T. O'Toole, Dec. 1, 1992.

[10] 39 U.S.C. 651-678 (West 1985 and Suppl. 1992).

[11] 29 CFR 1910.120.

[12] Office of Technology Assessment-Hazardous Waste Advisory Council (HWAC) Workshop, Washington, DC, Sept. 17, 1992.

[13] J Cocalis, personal communication to T. O'Toole, Aug. 19, 1991, op. cit.

[14] Occupational Safety and Health Administration, Office of Health Compliance Assistance, Directorate of Compliance Programs, U.S. Department of Labor, "Protocol for OSHA Compliance Inspections of Superfund Incineration Sites-Draft Final," Nov. 16, 1992.

[15] u.s. Environmental protection Agency-Labor Health and Safety Task Force, minutes of meeting, Sept. 22, 1992.

[16] U S Genera] Accounting Office, *Options for Improving Safety and Health para3:in the Workplace* , GAO/HRD-90-66BR (August 1990).

[17] U S .Environmental Protection Agency, Office of Solid Waste and Emergency Response, "Superfund Progress," 9200.1-12, May 1992.

[18] U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, "Supplementary Material, National Priorities List Proposed Rule," EPA 9320-7/05 1, February 1992, p. 3.

[19] Letter from J. Belaga, Regional Administrator, U.S. Environment Protection Agency to H. Lenow, counsel to Hanson Permanent Fire Fighters Association% Apr. 29, 1992.

[20] R. Harris, R, Kapuscinski, "Hardage ROD Overturned, " *Environ Report* , Winter 1989/Spring 1990, p. 1.

[21] *Superfund Report* "EPA Issues Guidance for Early Risk Assessment to Screen Alternatives," Jan. 15, 1992.

[22] U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, *Risk Assessment Guidance for Superfund: Vol. l—Human Health Evaluation para3:Manual, (Part B, Development of Risk-Based Preliminary Remediation Goals*, (December 1991).

[23] US Environmental Protection Agency, Office of Solid Waste and Emergency Response "Superfund Accelerated Cleanup Model—SACM," March 1992.

[24] L. Murphy, Director, Hazardous Materials Training, International Association of Firefighters, personal communication to T. O'Toole, OTA, July 17, 1992.

[25] Office of Technology Assessment Workshop on Cleanup Worker Health and Safety at the Department of Energy Nuclear Weapons Complex, Washington, DC, May 15, 1991.

[26] Office of Technology Assessment-HWAC Workshop, op. cit.

[27] EPA-Labor Health and Safety Task Force, notes from Mar, 5, 1991 meeting

[28] K, Ayers, Chief, Design and Construction Management Branch, Office of Solid Waste and Emergency Response, U.S. Environmental protective Agency, personal communication to T. O'Toole, Aug. 20, 1991.

[29] U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, "Hazardous Waste Operations and Emergency Response: General Information and Comparison" (9285 .2-09FS). April 1991.

[30] US .Environmental protection Agency, Office of Solid Waste and Emergency Response, "Hazardous Waste Operations and Emergency Response: Uncontrolled Hazardous Waste Sites and RCRA Corrective Actions" (9285 .2-08FS) April 1991.

[31] U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Responses, "Hazardous Waste Operations and Emergency Response: RCRA TSD and Emergency Response Without Regard to Location" (9285 .2-07FS) April 1991.

[32] U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Responses, "Hazardous Waste Operations and Emergency Response: Establishing Work Zones at Uncontrolled Hazardous Waste Sites" (9285 .2-06FS) April 1991.

[33] U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Responses, "Hazardous Waste Operations and Emergency Response: Health and Safety Responsibilities at Remedial Sites" (9285.1-02) April 1991.

[34] US Environmental protection Agency, Office of Solid Waste and Emergency Responses, "Hazardous Waste Operations and Emergency Response: Hazardous Waste Operations and Emergency Response: Available Guidance (9285 .2-1OFS) April 1991.

[35] Occupational Safety and Health Administration, Office of Health Compliance Assistance, "Protocol for OSHA Compliance Inspections of Superfund Incineration Sites," op. cit.

[36] EPA-Labor Health and Safety Task Force, July 18, 1991 meeting.

[37] Environmental protection Agency-Labor Health and Safety Task Force, minutes of Oct. 17, 1991, meeting.

[38] Letter from Don Clay, Asst. Administrator, Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, to Les Murphy, Director, Hazardous Materials Training, International Association of Firefighters, June 23, 1992.

