Hazards Ahead: Managing Cleanup Worker Health and Safety at the Nuclear Weapons Complex

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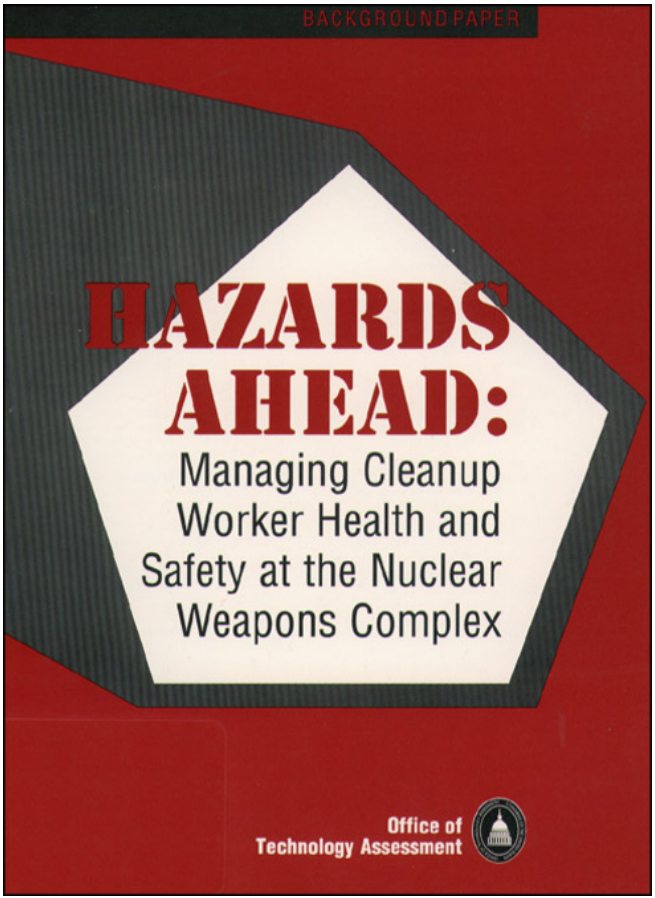

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Foreword

Cold War nuclear weapons production has left a legacy of environmental contamination that is unprecented in scope and complexity. The Department of Energy has begun cleaning up pollution at the Nuclear Weapons Complex (NWC)-an expensive, decades-long task that will require a workforce numbering tens of thousands of scientists, technicians, and laborers. Protecting their health and safety must be a major goal of this cleanup effort. Achieving this goal will require DOE to successfully confront significant technical and managerial challenges, but it also poses a unique opportunity to advance state-of-the-art occupational health and safety technologies and practices.

The Senate Committee on Armed Services asked OTA to undertake this project as part of OTA's evaluation of environmental restoration and waste management at the DOE Nuclear Weapons Complex. The Committee directed OTA to examine risks workers might face in cleaning up contamination at the Complex and to evaluate the effectiveness of DOE's occupational safety and health programs for cleanup workers.

This background paper concludes that, thus far, DOE and its contractors have devoted little attention to cleanup worker health and safety. They have not convinced workers and managers that a "new culture" of accountability in environment, safety, and health is truly ascendent. DOE's plans call for ambitious increased capability in occupational safety and health matters, but DOE has devoted few resources to these efforts. Policies and programs needed to protect cleanup workers are not yet in place.

Yet DOE could apply to great advantage both its own technical strengths and the lessons learned by the Nation's experience with protecting cleanup workers at non-Federal waste sites. If the Department aggressively addresses its organizational problems, it could become a major force in establishing the principles, practices, and technologies needed to restore contaminated environments to safe conditions-in a manner that ensures that the "cure" for contaminated environments does not do more harm than the pollution itself.

In the course of preparing this background paper, OTA received important assistance from many individuals and organizations. Workshop participants, employees of OSHA, EPA, and DOE, and numerous contributors and reviewers from academia, industry, and organized labor gave generously of their advice and time. In the absence of such expert advice and guidance, OTA would have been unable to accomplish this study. The analysis and conclusions of this background paper are, of course, OTA's, and OTA assumes full responsibility for the paper and the accuracy of its contents.

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NOTE: OTA appreciates and is grateful for the valuable assistance and thoughtful critiques provided by the workshop participants. The participants do not, however, necessarily approve, disapprove, or endorse this background paper. OTA assumes full responsibility for the background paper and the accuracy of its contents.

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List of Abbreviations

ACE-United States Army Corps of Engineers

DOE-United States Department of Energy

EH—-DOE Office of Environment, Safety and Health

EM—DOE Office of Environmental Restoration and Waste Management

ERMC-Environmental Restoration Management Contractor

GAO-United States General Accounting Office

HASP-Health and Safety Plan

HAZWOPER-Hazardous Waste Operations and Emergency Response Standard

HWAC-Hazardous Waste Action Contractors

LANL--Los Alamos National Laboratory

M+O-Management and Operation Contractor

NIOSH—National Institute of Occupational Safety and Health

NWC-nuclear weapons complex

OSH-occupational safety and health

OSHA-Occupational Safety and Health Administration

PEL—permissible exposure limit

PPE-personal protective equipment

RCRA—Resources Conservation and Recovery Act

RFI-Remedial Facility Investigation

RIFS-Remedial Investigation/Feasibility Study

USCG—United States Coast Guard

WAS—Westinghouse Hanford Corporation

Contents

Overview and Findings 1

The Manhattan Project-the secret effort to invent and build the first atomic bomb-was accomplished in less than 4 years at a cost of approximately $2 billion.[1] The project was backed by the resources of America's largest and most advanced corporations and engineering fins, and employed the talents of thousands of the world's best scientists, technicians, and workers.

A half century later, the institutional descendant of the Manhattan Project, the U.S. Department of Energy (DOE), cofronts a new mission: cleaning up the environmental pollution left by cold war nuclear weapons production. This new mission presents DOE with daunting technical and organizational challenges as it strives to revise policies that led to widespread pollution throughout the Nuclear Weapons Complex and to restore contaminated environments to safe conditions,

It is estimated that cleanup of environmental contamination from nearly **50** years of nuclear weapons manufacture will cost more than $100 billion and require more than 30 years to complete. The cost and length of the cleanup are uncertain because the true extent of pollution and the means to remedy it areas yet only dimly understood, Some areas of the Weapons Complex may never be restored to pristine conditions.[2]

DOE is responsible for protecting those who will do the work of cleaning up

The tasks involved in the cleanup of environmental contamination are unfamiliar to DOE. Indeed, the entire field of hazardous waste management and environmental remediation is in its infancy. Methods of characterizing contaminatedsites are highly uncertain,[3] and approaches to cleaning up are largely unproved at both waste sites owned by private industry and government-owned facilities such as DOE reservations.[4 5]

It is clear, however, that cleaning up the 14 facilities in **13** States that make up the Nuclear Weapons Complex (NWC) will

demand the application of great talent and resources. The tens of thousands of people who will be engaged in cleanup of the Weapons Complex will join a large and growing industry devoted to the characterization and restoration of contaminated environments. It is estimated that over the next 5 years, DOE's Office of Environmental Restoration and Waste Management could require the services of as many as 25,000 scientists, engineers, and technicians.[6]

Some workers will be involved in collecting environmental samples, studying groundwater movement, and designing remediation projects. Others will be operating earth moving equipment; handling, inspecting, and repacking waste drums; or building dams, digging trenches, and constructing complex waste treatment facilities. Still others will be plant operators, maintenance personnel, and technical experts at vitrification plants, wastewater treatment facilities, and incinerators. Municipal firefighters, police, medical experts, and other emergency response personnel may be called on in the event of fire, explosion, or accidental release of toxic materials.

The NWC cleanup will be one of the largest environmental remediation efforts ever, and very likely the largest undertaken by the Federal Government at taxpayers' expense. If conducted effectively, the DOE cleanup could serve as a model of how workers engaged in hazardous waste and emergency response operations should be protected from work-related illness and injury. DOE's past refusal to acknowledge its obligation to comply with environmental laws and regulations means that the Department is starting environmental characterization and remediation activities more than a decade after the private sector began cleaning up Superfund and Resource Conservation and Recovery Act (RCRA) sites. During those years, much has been learned about how to protect the health and safety of cleanup workers; DOE could apply these lessons to great advantage.

As DOE turns its attention toward its new mission of environmental restoration and waste management, the Department assumes responsibility for providing safe and healthful working conditions for those who will do the work of cleaning up. The vigor and success with which DOE implements health and safety programs for cleanup workers will be a signal of its willingness and ability to embrace the "new culture" spoken of by the Secretary of Energy—a culture that honors protection of the environment, health, and safety as a fundamental priority.[8] If effectively conducted, the DOE cleanup could serve as a model of how workers engaged in hazardous waste and emergency response operations should be protected from work-related illness and injury.

Environmental restoration and waste management activities at DOE provide an opportunity to advance the state of the art of occupational health and safety programs for cleanup workers. DOE's stated commitment to attain a new culture that respects the environment, health, and safety; its search for new ways of incorporating effective worker protection programs into contract agreements; and its intent to pursue cleanup in a responsible and cost-effective manner-all place DOE in a position to become a major force in advancing the programs and technologies needed to adequately protect workers from safety hazards and from the adverse effects of exposure to toxic materials.

Achieving such a leadership position in occupational health and safety will require DOE to adopt policies and undertake actions now only in their incipient stages. To apply management lessons gleaned from experience at non-Federal cleanup operations, DOE must first recognize the need for strong management commitment to the occupational safety and health (OSH) of its cleanup workers. Comprehensive, DOE-wide OSH policies, objectives, programs, and means of assessing progress must be developed. The cooperative efforts of line managers and health and

safety professionals will be required along with input from experienced workers. Consultation and interaction with other government agencies and organizations with expertise in worker protection issues will also be needed if DOE is to formulate a timely and effective approach to cleanup worker protection. The policies adopted then will have to be implemented and enforced. Finally, truly independent oversight of OSH policies will be necessary at DOE facilities, with mechanisms developed to reward or penalize adherence to or violation of these policies.

CLEANUP WORKER HEALTH AND SAFETY RISKS

In addition to many of the safety hazards associated with conventional construction operations, such as manual lifting, operation of heavy machinery, electrical hazards, exposure to extreme heat and cold, and confined space operations, workers involved in characterizing or remediating toxic waste sites may encounter fire and explosion hazards, as well as the health threats associated with exposure to toxic chemicals and radiation.[9,10] Stress-related illness can also afflict cleanup workers because of the unusual demands and uncertainties associated with this work.[11] Finally cleanup workers at DOE facilities will confront-in addition to all of the usual risks encountered in hazardous waste work—other hazards, such as high-level radioactive waste and mixed waste, that are unique to the Weapons Complex.

PHOTO CREDIT: THE WORKPLACE HEALTH FUND.

Cleanup workers face safety hazards associated with traditional construction tasks as well as health risks from exposure to toxic chemicals and radionuclides.

It is not known what specific health risks cleanup workers face.[12] No prospective studies have been done of health effects among workers employed in the new industry of environmental remediation. It is highly uncertain what, if any, specific biologic effects result from exposure to toxic substances encountered during work with hazardous waste. The health outcomes associated with exposure to most of the chemicals in commercial use are poorly understood,[13] and the health consequences of exposure to low doses of radiation are in dispute.[14-17] The long-term consequences of exposure to chronic, low dosages of toxic materials, radiation, or mixtures of these—the types of exposures most likely to be encountered by cleanup workers—remain largely uninvestigated.

The construction trades, which include many workers engaged in environmental cleanup, are among the most hazardous occupations in the United States and have long been associated with a high rate of worker injuries.[18,19] An estimated $8.9 billion is spent annually on costs related to construction accidents.[20] Indirect costs, including reduced productivity, schedule delays, and damage to equipment or facilities, account for most of this amount.

A number of useful objective measures of past safety performance have been developed, and research has demonstrated several ways of reducing workplace injury rates, including effective worker health and safety training, and the planning and enforcement of safe work practices. An analysis by the Business Roundtable concluded that site owners can effectively influence job safety and that strong construction safety programs are cost effective.[21]

Workers employed in the construction industry also suffer higher rates of some cancers and increased overall mortality compared to the U.S. population as a whole.[22] The causes of these increased rates of nontraumatic deaths among construction workers are not understood; possible relationships between work-related risks and health outcomes among construction workers have not been well studied.

The large number and variety of toxic chemicals present at many hazardous waste sites, the potential interaction of contaminants, and the "disorderly physical environment" of cleanup work make it difficult, and sometimes impossible, to accurately assess all potential chemical or radiologic hazards. In many cases, site contaminants are unidentified and loose in the environment or "uncontrolled." These factors result in work situations that:

- "may include numerous and varied hazards that may pose an immediate danger to life or health;
- Ž may not be immediately obvious or identifiable;
- may vary according to the location on site and the task being performed;
- may change as site activities progress."[23]

Because of these features, the application of traditional approaches to worker protection—namely, a reliance on industrial hygiene data to identify potentially dangerous worker exposures and the use of engineering controls to reduce or eliminate such exposure-is often precluded during environmental cleanup work. Instead, cleanup workers must depend on less certain strategies for identifying site-specific hazards, such as environmental monitoring and medical surveillance, and must rely in large measure on respirators, impermeable clothing, and other personal protective equipment to prevent exposure to toxic materials.[24]

The demographics of much of the private sector hazardous waste work force—youth, frequent turnover, high proportion of minorities[25]-serve to lessen the power of individual employees. The realities of workers' compensation laws in most States restrict a worker's means of legal recourse in the event of injury or adverse health effects. The burden of proof in cases of alleged work-related health problems is on the worker; pervasive scientitic uncertainties about the health impacts of environmental toxicants often make it difficult to prove that a given ailment is work related.

Many health professionals believe that in most cases, cleanup workers can be protected from the harmful effects of exposure to toxic substances.[26-28] However, achieving such protection requires that managers pay vigilant attention to identifying and anticipating potential site hazards and devote adequate resources to design and implementation of the occupational health and safety programs needed to mitigate such hazards. In addition, workers must be trained to recognize unexpected dangers when they are encountered and must be knowledgeable in the use of personal protective equipment.

The Office of Technology Assessment found that there is sufficient evidence to question the adequacy of existing provisions for protecting cleanup workers from occupational illness and injury. Concerns about cleanup worker health and safety have arisen during operations at non-Federal cleanup sites. These concerns are also salient to environmental restoration of the Nuclear Weapons Complex. Some features of the DOE cleanup may intensify worker protection problems encountered at non-Federal facilities.