[39] L. Murphy, Director, Hazardous Materials Training, International Association of Firefighters, personal communication to T. O'Toole, Office of Technology Assessment, July 17, 1992.

[40] U.S. Environmental protection Agency-Labor Health and Safety Task Force, minutes of Oct. 17, 1991 meeting.

[41] U.S. Environmental Protection Agency-Labor Health and Safety Task Force, notes from Mar. 5, 1991 meeting.

[42] J. Moran, Co-chair, U.S. Environmental Protective Agency Labor Health and Safety Task Force, Director of Occupational Safety and Health, Laborers' Health and Safety Fund of North America, personal communication to T. O'Toole, Jan. 22, 1991.

[43] U.S. Environmental Protection Agency Labor-Health and Safety Task Force, minutes of July 10, 1992 meeting.

[44] U.S. Environmental Protection Agency-Labor Health and Safety Task Force, minutes of June 17, 1992 meeting.

[45] Memo from L. Mᵤwhᵧ, Director Hazardous Materials Training International Association of Firefighters to Environmental Protection Agency-Labor Task Force, July 20, 1992,

[46] U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response *Risk Assessment Guidance for Superfund, Human Health Evaluation Manual, Part A (9285.701A)* Washington DC, Sept. 29, 1989.

[47] Most cleanup work to date has taken place at Superfund sites. Relatively few RCRA facilities have begun extensive remediation action. Although most of the observations in this report are drawn from experience at Superfund sites, regulators, environmental professionals, and labor representatives believe that this experience is also applicable to environmental cleanup at RCRA facilities,

[48] S. Golian, E. Dodge, B. Bixler, "Conducting Remedial Investigations and Feasibility Studies Under CERCLA," *Superfund '88-Proceedings of 9th National para3:Conference*, Washington DC, Nov. 28-30, 1988.

[49] OTA-HWAC Workshop, op. cit.

[50] J. Moran, Director of Occupational Safety and Health, Laborers Health and Safety Fund of North America, personal communication to T. O'Toole, Jan. 22, 1991.

[51] K. Ayers, Chief, Design and Construction Management Branch, U.S. Environmental Protection Agency, personal communication to J. Harn, T. O'Toole, Feb. 12, 1991.

[52] OTA Workshop on DOE CleanUp Workers, op. cit.

[53] U.S. Congress, Office of Technology Assessment-j *Coming Clean—Superfund Problems Can Be Solved, OTA-ITE-433* (Washington, DC: U.S. Government Printing Office, October 1989).

[54] U.S. Congress, Office of Technology Assessment, oTA-o-484, *Complex Cleanup —The Environmental Legacy of Nuclear Weapons Production* (Washington DC: U.S. Government Printing Office, February 1991).

[55] C Noble, "Keeping OSHA's Feet to the Fire," *Technology Review*, February/March 1992, pp. 43-51.

[56] General Accounting office, *Options for Improving Health and Safety in para3:the Workplace*, op. cit.

[57] OTA Workshop on DOE Cleanup Workers, op. cit.

[58] National Academy of sciences, *Hutnan Exposure Assessment for Airborne para3:Pollutants* (Washington, DC: National Academy Press, 1991).

[59] OTA-HWAC Workshop, op. cit.

[60] OTA Workshop on DOE Cleanup Workers Op. cit.

61 U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, "Guidance for Data Usability in Risk Assessment," 9285.7-05FS, September 1990.

62 U.S. Environmental Protection Agency Office of Emergency and Remedial Response, *Risk Assessment Guidance for Superfund-Part B*, op. cit.

63 Ibid., Part C.

64 J. Moran, and D. Elisburg, "Hazardous Waste Sites: Worker Protection Perspectives", *Conference Proceedings: First EPA Design and Construction Issues para3:at Hazardous Waste Site Conference*, EPA 540/8-91/012, May 1991

65 National Institute of Occupational Safety and Health (NIOSH), Occupational Safety and Health Administration (OSHA), U.S. Coast Guard (USCG), U.S. Environmental Protection Agency (EPA), *Occupational Safety and Health para3:Guidance Manual for Hazardous Waste Site Activities* (Washington, DC: U.S. Government Printing Office), October 1985.

66 Moran and Elisberg, op. cit.

67 Office of Technology Assessment-HWAC Workshop, op. cit.

68 u.s. Environmental Protection Agency-Labor Health and Safety Task Force, notes from Mar. 5, 1991 meeting.

69 Office of Technology Assessment-HWAC Workshop, op. cit.

70 Ibid.

71 U.S. Congress, House of Representatives Committee on Government Operations, "OSHA's Failure to Protect the Health and Safety of Workers at Hazardous Waste Sites," House Report 99-140, May 21, 1985.

72 42 U.S.C. 9601 et seq.

73 The contents of the HAZWOPER standard promulgated by each agency are identical. The jurisdictions of OSHA and EPA differ. EPA covers public employees of States without OSHA-approved State plans. Federal employees are covered under Executive Order No. 12196. OSHA and EPA have agreed that OSHA will be the agency responsible for interpreting the regulations. The OSHA HAZWOPER regulations are codified at 20 CFR 1910,120 (54 Federal Register 9294, Mar. 6, 1989). The EPA regulations are codified at40CFR311 (Federal Register 26654, June 23, 1989) and incorporate the OSHA standards by reference.

74 The standard is applicable at any cleanup carried out by a government body that revolves hazardous substances, including sites on or recommended for the National Priorities List; sites where preliminary characterization efforts are conducted before the presence of hazardous materials has been ascertained or ruled out; RCRA sites undergoing corrective actions; operations at RCRA treatment, storage, and disposal facilities; emergency response operations for releases of, or substantial threats of releases of, hazardous substances; and voluntary cleanup operations.

7529 CFR 1910.120.

76 R. Yodaiken, "Surveillance, Monitoring, and Regulatory Concerns" *J. of para3:Occupational Medicine*, vol. 28, No. 8, August 1986, pp. 569-571.

77 J. Melius, "Medical Surveillance for Hazardous Waste Workers," *J. of Occupational Medicine*, vol. 28, No. 8, August 1986, pp. 679-683.

78 E. Fanvata, and M. Gochfeld, "Medical Surveillance of Hazardous Waste Workers: Ability of Laboratory Tests to Discriminate Exposure," *American Journal para3:of Industrial Medicine*, vol. 15, 1989, pp. 255-265.

79 N. Nelson et rd., "Cleanup of Contaminated Sites," *Toxic Chemicals, Health and the Environment*, L. Lane and A. Upton, eds. (Baltimore, MD: Johns Hopkins University Press, 1987).

80 U.S. Environmental Protection Agency-Labor Health and Safety Task Force, notes from Mar. 5, 1991 meeting.

81 OTA Workshop on DOE Cleanup Workers, op. cit.

82 OTA-HWAC workshop, op. cit.

83 Hazardous Waste Action Contractors, *The Hazardous Waste Practice—para3:Technical and Legal Environment 1991* (HWAC, Washington DC: 1991), p. vi.

84 U.S. Environmental Protection Agency-Labor Health and Safety Task Force, notes from Mar. 5, 1991 meeting.

85 J Moran, and D. Elisburg, Op. cit.

86 2"9 CFR 1910.1000.

87 *Federal Register* 37591 (Sept. 27, 1988).

88 *Federal* Register 2332 (1989)

89 OTA-HWAC Workshop, op. cit.

90 National Academy of Sciences, *Risk Assessment in the Federal Government: para3:Managing the Process* (Washington DC: National Academy Press, 1983).

91 U.S. Congress, Office of Technology Assessment, *Neurotoxicity: Identifying and Controlling Poisons of the Nervous System* (Washington DC: U.S. Government Printing Office, April 1992).

92 National Academy of Sciences, Biologic Markers "n Immunotoxicology (Washington, DC: National Academy Press, 1992).

93 National Academy of Sciences, *Biologic Markers in Reproductive para3:Toxicology* (Washington, DC: National Academy Press, 1983).

94 OTA-HWAC Workshop, op. cit.

9539 U.S.C. *651-678* (West 1985 and Suppl. 1992).

96 U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, "Hazardous Waste Operations and Emergency Response: Uncontrolled Hazardous Waste Sites and RCRA Corrective Actions," op. cit.

97 U.S. Court of Appeals for the Eleventh Circuit, *S. Phillips and P.D. para3:Phillips v. United States of America, No. 91-8040, Mar. 30, 1992.*

98 U.S. Department of Labor, Occupational Safety and Health Administration, data from Federal and State (18B) State Inspection of Hazardous Waste Activity, Mar. 1, 1990 through Dec. 6, 1991.

99 EPA-Labor Health and Safety Task Force, minutes from Oct. 17, 1991 meeting,

100 Occupation Safety and Health Administration, Directorate of Compliance Programs, "HAZWOPER-Interpretative Quips (IQs)," October 1992.