CONSEQUENCES OF FAILURE TO PROTECT WEAPONS COMPLEX CLEANUP WORKERS

The failure to adequately protect cleanup workers now can have effects that range from near-term public dissatisfaction to future claims of liability against the Federal Government. The linkage between worker health and safety and off-site health impacts is well recognized by communities surrounding hazardous waste sites, as experience with Superfund has shown.[29] 30 If worker health and safety is perceived by the public to be neglected or poorly protected, public confidence in the overall cleanup effort could be undermined. Public doubts about the adequacy of worker protection, the accuracy of site characterization, the hazards of proposed remediation plans, and the reliability of emergency response capabilities could lead to strong pressures to repeat characterization studies, revise planned cleanup strategies, strengthen emergency response plans, or take other measures that would delay cleanup schedules and increase costs.

Given the extent and complexity of contamination at the NWC, the projected size of the cleanup work force, and the expected decades-long duration of cleanup activities, work-related accidents and illnesses are bound to occur.[31] Occupational illnesses are also likely in view of the volume and nature of hazardous materials known to exist on weapons plant reservations .32

In addition, uncertainties about the health hazards associated with characterization and restoration of contaminated environments are pervasive; existing regulatory mandates governing cleanup worker health and safety are ambiguous; and significant weaknesses characterize DOE's and its contractors' occupational health and safety programs for cleanup workers. These features suggest that the Federal Government could face significant liability claims in the future if large numbers of the cleanup workers develop work-related diseases or suffer injuries that might reasonably have been prevented, or if future investigations demonstrate that DOE or its prime contractors failed to exercise prudent judgment in occupational health and safety matters during cleanup. Inadequate attention to OSH issues during cleanup of federal facilities may leave the government vulnerable to lawsuits and claims akin to those now being made by veterans of atomic bomb tests,[33] by citizens living downwind of nuclear tests,[34] and by DOE workers and others alleging radiation-related illness and damages .35-39

APPROACH USED IN THIS STUDY

This OTA background paper was written after review of available government documents and published articles that chronicle cleanup worker health and safety issues.[40] OTA also consulted numerous government officials involved in oversight or regulation of cleanup worker safety and health, as well as DOE contractor employees, DOE and private sector workers involved in hazardous waste operations, labor representatives, academic experts, and health and safety managers from environmental and engineering firms.

Two workshops were held to discuss issues raised in this background paper. The first, referred to as the "OTA Workshop on DOE Cleanup Workers,"[41] included employees of DOE, the Environmental Protection Agency (EPA), and the Occupational Safety and Health Administration (OSHA); workers at DOE weapons facilities; representatives of labor unions engaged in cleanup work; and health and safety professionals from academia and the private sector. The second workshop, the "OTA-HWAC Workshop,"[42] included OTA staff and members of Hazardous Waste Action Contractors (HWAC), a national association of engineering and science firms practicing in hazardous waste management.

In the course of this project, OTA staff visited all of the facilities in the DOE Nuclear Weapons Complex. The EPA-Labor Health and Safety Task Force, a group that includes representatives

from several government agencies and labor organizations convened to address controversial issues surrounding cleanup worker health and safety, allowed OTA staff to attend several of its meetings and to review the minutes of other meetings. OTA staff benefited greatly from the opportunity to accompany representatives from OSHA, EPA, the Army Corps of Engineers (ACE), and the EPA-Labor Health and Safety Task Force on a tour of a (non-DOE) Superfund site. This tour was part of an interagency effort to establish an OSHA inspection protocol for Superfund incineration sites.[43 44]

There is no comprehensive documentation of the successes or problems associated with worker health and safety programs at hazardous waste sites either in the private sector or at DOE facilities. The government does not categorize workers engaged in environmental remediation or hazardous materials emergency response actions in ways that allow accurate analyses of occupational health and safety statistics in this industry.[45] Further, much of the activity at hazardous waste sites thus far has involved characterization studies aimed at mapping pollution pathways and short-lived emergency removal projects.[46 47] Only recently have actual remediation and cleanup activities become a prominent aspect of work at Superfund and RCRA sites. This is also the case at DOE facilities, where site characterization efforts are ongoing and environmental cleanup work is just getting underway.[48]

OTA's analysis of DOE's capacity to protect cleanup worker health and safety draws on a number of documents reviewing DOE's management of environment, safety, and health issues. (See, for example, work cited in footnotes 49-64.) Some of these reports were compiled by expert independent panels, many convened at the request of the Secretary of Energy. These reviews, although focusing primarily on the DOE weapons production work force and not on cleanup workers, provide useful information about the Department's general approach to worker health and safety. OTA also examined DOE documents pertinent to occupational safety and health policies and practices, including internal memoranda and drafts of proposed OSH orders and programs. The DOE Office of Environmental Restoration and Waste Management (EM) and the Office of Environment, Safety, and Health (EH) reviewed and commented on a draft of this OTA background paper.

Because of the limited data documenting health and safety risks or health outcomes among cleanup workers, the lack of reliable surveys of work conditions at hazardous waste sites, and the absence of any comprehensive or prospective studies of the occupational illnesses or injuries encountered during environmental cleanup work at private sector sites or at government facilities, some of the information presented in this OTA background paper is necessarily anecdotal. Nonetheless, several themes and issues were raised consistently and repeatedly in the course of OTA's investigation; these are discussed here. There is also considerable consensus among the diverse participants in the EPA-Labor Health and Safety Task Force on the major health and safety problems at private sector waste sites—although individuals have differing ideas about the sources and solutions to these problems.

SUPERFUND AND RCRA EXPERIENCE: WORKER PROTECTION LESSONS

The experience accumulated in the course of nearly two decades of Superfund and RCRA activities provides valuable lessons on how to establish effective occupational health and safety programs during hazardous waste operations and environmental remediation. As the environmental restoration industry continues to grow and hazardous waste operations shift from characterization studies to actual cleanup, new problems are identified and the regulatory response to these emerging issues continues to evolve.

Some of the problems that plague efforts to establish sound OSH programs during environmental cleanup operations are technical in nature and

result from the difficulties associated with efforts to identify site contaminants and worker exposures, and from the pervasive uncertainties regarding the human health consequences of exposure to environmental pollutants. However, *the overriding problems that hinder worker protection efforts during hazardous waste cleanup result from a lack of emphasis on* OSH *issues in Superfund and RCRA procedures, and inadequate management commitment to or accountability for cleanup worker health and safety.*

The next section of this chapter introduces some of the reasons why cleanup workers in the private sector are not better protected against occupational injury or illness. Chapter 2 of this OTA background paper addresses these matters in more detail. Chapter 3 discusses cleanup worker health issues within the context of cleanup of the Nuclear Weapons Complex.

Management Commitment and Accountability

Management commitment to worker health and safety is increasingly recognized as a critical element of all good occupational health and safety programs.[91,92] The environmental laws and regulations that drive most cleanup operations do not however, assign OSH matters a high priority. Cleanup managers who are compelled to devote great attention to complying with environmental laws and other competing priorities, sometimes neglect the need for aggressive and sustained management involvement in developing and implementing effective worker protection strategies.

Moreover, cleanup operations are characterized by a diffuse managerial structure that makes it difficult to maintain clear chains of command or to determine who is accountable for occupational health and safety. Cleanup workers have been endangered because health and safety experts were unavailable on-site; lacked the seniority, training, or authority to interrupt production schedules when worker safety was threatened; or were not familiar enough with site operations to recognize potential hazards.[93,94]

Site owners and prime contractors often "push down" responsibility and accountability for worker health and safety to subcontractors[95]—even though subcontractors frequently have less experience, can devote fewer resources to hazard identification and worker protection, and command less access to trained occupational safety and health professionals than the prime contractor.[96] Fear of legal liability has made some managers reluctant to intercede in worksite health and safety problems that do not directly involve their own employees-even when they are aware of obvious exposure hazards or unsafe work practices.[97] Furthermore, the lack of rigorous enforcement of OSHA standards during hazardous waste operations and emergency response leaves employers unaccountable for the adequacy of worker protection measures.

Inadequate Characterization Data

The Remedial Investigation/Feasibility Study (RIFS) process in Superfund cleanups and RCRA Facility Investigation (RFI) efforts are supposed to provide information about the presence, location, and concentration of hazardous contaminants at a site. These data are then analyzed to produce assessments of baseline health risks posed by site contaminants and devise appropriate engineering responses to the pollution.[98] Unfortunately, the data gathered by the engineers and environmental scientists who design and conduct characterization studies typically fail to provide the type of information needed to evaluate potential worker health and safety threats.[99-103] In some cases, characterization studies are incomplete when requests for cleanup proposals are sent out for bid or when remediation work begins. In other instances, site assessment activities may have been carried out years before actual remediation gets under way; thus assessment reports do not represent the site conditions existing when cleanup work begins.

Site characterization activities are generally not designed to produce the information needed to "engineer" a cleanup. Most professionals with experience in environmental cleanup anticipate that remediation activities will uncover "surprises" not revealed during the site characterization phase. These surprises are usually unpleasant and may include, for example, more extensive zones of subsurface contamination or additional "hot spots" with high contamination levels.

These realities have led many environmental remediation specialists to endorse the so-called observational approach to cleanup. The observational approach is a method for staging data collection and remedial action so as to account for the uncertainties inherent in assessing environmental contamination. The approach involves initiating response action early to prevent migration of contaminants and then collecting the additional information necessary to design the final remedy. Contingency plans are developed to define actions that will be taken if additional areas of contamination are found or if remedial actions are not as effective as planned.

The quality and focus of site characterization data are important because these data are the basis of site health and safety plans (HASPs).[104] HASPS are legally mandated by HAZWOPER, the OSHA standard governing worker protection during hazardous waste site operations and emergency response. HASPS must present a written blueprint of health and safety hazards associated with proposed work plans at contaminated sites and must establish the personal protective gear, work practices, medical surveillance, and health and safety training required to conduct the cleanup and respond appropriately to any emergencies that might arise.

When characterization data are inaccurate or incomplete, there is no sound basis from which to craft effective site-specific health and safety plans or to determine the level of worker protection required in performing specific work tasks. To address this deficiency, the basic premise of health and safety practice must be to "expect the unexpected" and to train workers to identify unforeseen contamination problems.

Poor Contracting Practices

The lack of flexibility in many cleanup contracts contributes to the difficulties of creating effective occupational health and safety programs for cleanup workers. Contractors bidding on cleanup jobs are placed in a difficult position as a result of the large uncertainties inherent in all environmental restoration work, the errors and omissions that distinguish most characterization data, and the failure to include provisions in cleanup contracts that allow changes in original HASPS or renegotiation of worker protection costs. Managers are often forced to choose between either assuming "worst-case" scenarios and planning for elaborate worker health and safety provisions in their bids; or hoping that no new hazards come to light in the course of cleanup (a hope that experience has shown is usually unrealized) and budgeting less money for worker protection.

Employers engaged in cleanup work command widely differing levels of expertise in occupational health and safety matters. Even large firms that possess significant technical abilities vary widely in the amount of attention paid to implementing and enforcing principles of worker safety and health protection.[105] In an effort to better assess work-related hazards, some large environmental firms have tried to include costs of additional characterization studies in the cleanup bids submitted, but they have not always succeeded, especially when negotiators lack health and safety backgrounds or are unfamiliar with the hazards of environmental cleanup work. The practice of awarding contracts for environmental cleanup solely on the basis of a low bid may militate against firms that incorporate strong worker protection programs into contract proposals.

Difficulties in Interpreting OSHA'S Hazardous Waste Operations and Emergency Response Standard

The regulation that protects hazardous waste workers is vague and difficult to enforce. In 1990, the Occupational Safety and Health Administration promulgated a regulation to protect workers engaged in hazardous waste operations and emergency response, the so-called HAZWOPER standard.[106] Other OSHA regulations, such as standards governing construction worker protection, use of respirators, and exposure to certain regulated materials, also apply to environmental cleanup work, but HAZWOPER is the most comprehensive and important regulation applicable to cleanup worker health and safety.

HAZWOPER is a "performance-based" regulation. The standard sets forth a number of goals and approaches that employers must adopt, but does not prescribe how cleanup worker protection programs should be designed or implemented. Some aspects of HAZWOPER are ambiguous. OSHA has not issued guidance documents that would aid employers in interpreting and applying the standard. Also, different OSHA regional offices have offered contradictory interpretations of some HAZWOPER provisions.[107]

Consequently, there is significant controversy about how elements of the standard should be implemented, and wide variations exist in the rigorousness of cleanup worker protection programs at hazardous waste sites. To respond to such controversy in a more timely manner than its bureaucratic procedures usually allow, the OSHA Directorate of Compliance Programs recently published a compilation of letters and memos from OSHA headquarters that respond to specific queries on HAZWOPER interpretation.[108]

Especially controversial aspects of HAZWOPER implementation include the following:

- provisions for dividing waste sites into work zones categorized by the potential for worker exposure to hazardous materials within these zones;
- methods for monitoring worker exposure to potentially hazardous substances;
- methods for determiningg acceptable worker exposure levels during cleanup operations;
- the criteria that determine an individual worker's eligibility for inclusion in legally mandated medical surveillance programs and prescribe minimum hours of health and safety training;
- the content of medical surveillance programs and the qualifications of physicians who design and manage the activities; and
- the adequacy of emergency response preparations and capabilities during hazardous waste operations.

OSHA has also proposed a regulation that would establish certification criteria for cleanup worker health and safety training programs mandated by HAZWOPER.[109] Some aspects of the proposed rule (29 CFR 1910.121) have been criticized; in particular, the absence of any required certification for trainers or for the programs that train emergency response personnel have been cited.[110-112]

Weak Oversight of Occupational Health and Safety Rules by Regulators

The Occupational Safety and Health Act holds employers responsible for providing workers with "safe and healthful working conditions.'[66] HAZWOPER, the OSHA regulation enacted to protect cleanup worker health and safety, mandates a structured, but nonspecific, approach to worker protection during hazardous waste operations and emergency response.[67] Under this standard, critical decisions about how to identify and mitigate cleanup worker health risks are left to the judgment of individual employers.

The quality of worker health and safety programs implemented under HAZWOPER at Superfund and RCRA sites are reported to vary widely.[68,69] These inconsistencies are apparently a consequence of information gaps and uncertainties about necessary levels of worker protec-

tion; differences in the rigorousness with which different employers pursue worker safety and health; OSHA's failure to issue detailed guidance to help employers interpret and apply the broadly worded HAZWOPER regulation; and weak OSHA enforcement efforts.

OSHA and EPA have agreed to cooperate in developing an OSHA inspection protocol for incinerators at Superfund sites.[70] In general, however, OSHA enforcement of HAZWOPER has not been vigorous.[71,72] OSHA has about 1,000 inspectors (including supervisors and trainers) to enforce health and safety standards for nearly 3.6 million employers and 55 million workers .73 Aside from a few planned Superfund incinerator inspections, neither the more than 4,000 RCRA sites that require or have undergone remediation, nor the 1,354 sites on Superfund's National Priorities List[74,75] have been targeted as high priorities for OSHA inspections.