101 OTA Workshop on DOE Cleanup Workers, op. cit.

102 OTA-HWAC Workshop, op. cit.

103 29 CFR 1910.120.

104 M Gochfeld, "Medical Surveillance of Hazardous Waste Workers: Principles and Problems," Occupational *Medicine: State of the Art Reviews*, vol. 5, No. 1, January-March 1990, p 107.

105 OTA-HWAC workshop, op. cit.

106 OTA Workshop on DOE Cleanup Workers, op. cit.

107 OTA Workshop on DOE Cleanup Workers, 0p. cit.

108 Environmental Protection Agency-Labor Health and Safety Task Force, notes from Mar. 5, 1991 meeting.

109 L Murphy, Director, International Association of Firefighters, memorandum to Environmental Protection Agency-Labor Health and Safety Task Force, "New Bedford," July 20, 1992.

110 Wehran Envirotech, "Site Health and Safety Plan-New Bedford Superfund Site," November 1991.

111 H Openshaw, Chief, City of New Bedford, Massachusetts Fire Department, "Special Communication%" Oct. 7, 1992.

112 M. Boyle, N. White, "PCB Site Cleanup Hits Snag," *Cape Cod Standard para3:Times*, Oct. 27, 1992.

113 OTA Workshop on DOE Cleanup Workers, op. cit.

114 US Army Corps of Engineers, Accident Investigation Report, "Louisiana Army Ammunition Plant Incinerator Accident, Second of Two Accidents," Mar. 10, 1989.

115 Ibid.

116 US Army Corps of Engineers, Accident Investigation Report, "Cornhusker Army Ammunition Plant, Incinerator Accident, First of Two Accidents," Sept. 17, 1987.

117 US Environmental Protection Agency, Office of Solid Waste and Emergency Response, "Establishing Work Zones . . .", op. cit.

118 Occupational Safety and Health Administration, Director of Compliance Programs, "HAZWOPER-Interpretive Quips", op. cit.

119 U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, "Establishing Work Zone . . .", op. cit.

120 Patricia Clark, Director Designate, Director of Compliance, Department of Labor, Occupational Safety and Health Administration, letter to J. Moran, Laborers' National Health and Safety Fund, Oct. 3, 1990.

121 Occupational Safety and Health Administration, Director of Compliance Programs, "HAZWOPER-Interpretative Quips", op. cit.

122 29 CFR 1910.120, July 1, 1991, p. 367.

123 OTA-HWAC Workshop, op. cit.

124 David Rempel, "Medical Surveillance in the Workplace: Overview," *Occupational Medicine: State of the Art Reviews*, vol. 5, No. 3, July-September 1990.

125 NIOSH/OSHA/USCG/EPA, 1985, op. cit.

126 W. Halperin and T. Frazier, "Surveillance for the Effects of Workplace Exposure", *Annual Review of Public Health*, vol. 6, 1985, pp. 419-32.

127 W. Halperin, J. Ratcliffe et al., "Medical Screening in the Workplace: Proposed Principles", *Journal of Occupational Medicine, vol. 28, No. 8,* August 1986, pp. 547-552.

128 OTA Workshop on DOE Cleanup Workers.

129 E Favata and M. Gochfeld, "Medical Surveillance of Hazardous Waste Workers: Ability of Laboratory Tests to Discriminate Exposure," *American Journal para3:of Industrial Medicine, vol. 15, 1989,* pp. 255-265.

130 J. Melius, "OSHA Standard for Medical Surveillance of Hazardous Waste Workers," *Occupational Medicine: State of the Art Reviews*, vol. 5, No. 1, January-March 1990, pp. 143-150.

131 M Gochfeld, "Medical Surveillance of Hazardous Wrote Workers," op. cit.

132 20 CFR 1910.120.

133 The 30-day trigger also applies to eligibility for HAZWOPER-mandated health and safety training.

134 OTA Workshop of DOE Cleanup Workers, op. cit.

135 Ibid.

136 OTA-HWAC workshop, op. Cit.

137 J. Melius, op. cit.

138 U.S. Environmental Protection Agency, "U.S. Environmental Protection Agency Environmental Response Term's Occupational Medical Monitoring Program Guidelines for SARA Hazardous Waste Field Activity Personnel, " 9285.3-04, January 1990.

139 M. Silverstein, "Medical Screening, Surveillance and the Prevention of Occupational Disease," *Journal of Occupational Medicine,* vol. 32, No. 10, October 1990, pp. 1032-1036.

l@ Office of Technology Assessment *Complex Cleanup*, 1991, op. cit.

141 Pub L. 99-499, 42 U.S.C. 126(d).

142 40 CFR 1910.121 "

143 129 U.S.C. 8655; Pub. L. 99-499, Oct. 17, 1986.

144 40 CFR 1910.120.

145 J. Moran "Testimony of Laborers' International Union of North America, AFL-CIO, Laborers-AGC Education and Training Fund, and Laborers' Health and Safety Fund of North America on Proposed Rulemaking on Accreditation of Training Programs for Hazardous Waste Operations, " Docket No. S-760-B, U.S. Department of Labor, Occupational Safety and Health Administration, Jan. 22, 1991, p. 14.

146 OTA Workshop on DOE Cleanup Workers, op. cit.

147 L. Murphy, Director, Hazardous Materials Training, International Association of Firefighters, personat communication to T. O'Toole, Office of Technology Assessment, July 17, 1992.

148 National Institute for Environmental Health Sciences, *Minimum Criteria for Worker Health and Safety Training of Hazardous Waste Operations and Emergency Response*, April 1990.

149 40 CFR 1910.121

150 OTA Workshop on DOE Cleanup Workers, op. cit.

151 J. Warren, Executive Director, Laborers-AGC Education and Training Fund, "Testimony on Proposed Rulemaking on Accreditation and Training Program for Hazardous Waste Operations," Docket No. S-760-B, U.S. Department of Labor, Occupational Safety Health Administration Jan. 22, 1991.

152 Nolan Hancock, Director, Citizenship-Legislative Department, Oil Chemical and Atomic Workers International Union, personal communication to T. O'Toole, Office of Technology Assessment.

153 J. Moran, Director of Occupational Safety and Heal@ Laborers' Health and Safety Fund of North America, personal communication to T. O'Toole, Office of Technology Assessment.

154 R. Duffy, Director of Health and Safety, International Association of Firefighters, "Testimony on Proposed Rulemaking on Accreditation of Training Programs for Hazardous Waste Operations," Docket No. S-760-B, U.S. Department of Labor, Occupational Safety and Health Administration, Jan. 22, 1991.

155 OTA Workshop on DOE Cleanup Workers, op. cit.

156 Ibid.

157 Ibid.

158 U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Office of Emergency and Remedial Response, "Hazardous Materials Incident Response Training Program," Jan. 1, 1991.

159 B. Sattler, Director, National Center on Hazard Communications, University of Maryland, personal communication to OTA staff, Apr. 9, 1991.

160 U.S. Department of Health and Human Services, Public Health Service and the Agency for Toxic Substances and Disease Registry, *Evaluating Hazardous Waste Education and Training*, (November 1990).

161 National Institute of Environmental Health Sciences, Department of Health and Human Services, "Testimony of the National Institute of Environmental Health Services on the Occupational Safety and Health Administration's Proposed Standard for Accreditation of Hazardous Waste Operations and Emergency Response Training: 29 CFR 1910. 121", Jan. 29, 1991.

162 Superfund Amendments and Reauthorization Act of 1986, Section 126(g).

163 J. Hughes, "An Assessment of Training Needs for Worker Safety and Health Programs: Hazardous Waste Operations and Emergency Response," *Applied Occupational Environmental Hygiene, vol. 6, No 2*, February 1991, pp. 114-118,

164 51 *Federal Register*, 4556 Dec. 19, 1986.

165 National Institute of Environmental Health Sciences, "Summary of NIEHS Funded Supcrfund Worker Training Grants", 1991

166 National Institute of Environmental Health Sciences, "Request for Grant Application—Hazardous Materials and Waste Worker Health and Safety Training—Background Information," Mar. 16, 1990,

167 National Institute of Environmental Health Science S, "Summary Report of 1990 Site Visit Reviews of NIEHS Worker Training Granters—Draft Version 2-2591," February 1991.

168 D Dobbin, program Administrator, Worker Health and Safety Training Grant program, National Institute of Environmental Health Sciences, personal communication to T. O'Toole, Office of Technology Assessment, Feb. 20, 1991,

169 National Institute of Environmental Health Sciences, "Testimony of the NIEHS on the OSHA'S Proposed Standard for Accreditation of Hazardous Waste Operations and Emergency Response Training: 20 CFR 1910.121," U.S. Department of Labor, Washington DC, Jan, 29, 1991,

170 29 CFR 1910.120.