EPA is the Federal agency with the most expertise in hazardous waste operations, but 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, none of the staff members of EPA's Office of Solid Waste and Emergency Response (OSWER) Hazardous Site Control Division are occupational health or safety professionals, EPA maintains furthermore that it lacks the authority to enforce OSHA's HAZWOPER standards.[76]

EPA has, at times, neglected to consider worker risks when selecting cleanup options .77 EPA officials have acknowledged the need to weigh worker health risks against the benefits of particular remediation measures but have developed a formal means of doing so only in the past few months,[78]79 and the effectiveness of these proposed changes has yet to be tested.

To its credit, EPA's Office of Solid Waste and Emergency Response (OSWER) has established the EPA-Labor Health and Safety Task Force, consisting of employees from EPA, OSHA, the National Institute of Occupational Safety and Health (NIOSH), ACE, and representatives of labor unions whose members frequently conduct cleanup work. This Task Force has been constructive in identifying some of the more pressing and pervasive worker protection problems at RCRA and Superfund sites.

EPA's principal goals, however, 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 economically. EPA's "new Superfund paradigm," is designed to speed up site assessment and initiate activity early in cleanup so as to reduce "immediate risks."[80,81] Some contend that these priorities may beat odds with worker protection needs, which might dictate a "go-slow" approach in unusually hazardous situations or in implementing innovative remedies.[82]

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, and has broad statutory authority to intervene when environmental contaminants imperil human health,[83] ATSDR officials are rarely present during cleanup operations, however, and focus mostly on possible off-site health effects of Superfund and RCRA pollution.[84] In some circumstances, efforts to mitigate risks to off-site populations may actually increase the health and safety hazards faced by cleanup workers.[85,86]

Neither the assessment of cleanup worker health and safety risks nor the evaluation of worker protection programs has high priority for the regulatory agencies most involved in implementing 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, whereas the EPA regulators who are most familiar with hazardous waste work know little about occupational health and safety matters and refuse to enforce OSHA standards. The net result is that

the interpretation and implementation of cleanup worker OSH standards are highly variable and are left, essentially, to the voluntary efforts of employers.[87-90] Consequently, the forces that drive cleanup operations—particularly the need to comply with environmental regulations and the need to address concerns about off-site health impacts of pollution-may, in practice, overshadow questions and actions aimed at possible risks to cleanup workers,

CLEANUP WORKER PROTECTION IN THE DOE NUCLEAR WEAPONS COMPLEX CLEANUP PROGRAM

The task of cleaning up environmental contamination throughout the Nuclear Weapons Complex presents greater technical and political challenges than cleanup at private hazardous waste sites, DOE must grapple with the challenges of cleanup, even as it confronts other difficult and unfamiliar missions such as nuclear weapons dismantlement. Accomplishing these missions is likely to require significant changes in DOE's priorities, organizational structure, and approach to problem solving.

The Secretary of Energy has acknowledged that DOE and its predecessor agencies have historically embodied an institutional culture that valued weapons production over the protection of human health and the environment.[113] Multiple expert and government reports have documented DOE's past inattention to occupational health and safety and to environmental protection, DOE's past failures in these realms have been pervasive and serious.114

In efforts to alter this record, DOE initiated a number of reforms and issued directives in 1991 and 1992 aimed at improving health and safety programs at its facilities,[115-119] Management responsibility for worker protection has been reemphasized within the DOE organization; its Office of Environment, Safety and Health (EH) has been restructured;[120] and DOE's contractors have been told to devote more resources to health and safety matters.

The Occupational Safety and Health Act of 1970 exempted Federal agencies from the authority of OSHA to the extent that those agencies exercised independent authority over worker safety and health,[121] DOE, granted such authority under the auspices of the Atomic Energy Act, is the only Federal agency that claims such an exemption. DOE Order No. 5483 requires DOE contractors to obey and implement all OSHA standards.[122] However, OSHA does not have right-of-entry or inspection at DOE weapons facilities, nor can it issue citations at DOE facilities or impose financial or criminal penalties if DOE contractors fail to comply with these standards.[123]

The DOE Office of Environmental Restoration and Waste Management, which has line management responsibilities for cleanup of the NWC, is struggling to establish OSH policies applicable to DOE contractor employees engaged in environmental remediation and waste management. EH, the DOE office charged with providing independent oversight of occupational health and safety programs within DOE and among its contractors, has reorganized, added new safety and health staff, and is in the process of revising and updating DOE orders, some of which are relevant to cleanup worker protection.

These and other proposed and accomplished actions indicate that DOE has taken a number of positive steps to improve worker health and safety at its facilities. However, DOE and its contractors continue to operate under an organizational structure that presents serious obstacles to progress in safeguarding worker health and safety. OTA notes three major organizational issues that must be confronted if DOE is to institutionalize a "new culture of accountability in environment, safety, and health."

First, *managers and workers throughout DOE and its contractor corps must be convinced that occupational health and safety is truly a top priority of the Department.* OTA analysis indicates that this is not now the case.[124-131] In 1990,

OSHA found that "pressures to get the job done often overrule safety and health concerns." Some top managers openly derided the significance of the "new culture," and workers also indicated skepticism of health and safety as a serious priority. Today, assertions that DOE management is aggressively pursuing staunch worker protection policies are undermined by delays in addressing inadequate OSH practices documented by Tiger Teams,[132] 133 as well as delays in official adoption of proposed OSH orders; by the failure of DOE managers to impose penalties on contractors who do not enforce sound worker protection policies; and by reports that DOE facility operations have continued or been resumed before appropriate safety training and procedures were completed.[134] [135]

Second, *DOE line organizations require significantly more staff and more resources devoted to OSH matters. The* DOE approach to worker health and safety protection calls for its line organizations, such as EM, to develop OSH policies within the purview of their program missions and ensure that contractors implement these policies adequately. In practice, there are far too few OSH professionals in DOE to accomplish this. DOE staff trained or experienced in OSH matters are scattered throughout the line organizations and are frequently found in "advisory" positions with no real influence.

As in the private sector, actual cleanup at DOE facilities is just beginning. EM, the line organization directly responsible for cleanup, has laid an important foundation for the DOE cleanup effort and may, in time, develop effective and innovative occupational safety and health programs. However, OSH issues have been neglected by EM thus far, and the Office does not have the staff needed to create or monitor a robust worker health and safety program for the cleanup. EM managers, preoccupied with other priorities, address OSH issues only reactively.

Third, *DOE has no reliable or credible process for rewarding or punishing managers' performance in matters of safety and health. The ability of EH to properly monitor DOE and contractor performance in OSH matters is inadequate* and is likely to remain so despite progress in formalizing contractor assessment protocols, because of the small numbers of qualified field staff. Actual enforcement of OSH orders is haphazard, and the only penalty levied DOE or contractor managers for failure to comply is embarrassment. EH, which is charged with providing independent oversight of OSH activities, is not truly independent. Its policy recommendations must, in practice, receive the concurrence of other DOE program managers. The EH role is advisory only; this Office has no authority to enforce its own stated policies.

These three structural flaws in DOE's approach to worker protection—lack of strong management commitment to OSH priorities; lack of sufficient OSH staff and resources in DOE program offices to carry out stated OSH responsibilities; and lack of independent oversight or enforcement of OSH policies and orders at DOE facilities-are likely to impede efforts to ensure protection of workers engaged in cleanup of the Nuclear Weapons Complex.

In addition, DOE's decentralized internal organization and the diffuse, multilayered structure of DOE-contractor relationships are likely to intensify the difficulties with accountability, efficient communication, and chain of command that have hampered the protection of cleanup workers during other hazardous waste operations.

Finally, because of the scope and complexity of environmental contamination throughout the NWC, *worker protection issues encountered at non-Federal cleanup sites, including inadequate characterization of site OSH hazards, poor contracting procedures, and controversial and variable implementation of HAZWOPER, are likely to be not only revisited but magnified during the DOE cleanup. The* DOE institutional structure that will frame OSH policy and practice for the cleanup is poorly suited to address many of these matters.

SUMMARY OF FINDINGS

Opportunities for DOE

The challenge of environmental restoration and waste management at the DOE Weapons Complex provides an opportunity both: to advance the state-of-the-art of occupational health and safety programs for the cleanup workers who will carry out DOE's new mission of environmental restoration; and to create a model for keeping the thousands of workers engaged worldwide in this task safe and healthy.

Current DOE Approach Inadequate

DOE's current approach to worker health and safety is marked by three major weaknesses:

- the Department has not established an institutional culture that honors protection of environment, safety and health as fundamental priorities;
- the DOE Office of Environmental Restoration and Waste Management (EM) has not developed effective OSH policies and programs for the cleanup or ensured that contractors are implementing appropriate worker protection programs;
- the DOE Office of Environment, Safety and Health (EH) does not have the field staff necessary to oversee cleanup worker health and safety and does not have sufficient authority to enforce OSH policies and orders among DOE line managers and contractors.

Draw From Experience

Experience in protecting cleanup workers during RCRA corrective actions and Superfund operations has revealed a variety of problems that have ranged from inadequate health and safety planning, to poor training to lax enforcement of cleanup worker protection standards. DOE could learn from this experience by participating in the EPA/Labor Superfund Health and Safety Task Force, and by initiating additional consultations and interactions with other government agencies and with labor representatives.

Focus Now

The need to focus high-level management attention and increased resources on protecting those who will do the work of cleaning up is urgent. Some needed provisions, such as worker training programs, medical surveillance strategies, and emergency response plans, will take time to develop and implement and must be in place when cleanup commences.

Areas Needing Attention

Key areas where concerted management efforts could bring needed results are:

- improving characterization data for contaminated sites in order to prepare good health and safety plans;
- improving contracting practices to ensure proper incentives for protecting workers at all contracting levels;
- interpreting and implementing OSHA worker protection standards and supplementing these with rigorous management attention to safety and health, including outside oversight;
- providing for informed and active worker participation in protection programs.

Consequences of Failure

Failure to prudently and adequately protect cleanup workers at Nuclear Weapons Complex could have serious consequences. Individual workers might experience illnesses or injuries that could have been avoided had effective OSH programs been in place. In addition, concerns about worker protection might result in schedule delays, increased costs, and erosion in the public's faith in proposed cleanup plans.

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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 *Q A*.[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.

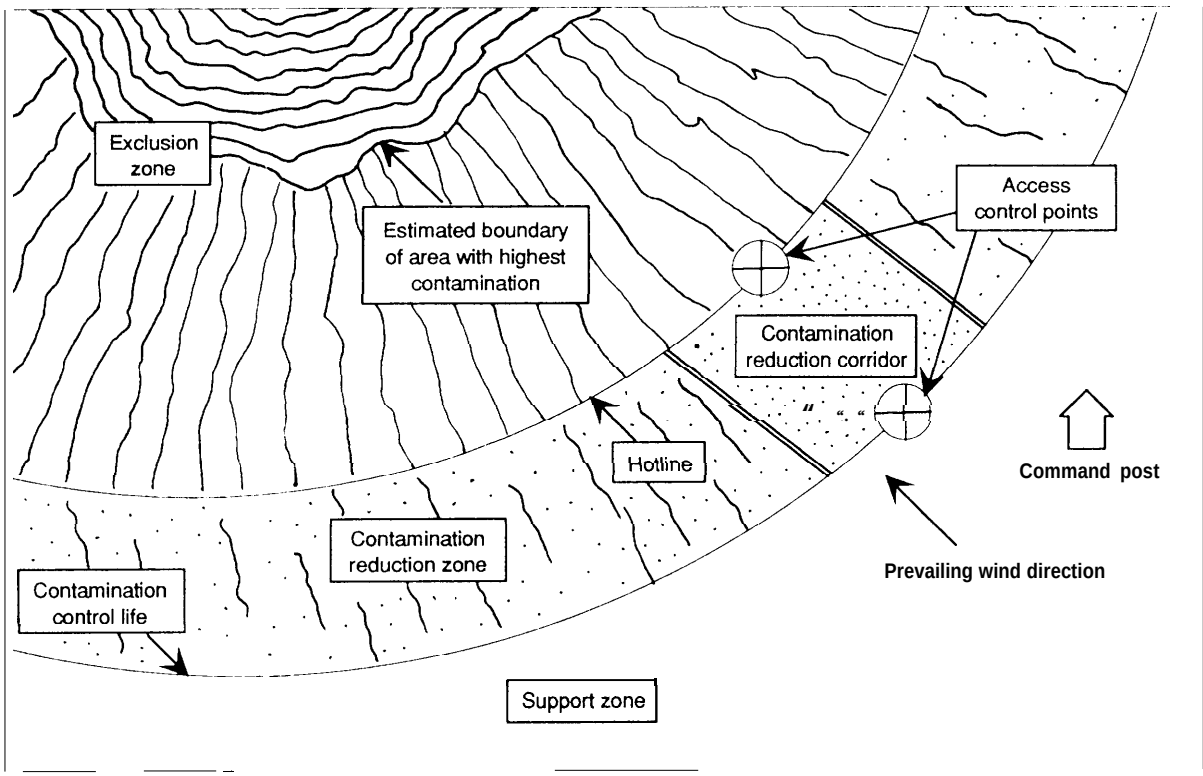
At one site, while soils contaminated with explosives were being incinerated, an explosion resulted in more than $200,000 in property damage and more than $1 million in costs for research, incinerator redesign, and lost production. One employee received first- and second-degree burns over 40 percent 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

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Cleanup Worker Protection at the DOE Nuclear Weapons Complex

3

More than **3 years** have passed since the Department of Energy began a concerted, publicly declared campaign to chart a "new course" toward full accountability in the areas of environment, safety, and health.[1] Yet evidence of DOE leadership and substantive accomplishments in furthering worker health and safety remain sparse. The "new culture" pursued by the Secretary of Energy, a culture that honors protection of the environment, health, and safety as fundamental organizational values, has not been translated into official policies and programs-or even been wholly accepted—by DOE and its contractors.

The new culture has not taken hold largely because of three flaws in DOE's approach to worker protection:

1. Not all DOE employees, contractor managers, and workers are convinced that worker health and safety truly takes precedence over other goals.
2. Within DOE, organizational responsibility for occupational health and safety is dispersed among different program **offices.** This has caused staff with occupational safety and health (OSH) experience to be thinly spread throughout DOE line organizations. Within the DOE Office of Environmental Restoration and Waste Management (EM), there are insufficient numbers of OSH professionals to develop program-specific policies or ensure implementation and enforcement of such policies by EM contractors.
3. Internal oversight of DOE and contractors' implementation and enforcement of OSH programs is weak. The DOE Office of Environment, Safety and Health (EH) does not have enough qualified field staff to monitor contractor operations. Furthermore, EH has no direct authority to en-

The "new culture" at DOE has not yet been translated into official policies and programs

force OSH orders or regulations. EH influence on DOE line organizations rests chiefly on the capacity to embarrass line managers into complying with OSH orders and regulations. There are no meaningful rewards or penalties for occupational health and safety performance levied on DOE or its contractors.

The Occupational Safety and Health Act of 1970 established that those Federal agencies that exercise statutory authority to prescribe or enforce occupational safety and health standards, or regulations affecting those conditions, were not subject to the authority of the Occupational Safety and Health Administration (OSHA) under Section 4(b) 1 of the Act.[2] DOE is the only Federal agency that claims such an exemption. DOE and its contractors derive authority to determine their own occupational safety and health standards from the Atomic Energy Act of 1954.[3] There is thus no external oversight or regulation of DOE's or its contractors' performance in OSH matters.

When OSHA released its comprehensive December 1990 report on occupational safety and health programs at DOE facilities, it recommended that DOE institute a number of major organizational changes to ensure adequate worker safety and health protection.4 DOE reacted promptly to the OSHA review by reasserting line management responsibility for contractor safety and health programs[5] and by directing the relevant DOE program offices to present the Secretary with ways of responding to the OSHA findings.[6-8]

Several important reforms resulted from these efforts, including the establishment of an Office of Occupational Safety within EH[9] and the addition of many health and safety professionals, among them former OSHA employees, to DOE headquarters staff. In addition, both EH and EM have established advisory boards consisting of outside experts to augment in-house expertise and provide an independent perspective on DOE activities.[10] DOE also ordered its program offices to include specific crosscuts in the fiscal year 1993 budget to identify and summarize all occupational health and safety activities in a single document "to make visible and facilitate action on OSH activities." Future budget submissions will be subjected to comprehensive OSH reporting and will be used to support an OSH Five-Year Plan that is under development.[11]

In August 1992, DOE and OSHA signed a Memorandum of Understanding that provides DOE with access to OSHA's technical expertise and formalizes arrangements for joint training programs. The agreement acknowledges that DOE retains authority to develop, implement, and enforce OSH policies for its contractor employees, whereas OSHA has the right to conduct unannounced inspections at DOE facilities to protect Federal (i.e., DOE) employees.[12-14]

These are positive steps, but it is unclear if such efforts can overcome fundamental organizational obstacles that underlie DOE's approach to worker protection. DOE's problematic organizational OSH framework, coupled with the enormous scope and complex nature of the pollution at Nuclear Weapons Complex (NWC) will likely reflect and magnify worker protection problems already encountered at non-Federal Superfund sites. Success in addressing cleanup worker health and safety at the NWC will depend to a large extent on achieving substantial changes in the organizational format of DOE's approach to worker protection. The next section discusses organizational problems pertinent to OSH matters at DOE. Subsequent sections of the chapter address particular OSH issues encountered at non-Federal hazardous waste sites that are likely to be troublesome during cleanup of the NWC.

MANAGEMENT COMMITMENT TO OCCUPATIONAL SAFETY AND HEALTH PRIORITIES

Skepticism about the vigor and persistence of DOE's commitment to occupational safety and

health continues to haunt the Department. In the course of OSHA's 1990 audit of DOE worker health and safety programs—carried out at DOE's request—OSHA inspectors noted that "pressures to get the job done often overrule safety and health concerns."[15] OSHA found that resource allocation decisions and planning by DOE managers and contractors did not indicate worker health or safety to be of paramount concern. OSHA reported that some top managers in DOE's contractor organizations failed to demonstrate a strong commitment to worker health and safety:

> One top manager stated that occupational safety and health was not a fundamental organizational value . , . [and] saw the emphasis on safety and health as a hindrance to the facility's mission.[16]

Assertions that DOE management is aggressively pursuing staunch worker protection policies are weakened by failure to correct inadequate OSH practices documented by Tiger Teams; [17,18] by long delays in official adoption of proposed OSH orders; [19-21] by the failure of DOE managers to impose penalties on contractors who do not enforce sound worker protection policies; [22,23] and by reports that DOE facility operations were resumed or allowed to continue before appropriate safety training and procedures had been completed. [24-27]

Workers, too, appear skeptical of the depth and staying power of DOE's commitment to the new culture. In November 1991 the Secretary's Advisory Committee on Nuclear Facility Safety found that the new philosophy of valuing health and safety over weapons production is "not understood, accepted or believed" by workers at Rocky Flats,[28] where public controversy over safety has been intense. The committee (referred to as the Ahearne committee after its Chair, John Ahearne) reported that DOE's response to high-profile safety issues has been characterized by

> [an] . . . insistence on rapid response without adequate understanding [that] has produced premature action plans and decisions, with resultant frequent schedule revisions, organizational changes, and unclear explanations of the need and bases for the actions and decisions. Workers may be left with no alternative but to consider production in fact as the continuing, dominant priority, and safety as simply a passing fancy of the current Secretary .29

OSHA noted that union representatives were not routinely included in health and safety committees, and that employees were not routinely asked to participate in safety and health inspection activities at weapons sites.[30] Although at most weapons sites, joint labor-management committees have been formed to facilitate communication about health and safety issues and other matters,[31,32] workers have not been actively enlisted in efforts to enhance occupational safety and health at DOE facilities. [33]

OSHA also noted that investigations of workers' complaints of health and safety problems had in some instances resulted in DOE field offices referring the problem back to the employer against whom the complaint was raised. In some cases, OSHA found that allegations of reprisals against employees who had initiated health and safety complaints had not been investigated properly by DOE.[34]

Reports of workers being harassed for raising health and safety concerns continue to surface. For example, the DOE Inspector General reported in September 1991 that a DOE contractor and a former contractor at Hanford had acquired wiretapping and eavesdropping equipment designed for covert surveillance, in violation of DOE orders and Federal acquisition requirements. Security forces at the Idaho National Engineering Laboratory and at Savannah River were discovered to have similar equipment. [35] The Inspector General reviewed 14 instances of covert video surveillance conducted by security forces at Hanford, but found no evidence to sub-

stantiate allegations by Hanford workers that they had been subjected to illegal surveillance after complaining about health and safety problems.[36]

In February **1992 the** Department of Labor found that a worker at the Oak Ridge National Laboratory had been isolated, assigned to menial jobs, and forced to work in hazardous areas after raising concerns about safety issues.[37,38] The DOE contractor involved is appealing this ruling.

In April 1992, DOE published its proposed Whistleblower Rule in the *Federal Register*.[39] *The* DOE Office of Nuclear Energy has taken the lead in developing complaint procedures for DOE contractor employees, but these procedures have not been finalized.[40] EH reviews of employee concerns programs indicate that some DOE field offices have neglected to establish adequate employee concerns programs in spite of long-standing directives to do so.[41]

LINE MANAGEMENT RESPONSIBILITY FOR OCCUPATIONAL SAFETY AND HEALTH

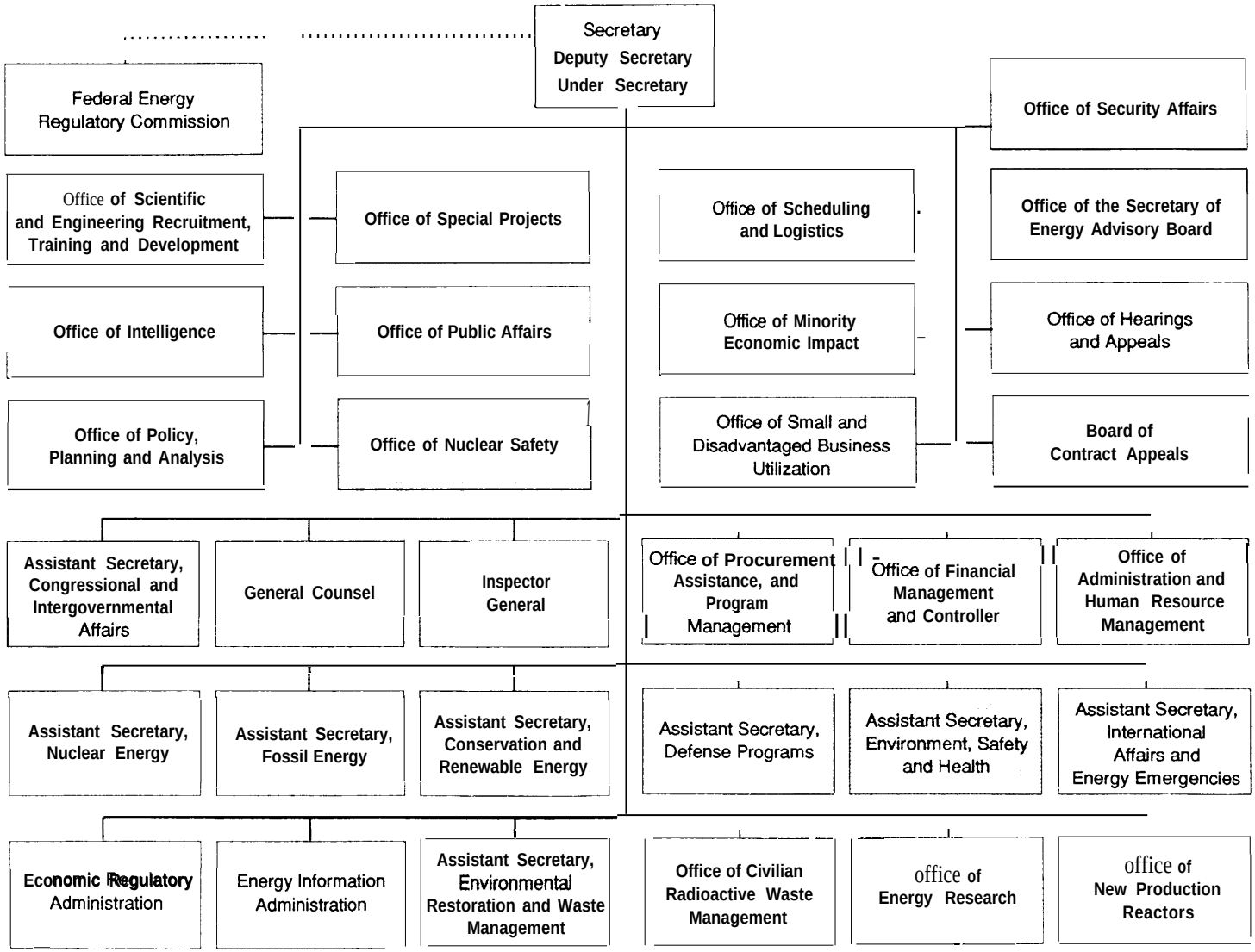
Occupational health and safety programs within DOE and its contractor corps are based on two organizational "pillars": line responsibility for safety and health, and independent oversight.[42] (See figure 3-1,) A directive from the Secretary of Energy explicitly charged DOE line organizations with responsibility for occupational health and safety matters within their purview.[43] Each program office (e.g., Environmental Restoration and Waste Management, Defense Programs, Nuclear Energy) is expected to develop health and safety policy relevant to its mission, to issue guidance in worker safety and health matters, and to assess contractors' OSH performance.

Responsibility for worker safety and health may be an appropriately decentralized function in a large organization. However, EM, the DOE program office examined by the Office of Technology Assessment, lacks adequate numbers of qualified staff to develop occupational health and safety programs suited to EM line operations and has little capacity to assess contractors' performance in health and safety matters. As of late 1992, the DOE Office of Environment, Safety, and Health, had not initiated serious consultations with EM or other line organizations to determine the top priorities of the line programs or to assist managers in formulating effective OSH policies.

EM headquarters staff handling worker safety and health matters are overwhelmed with the constant need to react to the latest crisis, and are unable to devote the time and resources needed to develop coherent cleanup worker protection policies.[44] EM's office of Oversight and Self-Assessment is responsible for producing health and safety policy, implementation guidance, and technical advice on EM related OSH matters, and for assessing the adequacy of EM and its contractors' occupational safety and health performance.[45] **EM has a single** staff person with training in occupational health and safety, and two employees with nuclear safety expertise.[46,47] The EM program office responsible for environmental remediation has no staff trained in occupational safety or health, and is planning to rely entirely on contractors to meet its OSH needs. One consequence of such staffing patterns is that by August 1992, EM headquarters staff had not reviewed a single cleanup site health and safety plan (HASP).[48]

When the DOE Office of Environmental Restoration and Waste Management was established in 1989, its leaders confronted pressing responsibilities. Undertaking cleanup of the Weapons Complex required EM to create and staff a new program office; to initiate more productive relationships between DOE and its contractors and between DOE and a skeptical, alarmed public; to demonstrate progress and justify proposed cleanup budgets to Congress; to comply with environmental regulations, and to meet schedule deadlines in Interagency Agreements. Amidst these diverse and urgent efforts, EM neglected the de-

Figure 3-1-The Department of Energy



SOURCE: U.S. Department of Energy, 1992.

velopment of rigorous or high-profile policies related to cleanup worker safety and health.

It maybe that EM will evolve a more purposeful and aggressive approach to occupational safe~ and health as the organization becomes established, as cleanup gets underway, and as the cleanup workforce increases in size. Currently, however, there is little evidence of leadership in OSH matters at EM headquarters, and few indications that decision makers have recognized the need to urgently address cleanup worker protection issues.

The head of DOE's Environmental Restoration and Waste Management program explicitly reaffirmed the Secretary of Energy's commitment to protecting worker health and safety as the "highest programmatic priority" in a July 1991 memo to all EM and contractor personnel.[49] The memo goes on to list actions and programs needed to accomplish EM's OSH goals:

- establishment of firm OSH priorities and responsibilities,
- development and implementation of quantitlable OSH performance standards to ensure programmatic accountability,
- planning and budgeting for necessary OSH resources to ensure availability, and
- formulation and application of improved channels of communication.[50]

Little progress has been made in implementing these programs. Some of EM's OSH goals could be accomplished by adopting the proposed DOE Order 5483, XX, "Occupational Safety and Health Program for DOE Employees;' which was designed by EH and has been under review by DOE program offices for months. Adoption of this order would be a constructive response to the recommendation repeated over the years by multiple expert advisory bodies—including the National Academy of Sciences,[51] OSHA,[52] the Advisory Committee on Nuclear Facility Safety,[53] and the Defense Nuclear Facilities Safety Board (DNFSB)[54]—that DOE develop clear health and safety policies at the national level and establish explicit, measurable goals that its operations offices and contractors should achieve to implement these policies.

In the absence of a comprehensive OSH order or policy directed at cleanup work, DOE contractors must rely on existing DOE orders. Numerous expert reviewers[55-57] have cemented that many DOE OSH orders lack specificity and adequate implementation guidance. This lack of precision allows DOE contractors great leeway in determining what constitutes satisfactory compliance with Occupational Health and Safety orders. Also, DOE's existing OSH orders and policies do not address some worker protection issues specific to the DOE cleanup, such as the content of health and safety training programs or medical surveillance for hazardous waste workers.