171 Ibid.

172 SARA Title III, Sec. 301-305, *Environmental Statutes* (Rockville, MD: Government Institutes, Inc., 1991), p. 1048.

173 Ibid.

174 U.S. Environmental protection Agency-Labor Health and Safety Task Force, Minutes of Meeting, June 25, 1992.

175 U.S. Environmental Protection Agency-Labor Health and Safety Task Force, Minutes of Meeting, Aug. 17, 1992.

176 U.S. Environmental Protection Agency-Labor Health and Safety Task Force, Minutes of Meeting, May 14, 1992.

177 U.S. Environmental Protection Agency-Labor Health and Safety Task Force, Minutes of Meeting, April, 13, 1992.

178 L. Murphy, "*Crisis in the Fire Service,*" *Proceedings of First EPA Design and Construction Issues at Hazardous Waste Sites Conference*, Dallas, TX, May 1-3, 1991, p. 827.

179 Les Murphy, Director, Hazardous Materials Training, International Association of Firefighters, letter to R. Guimond, Deputy Assistant Administrator, Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Mar. 4, 1992.

180 R. Guimond, Deputy Assistant Administrator, Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, letter to Les Murphy, Director, Hazardous Materials Training, International Association of Firefighters, Apr. 6, 1992,

181 R, Camara, Firefighters Association of Fall River, Massachusetts letter to Don Clay, Assistant Administrator, Office of Solid Waste and Emergency Response, LT. S. Environmental Protection Agency, Feb. 12, 1992.

182 D Clay, Assistant Administrator, Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, letter to L. Murphy, Director, Hazardous Materials Training Program, International Association of Firefighters, June 23, 1992.

183 J Moran, Co-Chair, EPA-Labor Task Force, memorandum to Vicki Santoro, Environmental Protection Agency Emergency Response Team, "Fall River, MA Title III Audit, June 26, 1992," July 9, 1992.

184 P. Lizer, District Chief, Ncw Bedford, MA Fire Department, "memorandum to H. Openshaw, Chief of Department, re: Grass Fire PCB Site Foot of Sawyer Street," Mar. 14, 1992.

185 H. Lenow, Esq., On behalf of Hanson Permanent Firefighters Association, IAFF Local 2914, letter to J. Belaga, Regional Administrator, Region 1, U.S. Environmental Protection Agency, Apr. 9, 1992.

186 L. Murphy, Op. cit.

187 J. Cocalis, Co-Chair, Environmental Protection Agency, Health and Safety Task Force, personal communication to T. O'Toole, May 18, 1992.

188 R. Camara, letter to Don Clay, Feb. 12, 1992, op. cit.

189 L, Murphy, Director, Hazardous Materials Training, International Association of Firefighters, personal communication to T. O'Toole, Office of Technology Assessment, July 17, 1992.

190 J Moran, "Fall River Audit," Op. Cit.

191 Les Murphy, Director, International Association of Firefighters, Hazardous Materials Training, memorandum to Environmental Protection Agency-Labor Health and Safety Task Force, "Ncw Bedford," July 20, 1992.

192 J Cocalis, Co-chair, EPA-Labor Health and Safety Task Force, personal communication to T. O'Toole, Office of Technology Assessment, Aug. 19, 1992.

193 Ibid.

194 Ibid.

195 Stephen Luftig, Director, Emergency Response Division, U.S. Environmental Protection Agency, "Comments of OSHA'S Proposed Rule: Accreditation of Training programs for Hazardous Waste Operations," OSHA Docket, No. S-760-B, U.S. Department of Labor, Occupational Safety and Health Administration.

196 R. Duffy, op. cit.

197 Don Clay, Assistant Administrator, Office Of Solid Waste Emergency Response, U.S. Environmental Protection Agency, letter to K. Ringen, Executive Director, Laborers' Health and Safety Fund, June 23, 1992.

198 55 *Federal Register* , 2778, Jan. 26, 1990.

199 29 CFR 1910.120.

200 Ibid.

201 55 FR , 2778, Jan. 26, 1990.

202 R. Duffy, 1991, Op. cit.

203 L. Murphy, "Crisis in the Fire Service," op. cit.

204 L. Murphy, Director, Hazardous Materials Training, International Association of Firefighters, personal communication to T. O'Toole, Office of Technology Assessment, Jan. 20, 1991.

205 J. Moran, memorandum to Vicki Santoro, June 16, 1991, op. cit.

206 L Murphy, memorandum to Environmental protection Agency-Labor Task Force-New Bedford, June 20, 1992. op. cit.