Recent DOE policy changes designed to reduce risks to off-site populations, but developed in the absence of comprehensive occupational health and safety policies or a clear focus on worker protection needs, may have heightened cleanup worker health and safety threats. For example, the Final Safety Analysis for Rocky Flats concentrated principally on off-site radiological risks from plant operations. The Secretary's Advisory Committee on Nuclear Facility Safety expressed concern that changes in plant operations made on the basis of this safety analysis might actually increase risks to workers.58 In addition, the committee worried that concerns about environmental threats might prompt managers to replace carbon tetrachloride, a liver toxin used in large quantities at Rocky Flats, with less toxic—but more flammable-solvents. Because fire hazards are among the most serious threats at the plant, a narrow analysis that focuses on health hazards but ignores potential worker safety risks could be disastrous.[59]

The Ahearne committee also expressed concern that ongoing activity may jeopardize workers at the Hanford tank farms, where potentially

flammable high-level radioactive waste is stored. The committee noted that DOE and its contractor managers "have shown little appreciation of the safety of workers working on top of Tank 101-SY,' which is suspected to have an appreciable chance of exploding. The committee went on:

> At Hanford, as elsewhere in the DOE, there is a tendency to concentrate on risk to the general public and give much less attention to workers. At such an isolated site as Hanford, this can make conditions seem much better than they really are.[60]

There is a pressing need to establish the primacy of orders, standards, and regulations applicable to cleanup worker protection at DOE facilities. Throughout DOE and its contractor corps, compliance with environmental laws is seen as having a higher priority than compliance with occupational health and safety regulations. The former are statutory requirements, and violation is understood by DOE and its contractors to carry a threat of great embarrassment and possible fries against DOE. Some fear that criminal sanctions might be levied against the employees responsible.

Occupational health and safety regulations, on the other hand, have the status "merely" of DOE orders, which many mangers consider "policy" rather than explicit, legally enforceable commands. Although the Secretary of Energy specifically instructed managers to comply with all applicable OSHA standards and regulations,[61] DOE and its contractors appear to regard this directive as 1ess compelling or of lower priority than compliance with environmental statutes. This attitude is understandable, if regrettable, given the absence of effective mechanisms for enforcing OSH orders at DOE facilities and the lack of significant or visible penalties imposed for failure to implement sound worker protection policies.

A litany of problems at the Hanford tank farms suggests that DOE's ability to monitor contractor OSH practices or induce contractors to follow adequate worker health and safety practices is extremely limited.[62-65] DOE regards Hanford's single-shell tanks as its top safety concern because of the potential for tank contents to undergo a chemical explosion and spew radionuclides across the surrounding countryside. Yet at least 16 different "events" resulting in worker exposure to tank vapors occurred between 1987 and 1992, before a DOE investigation revealed the seriousness of the problem and the lack of adequate management response,[66]

Several of these exposures caused workers to be hospitalized; at least one worker suffered permanent loss of lung function. In January 1992 an investigation by the DOE Richland Field Office concluded that the causes of the recurring exposures were inadequate "implementation of management systems," lack of a properly developed industrial hygiene program, and "failure to properly characterize the work environment and develop appropriate engineering controls."[67] It is notable that the Richland Field Office Safety Program had no staff whatsoever from August 1991 until April 1992.[68] From 1980 through August 1991 the Richland Field Office had only one-half of one full-time-equivalent (FTE) staff person for industrial hygiene functions .69

A former Assistant Secretary of Labor for Occupational Safety and Health, who reviewed DOE's internal report investigating the tank farm exposures[70] at OTA's request, commented:

> The failure of those in responsible management charge to assign resources to this problem in the presence of repeated violations would, without any doubt, have been viewed by OSHA as willful violations of the [Occupational Safety and Health] Act and subject to possible criminal penalties. This conclusion would probably have been reached by the end of 1987 when three [worker exposure] episodes had occurred, but certainly by 1989 when the episodes reoccurred. The absence of high priority for solving this problem in 1990, with attendant lack of professional staff and resources could well put someone on trial for criminal behavior [had the oc-

currences been subject to OSHA enforcement and penalties]. Also, in 1989 with the reoccurrence of the episode, [an OSHA finding of] "imminent danger" and a series of restrictive procedures akin to closure of a manufacturing facility probably would have been invoked.'[1]

A DOE internal memo on the subject of the tank farm vapor exposures noted that if Hanford were subject to OSHA citations and penalties, fines up to $70,000 per day might be expected.[72] Nonetheless, despite these and other failures in occupational health and safety performance, the DOE contractor at Hanford was granted an award fee of almost $5 million in 1991.[73]

OVERSIGHT OF OCCUPATIONAL SAFETY AND HEALTH PRACTICES

DOE's Office of Environment, Safety, and Health makes up the second pillar of the Department's approach to worker health and safety protection: independent oversight. EH is responsible for providing DOE line management programs with internal review of DOE and contractor OSH programs. EH also provides line organizations with technical advice, develops and maintains DOE orders, and conducts Technical Safety Appraisals and Tiger Team Assessments.[74]

EH has 11 site representatives or "residents" stationed at 5 weapons facilities. These 11 individuals are responsible for monitoring contractor OSH performance throughout the NWC,[75] covering a total work force of more than 100,000.[76] EH site representatives have been directed to shift their evaluation of DOE facilities from compliance-oriented inspections to "programmatic assessment" of DOE line management OSH performance and to identify root causes of deficiencies.[77] The **results** of these assessments are sent directly to DOE Program Secretarial Officials (PSOs) such as the Assistant Secretary for EM.[78]

Formerly, EM field resident reports were reviewed at the DOE field office level. The change in reporting structure was made to increase the visibility of OSH performance[79] and to respond **to** OSHA's complaint that DOE field offices were embroiled in a "major conflict of interest" because they were responsible both for ensuring contractor compliance with DOE health and safety policies and for reporting back to program offices at DOE headquarters on their own effectiveness as overseers and enforcers of such compliance.[80]

The EH site representative reports indicate that significant progress must be made if DOE line managers are to exercise meaningful oversight of contractor OSH activities. For example, EH site residents found that the Oak Ridge Field Office had not assessed the adequacy of the site construction contractor's work control program and could not guarantee that "adequate work controls will be established and implemented to ensure worker safety during construction activities."[81] This report also documented that the construction management contractor had not ensured that the personnel who assessed the site for the presence of possible worker safety hazards were properly trained to perform this task.[82] In addition to these findings of inadequate DOE oversight of OSH matters, the EH representative found that "work controls specifying safety requirements are not effectively and consistently implemented and followed by construction personnel and their management at work sites."[83]

DOE Chain of Command and Accountability for Occupational Safety and Health

Other monthly reports of EH site representatives provide additional evidence that DOE line management is not effectively overseeing contractor occupational health and safety performance. One impediment to effective DOE oversight of contractors is the complex and overlapping jurisdictions of its different line organizations at weapons facilities.

According to an EH report on Idaho National Engineering Laboratory (INEL) for example, DOE managers failed to independently assess or

verify contractors' freeze protection initiatives. (Such winterization precautions are essential to ensure functioning fire protection systems at INEL.)[84] This failure was largely due to confusion about the jurisdictional overlaps between different line management organizations at DOE. A memo from the DOE Office of Defense Programs (DP) detailing department policy on freeze protection was interpreted by the prime contractor as being applicable to DP facilities only. Consequently, the contractors did not address INEL operations controlled by EM in its response to the Idaho Field Office questionnaire. DOE field office staff failed to realize that the contractor had not considered all aspects of INEL operations.[85]

Another instance of inadequate DOE oversight of contractor activities was documented by EH representatives at Hanford, who found that construction contractor safety programs were quite good, but that the Richland Field Office exercised only "weak" oversight over contractor construction safety programs and had failed to assign anyone the responsibility of identifying emerging regulations, requirements, or safety training needs in construction. The representatives determined that "contractor [IOSH] performance is due to the contractor's efforts rather than direction from the line organization."[86] The report noted that DOE field office staff "did not programmatically review any of the contractor's safety programs and that the contractor could revise existing safety programs without [the field office's] knowledge. Therefore there is no assurance that the apparently acceptable performance of a contractor will remain acceptable."[87]

The lack of strong, centralized control over DOE contractor organizations will hinder efforts to ensure consistent and comprehensive implementation of OSHA's Hazardous Waste Operation and Emergency Response (HAZWOPER) standard and other health and safety standards during the NWC cleanup. DOE headquarters is currently unable to determine the roster of workers at a given weapons facility.[88] Ascertaining that all contractor and subcontractor employees have undergone legally mandated health and safety training, are enrolled in required medical surveillance programs, and so forth, will be difficult under these circumstances. Currently, most weapons facilities lack administrative mechanisms to ensure that workers transferring to new jobs at a facility undergo initial fitness exams prior to beginning new duties or are subsequently enrolled in appropriate medical surveillance programs. Overseeing the quality and comprehensiveness of cleanup worker health and safety programs administered by hundreds of DOE subcontractors engaged in the cleanup will be a monumental task.

DOE Tiger Teams and OSHA noted that health and safety personnel at DOE facilities had a poor grasp of OSHA inspection and hazard assessment methods.[89] Recent guidance from EH headquarters to its site representatives on how DOE and contractor OSH performance should be assessed is an important step forward, but without a significant infusion of staff and resources, such guidance cannot overcome current staffing limitations within DOE.

OSHA and DOE have negotiated a Memorandum of Understanding (MOU) that establishes a formalized working relationship and allows "where practical" for "mutually beneficial" OSH training, technical assistance and information exchange, and program evaluations.[90] Although the MOU does not specifically mention cleanup worker issues, DOE EH has already arranged access to computerized files of OSHA's "HAZWOPER Interpretative Quips" and has plans to access much of OSHA's technical information as well.[91]

The interactions made possible by the MOU might be very helpful to DOE staff, who are trying in effect to reproduce OSHA policies and programs. The content of the MOU is vague, however; it contains no promises of specific interactions and proposes collaboration only "to the extent priorities and resources permit." Specific arrangements for reimbursing OSHA

will be worked out in future interagency agreements.[92]

EH has initiated major revisions of two DOE orders that are fundamental to worker protection at the Weapons Complex. The Occupational Safety and Health Program for DOE Contractor Employees (DOE Order 5483. XX)[93] is a comprehensive reformulation of DOE OSH orders that would codify the hierarchy of DOE-developed OSH standards, DOE-adopted OSHA standards, DOE-adopted consensus standards, etc., that managers should follow in implementing worker protection programs at DOE facilities. In addition, the proposed Order 5483.XX establishes DOE OSH program requirements; sets forth rules for procedures, schedules, and employee participation in DOE and contractor OSH self-assessments; prescribes reporting procedures for work-related illnesses and injuries; and describes a risk assessment methodology for determining the priority of abatement procedures .94

This proposed DOE order would also establish a formal process for hazard abatement and would require approval of any significant delays in correcting identified hazards.[95] OSHA found that at one facility, more than 5,000 hazards had gone uncorrected for over a year because managers did not recognize these items as a priority. At another facility, OSHA identified inadequate ventilation and electrical conditions that had been uncorrected for 6 years.[96] A 1992 EH review of occupational safety and health programs at the Portsmouth Gaseous Diffusion Plant revealed more than 500 violations of DOE OSH orders, most of which were classified as "serious." Many of these violations had been previously identified, but had not been corrected.[97] Situations such as the failure to abate—or even fully investigate—the vapor exposure hazards at the Hanford tank farms would hopefully become less likely with the adoption and implementation of the proposed order.

Another OSH order under development by EH is the Construction Safety Program,[98] which would replace the current construction safety and health program (DOE Order 5480.9) adopted in 1980. The new order would establish program requirements for DOE line management and contractors involved in all construction activities, including environmental restoration, and might provide some of the ingredients needed to create sound health and safety plans for cleanup work.

EH has tried to instill sound occupational health and safety principles into line management programs through the provision of technical support. EH has begun an effort to assist contractors with the development of model worker protection projects. Managers will have the option of using EH seed funds to pilot worker health and safety initiatives that will be published and reviewed in a DOE on-line clearinghouse.[99] This project was a response to OSHA's complaint that the historically insular nature of DOE operations had led it to repeatedly reinvent the wheel and had hindered consistency in OSH practices.[100] EH has also undertaken a significant upgrading of DOE's documentation of work-related injuries and illnesses in an effort to remedy serious inaccuracies noted by OSHA in current record-keeping procedures. [101]

The impact of recommendations and policy proposals from EH is tempered by the relatively weak authority it exerts over DOE line management. EH acts in an "advisory capacity" to DOE program offices; its policy products are subject to comment and review by these program offices. (The proposed "Occupational Health and Safety Order, 5480.XX' garnered 1,300 comments from within DOE.[102]) EH maintains that after such intra-agency review, it makes independent determinations on final policies to be submitted to the Secretary for approval. The Assistant Secretary for EH has the option of bringing EH proposals to the Secretary for approval that do not have the concurrence of other DOE program offices.[103] [104]

In practice, the process of gaining official approval of EH recommendations is one of compromise and accommodation.[105] EH has tried, with some success, to "leverage" its sparse resources

and authority by conducting "special assessments" of high-profile problem areas or operations. These reviews are used essentially to embarrass managers into more vigorous OSH efforts.

DOE's limited capacity to enforce worker health and safety policies and orders among contractors has been documented by OSHA and by EH site residents reports,[106-109] This failure was grimly illustrated by the death of a Hanford contractor employee, who was killed in April 1992 after falling through the roof of an abandoned reactor building known to be in danger of collapse. The fatality demonstrated that written safety procedures are not always followed, even when workers and supervisors are aware of their existence.[110]

DOE and contractor management participation in many EH initiatives is voluntary; the principal EH approach to oversight of line management OSH activities remains reactive responses to problems that might have been avoided had strong programs been implemented. Critical OSH orders proposed by EH have yet to be approved.

Nonetheless, progress in occupational health and safety at DOE should be measured against the pervasive and serious deficiencies in worker protection that characterized operations before 1989, with consideration for the difficulties of securing management and worker commitment to new DOE missions and priorities. In this light, EH efforts over the past year represent positive steps toward a programmatic approach to a "new culture" honoring environment, safety, and health at DOE.

The organizationally segmented structure of occupational safety and health activities at DOE demands extensive staff and resources that are not now in place. Further progress in institutionalizing rigorous worker protection throughout the Weapons Complex requires a significant increase in trained occupational health and safety professionals in DOE line organizations and in EH. In addition, serious and sustained consultation between EH and EM will be required to develop and implement OSH programs most urgently needed for cleanup. *EH initiatives and policies—no matter how valid---are meaningless unless line management and field staff have the will and resources to implement them.*

Finally, oversight and enforcement of contractor occupational health and safety activities by both line management and EH must be augmented. DOE must demonstrate its commitment to worker health and safety by making the formulation and implementation of clear and coordinated OSH policies an urgent priority. Otherwise, as will be discussed in the next section of this background paper, management attention will continue to focus on other goals, such as schedules for achieving environmental compliance and contract costs, at the expense of worker protection issues. The risks of such a course include the potential endangerment of thousands of employees and further erosion of DOE's credibility as a responsible and competent protector of environment, safety and health.

WORKER PROTECTION COMPETES WITH OTHER CLEANUP PRIORITIES

DOE and contractor managers involved in cleanup of the NWC must contend with all of the issues that clamor for attention and resources at non-Federal hazardous waste sites. If anything, the competing pressures and priorities are more diverse and intense at DOE weapons facilities. Communities neighboring weapons sites are greatly concerned about possible health and environmental impacts of the pollution—and have expressed this concern via Congressional hearings, the national media and in successful and pending lawsuits against DOE.[111-113] The pressure on EM and on DOE contractors to demonstrate progress while holding down costs is unrelenting, and occurs in a context of technical complexities unmatched at most non-Federal waste sites.

In addition to the need to comply with applicable environmental regulations, particularly Superfund and the Resource Conservation and Recovery Act (RCRA), the DOE cleanup is being driven by priorities and schedule "milestones" established in Interagency Agreements (IAGs) negotiated among DOE, EPA, and individual States. The milestones and deadlines set forth in IAGs were typically agreed to before reliable characterization data was available and in the absence of health-based cleanup priorities or analyses of potential occupational hazards associated with proposed cleanup work.[114] The need to respond to regulatory demands and IAG schedules has preoccupied much of the management talent in EM. Available evidence, including staffing patterns and resource allocation, indicates that DOE line management has paid relatively little attention to OSH issues associated with the cleanup.

DOE has convened the Tripartite Commission to discuss occupational health and safety matters related to its operations. This high-level working group consists of DOE senior managers, contractor managers, and representatives of national labor organizations with members employed at facilities in the NWC. The group has discussed DOE initiatives in medical surveillance, health and safety training, and other matters pertinent to DOE workers generally; it is not designed to focus solely on cleanup issues. Much of the group's discussion has reportedly been directed at the fate of DOE production workers whose original job titles will be eliminated as weapons production activities end and some facilities are converted into cleanup sites.[115] The Tripartite Commission does not address the level of technical detail that is the major focus of the EPA-Labor Health and Safety Task Force,[116] 117 nor does it include representatives from EPA, the National Institute of Occupational Safety and Health (NIOSH), OSHA, or other Federal agencies whose missions and expertise are pertinent to the NWC cleanup.

Many contentious questions are involved in interpreting and implementing HAZWOPER, coordinating policies among Federal agencies, and communicating effectively with those who actually do the work of cleaning up. DOE might more efficiently resolve some of these issues by convening a multidisciplinary, interagency task force—perhaps even broader in membership than EPA's—including for example, staff from the National Institute of Environmental Health Sciences (NIEHS) and the Agency for Toxic Substances and Disease Registry (ATSDR), as well as health and safety experts from relevant unions. Health and safety staff from DOE's EM and EH might also benefit from sitting in on sessions of the EPA-Labor Health and Safety Task Force.

DOE SITE CHARACTERIZATION DATA

Both the scale and the complexity of contamination at the Nuclear Weapons Complex distinguish the DOE cleanup from most other hazardous waste operations.[118] These factors increase the uncertainties involved in mapping environmental pathways or determining pollution boundaries, and in turn heighten the difficulties associated with identifying site hazards, recognizing potential worker health and safety risks, and designing and implementing work practices that effectively limit such risks.

Characterizing the nature, extent, and future course of environmental contamination is a time-consuming and technically difficult job in any case, but it will be especially challenging throughout the NWC. Records documenting past releases of contaminants from DOE weapons facilities are scant. The exact content and location of past releases are frequently unknown, and the environmental pathways followed by contaminants released years or decades earlier are often difficult to track. **9

In many cases, the volume of contaminants released to the environment at DOE facilities dwarfs the amount of hazardous material found at more typical waste sites. Groundwater contami-

nation has been confirmed at all NWC facilities. All nonarid sites are believed to have surface water contamination.[120] The volume of soil and sediment contaminated with radionuclides, hazardous chemicals, or both is estimated to total billions of cubic meters.[121] Thousands of solid waste management units have been identified throughout the Weapons Complex, many of which require remedial action. Hundreds of buildings and other structures will eventually require decontamination and decommissioning.

The sheer magnitude of characterization efforts at the NWC will pose great challenges to attempts to link environmental data with potential worker health and safety threats. Currently, DOE environmental cleanup requires the analysis of two to three million samples per year. DOE has estimated that by 1995, at least 10 million analyses of environmental samples conducted in offsite laboratories will be required annually.[122] The possible presence of radionuclides in DOE samples will magnify the costs and logistical problems typically associated with characterizing complex pollution scenarios-including long delays in obtaining sample results—because few laboratories are equipped to handle such analyses.

Very few DOE or DOE contractor employees involved in characterization of the nuclear weapons sites are trained in any health discipline. Trained industrial hygienists qualified to assess the adequacy of available characterization data and review the quality of contractors' HASPS are in short supply at DOE. The few industrial hygienists who are available still appear to be concentrating on reviewing exposure hazards and establishing industrial hygiene protocols for weapons production activities.[123] OTA was unable to identify anyone at DOE headquarters, in either EM or EH, who is attempting to establish guidance or policies that DOE contractors or field staff could use to assess the adequacy of characterization data used in formulating HASPS for cleanup worker protection.

DOE has not directed contractors to factor potential cleanup worker health threats into characterization strategies or remediation plans. The Los Alamos National Laboratory (LANL) recently proposed to assist the EH Office of Health Physics and Industrial Hygiene by developing technical documents in support of draft program requirements for a "Health and Safety Standard for Hazardous Waste Operations and Emergency Response" and an "Industrial Hygiene Technical Manual for Health and Safety During Hazardous Waste Operations and Emergency Response.''[124] The former document is to follow OSHA's HAZWOPER standard, whereas the latter "will be similar in depth and scope" to existing NIOSH and OSHA manuals.[125] It is unclear to what extent this proposed project might develop new material specific to the nuclear weapons sites cleanup. DOE has noted that this proposal "will be revised to include EM,''[126] but the draft documents appear to be aimed at worker protection efforts that commence only after site characterization is well under way or completed.

DOE lacks the field staff needed to determine if contractors have done a good job analyzing the type and extent of pollution, or to assess whether available characterization data adequately delineate the health and safety hazards that cleanup workers might encounter. Thus, DOE managers will have little substantive basis for evaluating contractors' proposed site-specific HASPS.

Prime contractors at some weapons facilities are attempting to reduce the time and costs required to complete characterization efforts by integrating Remedial Investigations with Feasibility Studies. Westinghouse Hanford is planning to use the "observational approach" in assessing pollution in Hanford old plutonium reactor areas for example.[127] This approach has been used with success at some non-Federal waste sites and incorporates the idea that characterization studies should be conducted for a specific purpose, not merely to satisfy regulatory checklists (see ch, 1).

A focal point of environmental studies used to support the observational approach to site characterization should be the identification of possible risks to cleanup workers. It is not evident, however, that either DOE or EPA has instructed contractors to make potential threats to cleanup worker health an important "purpose" of site characterization. In the absence of such policy, eagerness to reduce characterization costs may also reduce the availability of environmental data vital to site hazard identification and worker protection.

DOE has not issued any orders or guidance to ensure that contractors use approved or consistent methods in collecting and analyzing environmental samples throughout the Weapons Complex so that pollution scenarios at different sites can be compared. Indeed, DOE has no comprehensive plan for consistently gathering and analyzing environmental monitoring data within or across weapons sites, and no strategy and little technical capacity for relating such data to potential adverse health effects among workers or offsite populations who may be exposed to pollutants.[128] Consequently, DOE has no means of determining which of the many thousands of polluted areas within the NWC require more urgent or more rigorous characterization and cleanup because of their potential health risks. Nor will DOE be able to weigh potential risks to cleanup workers against possible benefits of proposed environmental remedies.

Another problem confronting identification of potential cleanup worker health and safety threats is the lack of coordination or consistent management of characterization data across DOE facilities. Subcontractors engaged in cleanup efforts at DOE facilities have complained to OTA that it is sometimes difficult to get access to characterization data pertinent to worker health and safety.[129] [130] The varying organizational structures associated with different DOE contractors are such that there is no consistency among sites in the titles of individuals assigned to data collection and analysis or in the procedures required for subcontractors to obtain these data.

Such inconsistencies in the structure of DOE contractor organizations add another layer of complexity to efforts to link characterization data to potential cleanup worker health threats. The lack of standard procedures for collecting, analyzing, and recording site characterization data and ongoing environmental monitoring data will also impede efforts to fashion efficient, effective, and consistent medical surveillance programs or health and safety training programs for the cleanup.

IMPACTS OF DOE CONTRACTING PRACTICES

DOE and its predecessor agencies were not conceived as organizations subject to strong centralized direction and control. The Manhattan Project was a loose consortium of private corporations who agreed to participate in building the atomic bomb for reasons of national security.

The companies that contributed their skills and expertise to managing and operating government-owned nuclear weapons facilities during the Cold War (the M&Os) did so in an era when the risks of nuclear technology and other potentially hazardous processes used in weapons production were not fully known. These considerations, and the pressure to augment the nuclear arsenal, induced the government to indemnify M&Os against nuclear and other losses, including workers' compensation costs. [131]

Over the years, a special "partnership" developed between DOE and its M&O's that has greatly complicated DOE's oversight of its contractors.[132] About 90 percent of DOE'S total budget is spent on contractors, primarily those who manage the NWC. This amounted to $17.6 billion in fiscal year 1990.[133]

Beginning in the 1980's, revelations about the seriousness of environmental contamination throughout the NWC, and a succession of weapons facility shutdowns prompted by safety con-

cerns raised questions about DOE's ability to effectively monitor contractor operations. Such events also prompted questions about the appropriate limits of contractor indemnification in the face of regulatory noncompliance.[134]

Environmental Restoration Management Contractors (ERMCS)

Environmental cleanup will be a significant activity at all sites run by M&O contractors, including those facilities that continue to have responsibilities for weapons production, testing, and dismantlement. DOE has determined that at facilities where environmental restoration is the only or major mission, Environmental Restoration Management Contractors (ERMCs) will replace or augment M&Os.

ERMCs will be responsible for conducting Superfund Remedial Investigation/Feasibility Studies, RCRA Remedial Field Investigations, and associated "base program" activities. Subcontractors supervised by the ERMC will actually carry out the characterization studies and will design and implement remedial actions. The ERMC Will be responsible for procuring and managing construction subcontractors.[135] The DOE Office of Environmental Restoration and Waste Management is the program office in charge of all environmental restoration and waste management act iv i ties, whether they occur at ERMC sites or at facilities run by M&O contractors.[136]

The ERMC concept was designed to help restore public confidence in the DOE cleanup effort by making a clear distinction between cleanup contractors and those who had generated the contamination, ERMCs also reflect DOE's desire to expand its contractor corps to include firms with environmental expertise and to inject more competition into bids for its cleanup contracts.

DOE claims that contractor accountability is increased under the ERMC rules.[137] *Some critics* have. however, dubbed the ERMC approach "an accountability disaster."[138] It is possible that the large number of subcontractors and the multiple layers of managerial responsibility characteristic of ERMC cleanup operations will dilute and confuse responsibility and authority for worker health and safety issues.

DOE has tried to build provisions into ERMC agreements that enhance its authority over contractors. For example, ERMCs will not be "bankrolled" in advance by the government for cleanup costs. Instead, they will have to invest their own capital, and DOE will reimburse costs after budgetary review.[139] This approach may force ERMCs to pursue more responsible and prudent cost-accounting practices than have always been followed by M&Os, but it might also encourage contractors to scrimp on outlays for occupational safety and health, unless DOE imposes and enforces explicit OSH performance criteria.

Two ERMCs are currently planned. The Fluor-Daniel Co. has been selected as the ERMC at Fernald, DOE estimates that up to $5 billion could be spent on the Fernald cleanup over the next 5 years; the ERMC could earn as much as $125 million annually during this period.[140] Bidding for the Hanford ERMC is under way. The Hanford ERMC will manage all environmental restoration and defense decontamination and decommissioning *projects.* Waste management activities at Hanford, including characterization and retrieval of materials stored in high-level waste tanks, will remain the responsibility of the current M&O contractor, Westinghouse Hanford Corporation. (WHC).[141]

Cost-Plus Award Fee Process

Contractors at all DOE weapons facilities (M&Os and ERMCs) are now subject to a new contracting process, the cost-plus award fee (CPAF) policy. DOE established the CPAF to encourage attention to environment, health, and safety issues,[142] Under the new policy, contractors are paid a "base fee" for reimbursement of costs, plus a variable "award fee,'" 51 percent of which is determined by DOE on the basis of con-

tractor performance in environment, safety, and health. [143] If the contractor fails any one of these categories, the entire award fee would be at risk. [144]

The record suggests that the award fee contracting provisions are not functioning as planned. Reports by the General Accounting Office (GAO) *45 and the DOE Inspector Genera1[146] have called into question DOE's willingness or ability to use the CPAF to hold contractors accountable for performance. OSHA noted that M&Os have avoided penalties for deficiencies in health and safety by negotiating larger base fees.[147] For example, the M&O contractor at Oak Ridge increased its "award fee" in 1992 compared to 1991, even though its performance in environment, health, and safety-areas that supposedly determine 51 percent of the award-had declined. The contractor accomplished this by negotiating a higher base fee in 1992,[148]

GAO reported that under the new cost-plus award fee system, DOE failed to reduce contractor awards even when serious deficiencies had been found in contractor performance.[149] 150 At Hanford, for example, multiple management errors in safety performance,[151] 152 and shortcomings in hazard analysis and worker protection at the high-level radioactive waste tank farms, *53 154 did not prevent WHC from receiving an appreciable award fee in fiscal year 1991.[155]

At the Nevada Test Site, the contractor's performance in environment, safety, and health in 1990 was rated "average." According to DOE policy, this should result in lower award fees. The DOE Inspector General found, however, that DOE field personnel adjusted the maximum award fees to allow their contractor to earn fees equal to earlier amounts-without increasing its performance score.[156]

The M&O contractor at Rocky Flats was granted an award fee of $1.7 million for 1991, even though the performance review board found that the contractor did not deserve the award. Defense Programs, the DOE office responsible for Rocky Flats, decided to overrule the board with the concurrence of the DOE field office manager.[157] DOE's EM and EH offices reviewed the award fee in an advisory role: EM supported the award; EH did not. EH opposition was based largely on 29 significant deficiencies in environment, safety, and health cited by the board. In reviewing this decision, GAO was unable to determine the weight accorded environment, safety, and health in the final award decision. GAO also recalled earlier undeserved awards to previous Rocky Flats contractors who tolerated serious environment, safety, and health problems, and noted that "some of the same problems we identified [in 1989] still exist.'' [158]

In practice, DOE contractor compliance with environmental regulations appears to receive more emphasis than occupational health and safety issues when award fees are assigned. The CPAF process does not establish what, if any, portion of the award is based on *occupational safety* and health performance. As discussed earlier in this background paper, the priorities and processes that guide Superfund and RCRA cleanups accentuate the importance of environmental cleanup schedules, costs, and possible off-site impacts of pollution, downplaying potential health and safety threats to on-site workers. DOE appears to be reasserting these priorities in its contractor awards. Contractor performance in *environmental* areas—measured by meeting schedule deadlines and milestones set forth in IAGs-appears to weigh more heavily than performance in occupational health and safety.

APPLICATION OF HAZWOPER TO DOE CLEANUP

Policy Guidance on Implementation

The DOE Office of Environmental Restoration and Waste Management has line responsibilities for the cleanup of weapons facilities. EM has made it clear that all environmental restoration and waste management activities are subject to existing DOE orders and must comply with

HAZWOPER, OSHA's construction standard (29 CFR 1926), and other relevant OSHA regulations.[159]

In December 1991, responding to earlier findings by the DOE Inspector General that failure to comply with HAZWOPER training provisions was widespread at NWC facilities,[160] the Office of the Environment within EH issued guidance on "OSHA Training Requirements for Hazardous Waste Operations.''[161] EH recently completed a draft of a document outlining HAZWOPER,[162] which essentially reiterates the requirements of OSHA's standard,[163] albeit in a more readable format. It also provides some important ancillary references that might be helpful in implementing the regulation and includes a sample outline of a site-specific HASP.

The effort proposed by LANL in October 1992 to develop a draft "Health and Safety Standard for Hazardous Waste Operations and Emergency Response" on behalf of the EH Office of Health Physics and Industrial Hygiene[164] will presumably focus more specifically on the programmatic requirements of identifying and controlling cleanup worker exposures to health and safety hazards, although available documents do not make clear how the EH HAZWOPER draft differs from the proposed LANL project. It is also unclear that either effort will significantly alter or augment the existing OSHA standard.

Full implementation of the OSHA HAZWOPER standard at DOE facilities will require considerable effort and cooperation on the part of DOE line managers and contractors. A robust implementation of the standard-for example, a program that takes into account private sector criticisms of deficiencies in OSHA's proposed health and safety training program accreditation process, includes reporting requirements and qualification criteria for physicians designing medical surveillance programs, and imposes more rigorous standards for emergency responder training—cannot occur unless DOE line managers and EH staff make such goals a priority.

It is also probable that cooperative cross-organization efforts among health and safety staff at EM and in different divisions of EH will be necessary to create workable and rigorous OSH policies for the cleanup. The EPA-Labor Task Force on Health and Safety has demonstrated that regular discussion among experienced health and safety practitioners from multiple disciplines and agencies can produce valuable insights and help resolve some of the more ambiguous and problematic questions surrounding HAZWOPER implementation. DOE's efforts to interpret and implement HAZWOPER effectively might also benefit from consultation with health and safety experts from academia and the private sector, as well as different branches of the government such as NIOSH, NIEHS, ATSDR, and the Army Corps of Engineers (ACE), who are familiar with some of the issues involved. DOE has not yet initiated any such outreach.

DOE and its contractors are not moving aggressively to ensure that the minimal requirements of HAZWOPER are met at DOE facilities. EM has not issued policies or guidance explaining how DOE field offices and contractors should interpret and implement HAZWOPER. The EH HAZWOPER draft, even if promptly finalized, will not address interpretive issues associated with HAZWOPER that were discussed in earlier sections of this background paper.

In the absence of clear DOE policies and guidance, implementation of HAZWOPER by different contractors at different facilities is certain to be of variable quality. Furthermore, compliance with some aspects of the HAZWOPER standard developing emergency response plans and meeting worker training requirements, for example-requires contractors to make preparations well in advance of initiating site cleanup activities. However, DOE has not yet carried out assessments of the resources and programs that must be established to ensure compliance with HAZWOPER. The next section of this background paper addresses the implication for DOE's complex cleanup of specific elements of

HAZWOPER that have proved contentious at non-Federal cleanup sites.

Health and Safety Plans

The site Health and Safety Plan is a cornerstone of HAZWOPER's approach to cleanup worker protection. Experience with Superfund and RCRA cleanups has shown that the design and implementation of HASPS encompass many of the most frequently encountered disputes associated with HAZWOPER.[165,166] EPA explicitly states that "there can be only one HASP per site ."[167] Many of the DOE sites, however, are huge. The Idaho National Engineering Laboratory is larger than the State of Rhode Island. Hanford is nearly as big. Even relatively small sites, such as Fernald and Rocky Flats, harbor multiple and complicated pollution sources.[168] At a given time, dozens of subcontractors may be operating on-site and potentially be exposed to different Solid Waste Management Units (SWMUs)[169,170] encompassing many different contaminants e n - vironmental transport pathways, and waste streams.

The scope and complexity of contamination throughout the NWC will probably accentuate the problems experienced at other waste sites in linking characterization data to potential cleanup worker health and safety risks. Characterization of the NWC will continue for years, and in some cases, will overlap with remediation activities and efforts to prevent contamination from spreading. It will be necessary to have systems in place that allow existing HASPs to efficiently integrate new site information, including environmental monitoring data, plans for altered or additional work tasks, and associated worker protection strategies.

Crafting HASPS that accurately delineate weapons site hazards will require a major effort on the part of DOE and its contractors. The EH Draft Hazardous Waste Operations and Emergency Response document stipulates that DOE contractors must designate a Company Health and Safety Supervisor who has "overall responsibility for development and implementation of the HASP."[171] The proposed guidance also requires that a health and safety officer be on-site during all level A,B, or high-hazard level C field operations, and during all invasive/evacuation work such as well drilling. Site OSH officers would have stop-work authorization. These provisions, if implemented, might mitigate some of the problems with accountability and chain of command that have been troublesome at non-Federal cleanup sites.

Organizing and updating the paperwork needed to document site characterization studies, work plans, and environmental monitoring results, and the challenges of linking appropriate worker protection strategies to particular cleanup jobs throughout the NWC, will be formidable. Paper reviews of written HASPs-let alone field assessments of the adequacy of implemented health and safety programs-will be daunting tasks. Thus far, the press of competing demands and limited staffing have prevented the EM headquarters Office of Oversight from reviewing a single HASP from any weapons facility.[172] No Federal or State agency currently reviews HASPS for the DOE cleanup. *73

OTA has reviewed site-wide HASPS written to support cleanup activities at some DOE facilities, but has not reviewed a sufficient number to draw generalizable conclusions. The few documents reviewed by OTA focused on weapons production activities—not cleanup operations-and emphasized hazards from radionuclide contamination. Health threats associated with potential worker exposure to hazardous chemicals did not receive much consideration, even though characterization data demonstrated the presence of these materials on-site. Potential safety threats were also given minimal attention.

The tendency of DOE and its prime contractors to focus on radionuclides and neglect nonradioactive chemical hazards has been noted by the National Academy of Sciences[174] and by DOE Tiger Teams auditing environment, safety, and

health programs at NWC facilities. This emphasis also reflects DOE staffing patterns and the importance accorded radioactive materials in DOE orders.

The focus on radioactive hazards that has traditionally characterized DOE contractor OSH practices need not be a Liability as DOE attempts to forge HASPS suitable for cleanup of environments contaminated with a wide variety of toxic materials, Although the Advisory Committee on Nuclear Facilities Safety 175 and the Defense Facilities Nuclear Safety Board [176] have strongly criticized the poor quality and dispersed organization of DOE radiation protection programs, DOE clearly has significant, if insufficient, expertise in this area. Radiation protection, which will be a critical component of worker health and safety programs during many cleanup operations at the NWC, is not an area in which many health and safety professionals outside DOE have extensive experience. If DOE "borrowed" expertise in nonradiologic hazard assessment and control from other agencies or sources of expertise, it could focus greater efforts on upgrading and applying its own capabilities in radiation protection.

The Nuclear Weapons Complex contains some environmental contaminants and mixtures of pollutants that may never be encountered at more typical hazardous waste operations, High-level radioactive waste and mixed waste (containing both radionuclides and hazardous chemicals) are in this category. For some contaminants and contamination scenarios, there are no published standards or guidelines setting forth appropriate action levels and permissible exposure limits. For example, no Federal agency has established allowable worker exposure levels for soil contaminated with radionuclides.[177]

Attempts by DOE to independently establish allowable worker exposure levels are likely to encounter strong opposition because its credibility in the field of occupational health and safety has been called into question as a result of past practices.[178-181] The need for such worker exposure levels and action levels is too pressing to wait the 3 years or longer that are usually required for OSHA to complete new rule making under the Administrative Procedures Act, EPA is working on the development of allowable soil standards for radionuclides,[182] but denies having jurisdictional authority over workers. A consensus approach that draws on expertise from EPA, NIOSH, OSHA, and other knowledgeable agencies and individuals might usefully address issues such as appropriate environmental monitoring strategies and methods, and the development of action levels and other worker exposure standards.

Medical Surveillance

In 1990 the Secretarial Panel for Evaluation of Epidemiologic Research Activities at DOE (SPEERA) strongly criticized DOE's past efforts to conduct medical surveillance among weapons production workers. In particular, SPEERA noted that epidemiologic studies and health surveillance programs were uncoordinated and lacked the capacity to monitor workplace exposure, to evaluate such exposure in terms of workers health, or to prescribe the corrective actions required. *83

DOE and its contractors still have very limited ability to monitor worker exposure to toxic materials. This is true even for weapons production workers, whose exposures are technically and administratively much less difficult to track than those of cleanup workers. Medical staff at many DOE facilities do not have access to information documenting potential production worker exposures and are not informed of job transfers that might result in worker exposure to hazardous materials.[184-190] Thus, some NWC facility medical departments are unable to verify that workers who are potentially exposed to hazardous materials are receiving appropriate medical surveillance.[191]

Efforts to establish a viable system of medical surveillance for workers engaged in the DOE

cleanup facilities must overcome several obstacles. The initial problem is that worker job titles and tasks, management procedures, and the organizational structure of occupational medicine departments are different at each weapons facility.[192] This makes it difficult to craft and implement DOE-wide procedures that would identify individual workers who potentially face hazardous exposures, are at greatest risk of acquiring work-related illnesses, and are required by DOE orders or OSHA standards to be offered inclusion in medical surveillance programs.

The task of identifying individual cleanup workers at high risk for exposure to potentially toxic contaminants and in need of medical surveillance is further complicated by the panoply of employers engaged at a given site, and by the lack of any coherent analysis of characterization data from the perspective of potential worker exposures. Medical directors at DOE facilities are not informed when subcontractors are working on-site, do not assess the potential hazards that subcontractor employees might encounter, and do not review subcontractors' medical surveillance programs.

Another problem impeding efforts to develop DOE medical surveillance programs that comply with HAZWOPER is the lack of influence and authority of the EH Office of Occupational Medicine.[193,195] which would presumably be the source of policies related to cleanup worker medical surveillance.

When DOE established the Office of Health within EH in May 1990, separate offices were assigned responsibility for industrial hygiene and health physics, epidemiology and health surveillance, and occupational medicine[196] (see figure 3-2). This reorganization of health activities was a direct response to SPEERA recommendations and accomplished the important goal of collecting previously disparate health-related programs under a single Deputy Assistant Secretary. It is not clear, however, that this reorganization has effectively signaled the importance of occupational medicine to DOE and its contractor managers, or improved the visibility and status of occupational health and safety professionals at DOE.

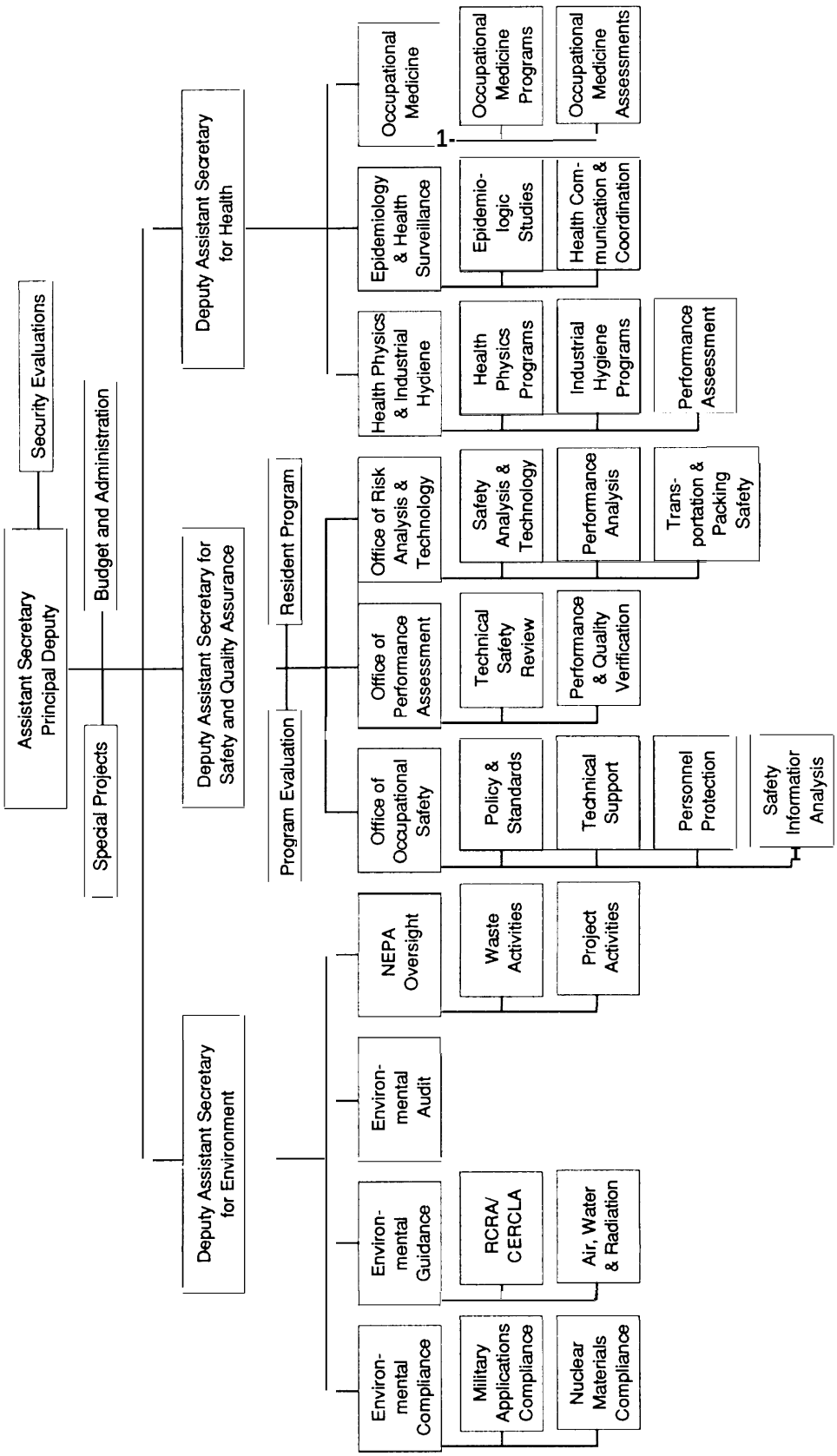
The separate Offices of Environment, Safety, and Health within EH and the different divisions in the Office of Health appear to remain independent domains with their own agendas. OTA found little evidence of coordination or communication among the Offices of Health Physics and Industrial Hygiene, Occupational Medicine, and Epidemiology and Health Surveillance, and no indications of regular contact between EH staff and health and safety professionals working in DOE line organizations.

The DOE Office of Occupational Medicine continues to exert little influence within DOE or among its contractors. Neither the newly created Office of Occupational Medicine, nor the Office of Epidemiology and Health Surveillance, had acquired its full complement of staff when a hiring freeze was imposed across all EH divisions. Consequently, as of late 1992, both of these offices remain well below projected size.[197,198]

In June 1992, DOE Order 5480.8A, which prescribes minimal occupational medicine program requirements for DOE contractors,[199] was updated for the first time in more than a decade.[200] The new order has the potential to place occupational medicine in a more proactive role at DOE facilities. For example, under the new order, managers must ensure that site occupational medicine physicians are informed of worker exposures.[201] On paper, the new Contractor Occupational Medicine Order is a significant improvement; the speed and thoroughness with which the order is actually implemented will be important indicators of managers' readiness to embrace a strong health and safety presence at the operations level.

EH had to make important concessions to DOE program offices to win approval of the Occupational Medicine Order, however. To achieve the "consensus" among DOE Program Secretarial Officers that is a prerequisite for adoption of most EH policy recommendations, EH dropped

Figure 3-2—Assistant Secretary for Environment, Safety, and Health



SOURCE: U.S. Department of Energy, 1992.

language requiring that contractor medical directors report directly to the site manager and instead allowed the option of medical directors reporting to "another management level with sufficient authority to ensure program effectiveness."[202,203] The importance of this concession is reflected in comments by the National Academy of Sciences,[204] SPEERA,[205] and OSHA,[206] These expert reviewers observed that occupational medical input to decisions at DOE facilities was "negligible" and "inadequate"; that medical departments were relegated to a reactive role at DOE facilities; and that these roles were mirrored at DOE headquarters.

In 1991 and 1992, EH conducted audits of occupational medicine programs throughout the Weapons Complex. These studies documented that as of 1992, occupational physicians at many weapons facilities remain uninformed of workers' potential exposure to hazardous materials, that physicians continue to experience problems in getting the attention of decision makers, and that every occupational medicine program in the Weapons Complex has fewer staff than called for by DOE orders .207-213

The weakness of contractor occupational medicine programs has important implications for the cleanup. As matters now stand, there is no entity in DOE or its contractor corps capable of designing, conducting, or overseeing the medical surveillance of cleanup workers required under HAZWOPER. In the absence of guidance from DOE, contractors and subcontractors are free to pursue any notion of adequate medical surveillance that a licensed physician is willing to endorse. Under these conditions, the quality and comprehensiveness of cleanup worker medical surveillance are destined to be uneven. The costs of this service are also likely to vary considerably because DOE has no means of competently assessing the scope or effectiveness of proposed surveillance activities.

The development, implementation, and analysis of useful medical surveillance data necessarily represent a multidisciplinary task requiring the cooperation of health experts from many disciplines including medicine, industrial hygiene, health physics, biostatistics, and epidemiology. OTA found little indication that the institutional capacity for such cooperative efforts exists at DOE.

In its approach to medical surveillance for the NWC cleanup, DOE is repeating some of the mistakes critics have accused it of making in studying the health outcomes of radiation-exposed workers.[214215] DOE is not reaching beyond its own organization to gather expertise from other government agencies or the private sector. The failure to institute an effective quality assurance program for medical surveillance data collection and analysis will compromise any findings the data might suggest. The absence of any system for following individual workers' cumulative exposures to hazardous materials will also limit what lessons can be learned from medical surveillance efforts. The data documenting surveillance activities will differ not only from site to site but also among subcontractors. There will be little chance of pooling data from different vendors in ways that support sound science, and the opportunity to learn what kinds of surveillance are useful, which are a waste of time and money, and what types of cleanup task or exposures are problematic, will be lost.

Finally, it is very important that DOE make a strong effort to guarantee workers that the contents of individual medical records will be treated confidentially, that pooled information used for research purposes or made available to the public will not permit identification of individuals, and that the contracts and affiliations of persons conducting medical surveillance will be disclosed if requested. These steps are necessary both to encourage extensive worker participation in surveillance projects and to comply with standard ethical medical practices.

Health and Safety Training

A December 1990 DOE Inspector General's report documented that contractors at seven M&O facilities and three field offices were not complying with AZWOPER health and safety training requirements. The report noted that the root causes of noncompliance were "acceptance of non-compliance conditions and a lack of corporate and DOE ownership of problems;' as well as failure of DOE field offices to issue site-specific guidance to M&O contractors or to monitor contractor training efforts.[216]

In response to these findings, EH staff prepared guidance on "OSHA Training Requirements for Hazardous Waste Operations.'' [217] Although this guidance does spell out procedures for documenting training at DOE sites, it is little more than a near-verbatim reiteration of the sections of the OSHA regulation that deal with worker training, stapled to a copy of EPA's "Fact Sheet on Establishing Work Zones at Uncontrolled Hazardous Waste Sites."[218] The guidance document does not indicate what the content of training curricula for DOE cleanup projects should be (beyond reproducing OSHA's suggested HAZWOPER course content checklist), nor does it incorporate the training course accreditation criteria proposed in OSHA's 1910.121 regulation[219] or indicate that DOE will evaluate the adequacy of cleanup worker health and safety training programs.

A year after EH released the guidance on HAZWOPER training, the Colorado Health Department found violations of RCRA training requirements among DOE contractor personnel at the Rocky Flats Plant.[220] In May 1992, the DOE Hanford contractor denied State inspectors from the Washington State Department of Ecology access to personnel training records. The State cited the contractor for "failure to properly identify personnel in the training plan," a violation that could include penalties up to $6,000 per day. DOE has admitted that under the terms of the DOE-Westinghouse contract, it would be compelled to reimburse Westinghouse for these fines.[221]

The National Defense Authorization Act for fiscal years 1992 and 1993 authorized DOE to award training grants to workers engaged in hazardous substance response or emergency response at nuclear weapons facilities.[222] DOE and NIEHS have begun collaborative efforts in this area.[223] [224]

A provision in an earlier Defense Authorization Act had required DOE to evaluate the suitability of NIEHS Training Grants for workers involved in hazardous waste operations and emergency response at DOE facilities.[225] In the course of its assessment of NIEHS training programs, DOE found that about half of the DOE contractors had trained all or most employees targeted for 24- and 40-hour health and safety courses. DOE also discovered that its contractors were "taking various approaches" to defining populations of employees who require training under HAZWOPER. At some DOE facilities, decisions about worker training were left to subcontractors who conducted cleanup operations.[226] The survey revealed that the confusion evident at non-Federal waste sites about which workers should receive 24 hours of training and which should undergo 40-hour training sessions was also bothering DOE contractors.[227] DOE facilities were relying on an assortment of vendors to deliver training, at costs of $1,000 to $1,200 per trainee for a 40-hour course.[228]

The report also noted a number of barriers to utilization of NIEHS training programs. It was suggested that NIEHS grant programs might be more attractive to DOE contractors if DOE headquarters guidance and standards "were to specify as a minimum criterion for all training that it meet the requirements of the [proposed 29 CFR 1910.121] OSHA rule on training program accreditation . . .".[229] DOE has not promulgated such guidance, however. Although EH plans to develop curricula for all worker health and training courses to be implemented by DOE line organizations, there is no program to develop mini-

mum criteria or course content for the cleanup on an urgent basis. DOE contractors continue to comply with HAZWOPER's worker training requirements without any guidance from DOE headquarters on course content, type or extent of hands-on training, or site-specific training needs.

The International Association of Firefighters (IAFF) has expressed concern that NIEHS grant monies set aside for DOE workers will not be directed toward the special training needs of firefighters. The IAFF contends that firefighters who might be called on during emergencies related to DOE cleanup activities—including personnel employed at on-site fire brigades and members of municipal fire departments located near weapons sites—are in urgent need of extensive training in hazardous materials incidents. 230 The IAFF maintains that most NIEHS programs do not provide adequate training for emergency response (ER) professionals,[231] and argues that firefighters require more substantive training courses than those that merely satisfy the minimal number of hours stipulated by HAZWOPER.[232] IAFF believes that providing adequate training for ER professionals should be a top priority in worker health and safety efforts at all hazardous waste operations, including DOE weapons facilities.[233]

The IAFF conducted an informal survey of hazardous materials training among emergency responders employed in fire brigades at DOE facilities and at fire departments located in communities near nuclear weapons facilities.[234] All responders reported having had some emergency response training, but most had received only "awareness/operational level" instruction. Training was provided by a variety of vendors including in-house instructors (Hanford); State-certified instructors (Savannah River, Oak Ridge National Laboratory, and Hanford); community college- or university-based training programs (Pantex, Rocky Flats); and instructors from a national chemical manufacturing concern (Hanford). There is presently no way of evaluating the content or quality of these courses.

Emergency Response

DOE weapons facilities have written emergency response or disaster plans addressing emergencies that might arise from regular (weapons production) operations at each facility.[235] All DOE facilities have on-site fire brigades and are required to establish liaisons with local fire departments and medical facilities.[236] DOE Tiger Team audits of environment, safety, and health performance at weapons facilities have documented deficiencies in emergency preparedness at DOE facilities, although these assessments presumed continued weapons production operations and did not usually address risks from environmental cleanup activities.

The Ahearne committee report noted that Hanford does not have plans to handle an emergency at high-level waste tanks.[237] The committee also concluded that at Rocky Flats, the potential release of toxic chemicals, "which could be catastrophic to the on-site population," had been inadequately assessed,[238] and that Rocky Flats "has not had much success in demonstrating its emergency preparedness and response capabilities, even in exercises" carried out as late as May 1991.[239] The Ahearne committee found fire detection and suppression systems at Rocky Flats to be "antiquated" This finding is of particular concern because, historically, fires have been the greatest safety hazard at that location. Recent decisions to cease production operations may reduce the possibility of accidents and emergency situations at this facility.

Many emergency scenarios that could plausibly arise during the DOE cleanup would require the involvement of off-site fire departments and emergency medical teams. At Pantex, where assembly, dismantlement, and testing of conventional explosive components of nuclear warheads take place, the Tiger Team found off-site medical facilities to be inadequate and noted no evidence that DOE had ever audited the real status of medical response there or compared actual capabilities to the commitment made by the local hospi-

tal in written contracts.[240] DOE has taken steps to remedy these deficiencies.

It is difficult to assess the ER capabilities available at DOE facilities with respect to cleanup tasks, in part because neither DOE nor its contractors have surveyed the possible emergency response needs specifically associated with environmental restoration and waste management operations. Most emergencies that might plausibly arise from environmental restoration or waste management functions are likely to be less calamitous than the worst-case scenarios associated with weapons production activities. Some exceptional situations covered by the environmental restoration and waste management program-such as the potential for fire or explosion at the Hanford tank farm where residues of high-level radioactive waste are stored, fire in a radiation-contaminated building at Rocky Flats, or an emergency involving vitrification of high-level radioactive waste-could potentially jeopardize large numbers of workers or pose significant risks to off-site populations.

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Conclusion—Opportunities and Dangers

Cleanup of the DOE Nuclear Weapons Complex offers the opportunity to define and advance the standard of health and safety protection provided to workers engaged in the growing, world-wide industry of environmental remediation. To meet this challenge, DOE and other federal agencies must recognize that protection of those who do the work of cleaning up is urgent and has been too long neglected.

Characterization and remediation of polluted environments pose numerous work-related health and safety hazards. During environmental cleanup operations at non-federal sites, worker protection issues have been given insufficient attention. Experience at these sites indicates that many issues compete for management attention. The regulations and procedures of Superfund and RCRA do not emphasize worker protection issues. Environmental compliance, schedule deadlines, cleanup costs, and community concerns about possible off-site health risks are usually given higher priority than occupational health and safety. Worker protection is often neglected by managers, or addressed only in written health and safety plans that do not accurately portray site hazards or work practices.

Under OSHA's Hazardous Waste Operations and Emergency Response Standard (HAZWOPER), employers are responsible for identifying site hazards, designing effective programs to protect cleanup workers, and ensuring that such programs are properly implemented and enforced. OSHA has not issued regulatory guidance for this complex regulation, which has left some technical provisions of the standard subject to controversial and diverse interpretations. In addition, OSHA's limited capacity to inspect work practices or enforce OSH standards at cleanup sites has meant that enforcement of HAZWOPER is left largely to voluntary efforts by employers. The quality and effectiveness of cleanup worker protection is reported to vary greatly.

Worker protection problems at DOE are even more critical than in the private sector due to the scope and complexity of environmental contamination at the NWC and organizational features of DOE's approach to occupational safety and health. DOE has not yet institutionalized its stated commitment to a culture of excellence and accountability in environment, health, and safety matters. The meager staff and resources allocated to OSH matters within the Office of Environmental Restoration and Waste Management indicates a neglect of this crucial area. To date, DOE has failed to develop cleanup-specific OSH policies, or to effectively monitor or enforce contractors' OSH programs. Unless this is changed, effective cleanup worker protection throughout the NWC will not be achieved.

The reorganized DOE Office of Environment, Safety and Health has issued some proposals to

revise existing DOE OSH orders that would, if adopted, provide a more coherent and workable approach to worker protection programs generally. EH has little capacity to oversee DOE line managers' or contractors' OSH practices in the field, however, and no authority to actually enforce OSH orders. In the absence of independent enforcement authority or close collaboration with, and commitments from, the DOE line organizations, EH efforts—no matter how valid — will remain largely reactive.

As the owner-manger of the largest environmental cleanup effort in history, DOE is positioned to develop the organizational approaches, information, and technologies that would advance the state of the art of occupational health and safety practices for the growing, world-wide cleanup industry. To accomplish this, DOE must, at minimum, acknowledge the urgency of the worker protection issues that confront the department and significantly augment OSH expertise at EM headquarters and in the field. An approach to site characterization and cleanup must be developed that takes worker health and safety hazards into account, and that allows risks to cleanup workers to be weighed against the benefits of proposed remediation plans. Means of monitoring contractor OSH performance must be developed and an incentive system that levies appropriate rewards and penalties for OSH practices must be put in place. Achieving these goals will most likely require the cooperation of government agencies and experts outside of DOE.

As the cleanup workforce expands, so do the chances of accidents, toxic exposures, and further loss of trust in DOE's willingness or ability to demonstrate responsible oversight of contractor practices and to make good its promise to "honor environment, safety and health as fundamental organizational priorities." DOE has an opportunity to create policies, programs and technologies for cleanup worker health and safety that could set the standard for the entire environmental remediation industry. But it must move swiftly.