WORKER SAFETY AND HEALTH ISSUES ASSOCIATED WITH THE DOE ENVIRONMENTAL CLEANUP PROGRAM: INSIGHTS FROM THE DOE LABORATORY DIRECTORS' ENVIRONMENTAL AND OCCUPATIONAL/PUBLIC HEALTH STANDARDS STEERING GROUP

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ABSTRACT

The U.S. Department of Energy (DOE) Laboratory Directors' Environmental and Occupational/Public Health Standards Steering Group (or "SSG") was formed in 1990. It was felt then that "risk" could be an organizing principle for environmental cleanup and that risk-based cleanup standards could rationalize clean up work. The environmental remediation process puts workers engaged in cleanup activities at risk from hazardous materials and from the more usual hazards associated with construction activities. In a real sense, the site remediation process involves the transfer of a hypothetical risk to the environment and the public from isolated contamination into real risks to the workers engaged in the remediation activities.

Late in its existence the SSG, primarily motivated by its LANL representative, Dr. Harry Ettinger, actively investigated issues associated with worker health and safety during environmental remediation activities. This paper summarizes the insights noted by the SSG. Most continue to be pertinent today.

INTRODUCTION

The DOE Laboratory Directors' Environmental and Occupational/Public Health Standards Steering Group (or "SSG") was formed in 1990 near the beginning of the DOE Environmental Management (EM) program. It was felt then that "risk" could be an organizing principle for environmental cleanup and that risk-based cleanup standards could rationalize clean up work. The SSG represented the only organized "risk" program within DOE EM until Dr. Carol Henry was asked to head up such an organization in Washington for the DOE. The SSG continued on until 1998 when it's funding was discontinued by DOE.

The SSG organized three meetings to investigate issues associated with worker health and safety during environmental remediation/waste management (ER/WM) projects. A particular focus of the meetings was on worker exposure to hazardous materials and situations since "exposure" constitutes an important parameter in the determination of ER/WM worker risk. How well worker exposure to hazards is controlled will determine how much risk workers will suffer during the DOE cleanup program. The meetings featured attendance by representatives of a wide variety of organizations ranging from Federal agencies to stakeholder organizations and speakers were invited to discuss many topics relevant to worker health and safety.

BACKGROUND

The first meeting, the "Workshop on Improving Exposure Analysis for DOE Sites," took place in San Francisco, CA on September 4 - 5, 1996. It was organized by Dr. Joan Daisey and co-sponsored by the Consortium for Risk Evaluation with Stakeholder Participation (CRESP). There were 40 participants drawn from DOE, DOE laboratories, CRESP, the Indian Nations, the International Union of Operating Engineers (IUOE), local stakeholder groups, the U.S. Environmental Protection Agency (EPA), the California EPA, universities, Brooks Air Force Base, Geomet Technology, and the Energy Research Foundation. A brief description of the workshop is available (1).

The second meeting, the "Workshop on Worker Health and Safety," was held in San Antonio, TX on April 1 - 3, 1997. It was organized by Dr. Samuel Morris of Brookhaven National Laboratory and was jointly sponsored by the U.S. Air Force Armstrong Laboratory at the Brooks Air Force Base. Thirty-one people attended representing the United States Air Force (USAF), DOE, the DOE laboratories, the USAF Center for Environmental Excellence, organized labor (IUOE, Local 478, the ICWU Training Center and Local 252, the U.S. Army Center for Health Promotion & Preventive Medicine, the Beta Corporation, a private law firm, and universities. A paper describing this meeting (2) is available from the authors.

The third meeting, the "Symposium on the Monitoring, Recording, and Tracking of Worker Exposure During ER/WM Activities," was held in Columbia, MD on September 10 - 12, 1997. It was organized by Dr. Martin Edelson of the Ames Laboratory and was jointly sponsored by the DOE Office of Environmental Health. This symposium was attended by 88 people who represented the DOE, DOE laboratories, the USAF Armstrong Laboratory, the EPA, OSHA, the National Academy of Public Administration (NAPA), state regulators, Physicians for Social Responsibility, instrument manufacturers, the Nuclear Regulatory Commission (NRC), organized labor, U.S. Army Corps of Engineers, consulting firms, and an electrical utility with many on-going environmental remediation activities. The insights of this symposium were summarized in a videotape (3). A limited number of copies are still available for distribution.

INSIGHTS ON WORKER SAFETY AND HEALTH

Total exposure analysis

To understand the impact of incremental exposures of workers to hazards during environmental restoration and waste management (ER/WM) activities it is necessary to know the existing body burden

so that the *total exposure* of the worker can be estimated. For example, it is insufficient to rely on workplace monitoring to determine the health effects of exposure to mercury unless the special dietary practices of the workers (or nearby residents) are unknown. Reliance on default values for food consumption can fail badly when the subject being studied belongs to a cultural group with unusual (to the majority population) dietary practices. In addition to needing this information for chemical and radiotoxic materials, it may also be the case for physical stress. If a worker subject to heat stress on the job engages in sports activities away from work and fails to maintain proper hydration levels, that worker may be at unusual risk for heat stress on the job. Information was presented on a novel medical syndrome, Toxicant Induced Loss of Tolerance (4), where it is speculated that the human systems that normally enable us to sustain exposures to minor levels of chemicals can be rendered less efficient by prior exposures to toxicants.

It is noted that monitoring of exposure to workers should be designed to protect the worker, not to protect an employer against potential liability for injuring a worker. The prime output from a monitoring program should be a comparison of the subjects' total exposure against the recognized threshold levels of toxicants that can cause harm. It is insufficient to simply compare the monitoring result against a regulatory exposure level and then conclude that if that level is not exceeded, there is no possibility of harm to the worker. In the nuclear industry, the NRC maintains a database of exposure records and employers compare the integrated dose against the recommended annual level of exposure for nuclear workers. When and if a worker approaches that level of exposure, the worker is moved to a job that will not involve additional exposure. This practice needs to be extended to exposure to chemical toxicants.

Exposures to mixtures of chemicals and radionuclides

Each meeting devoted attention to the need for better methods for evaluating the impacts of *mixed* exposures since it is likely that DOE ER/WM workers will face complex exposure situations where they may contact sources of radiation, chemicals, and physical stresses such as heat, noise, and vibration. The 1997 Columbia symposium presented discussion of the current state of the art in radiation and chemical monitoring. In addition instrument vendors were invited to display their wares during the meeting. B.K. Nelson (NIOSH) described the interactions that can occur between certain chemicals as well as between chemicals and physical stresses (5).

Temporal variation in exposure patterns

Whereas conventional occupational health physics deals with the protection of workers in well-defined occupational settings where exposure can be monitored and assumed to be fairly consistent from day to day, workers in ER/WM occupations can be assumed to suffer episodic exposures that may swing from zero to high values over small time intervals. Additionally, the ER/WM worker is likely to be exposed to a wider variety of hazardous materials in the course of her work than is the case for a typical industrial worker. This exposure scenario is unusual and it may be more difficult to estimate health effects to ER/WM workers than to workers in an industrial setting.

Balance between worker safety and health

Evidence was presented at each meeting that estimating ER/WM worker risk requires attention to both the worker's exposure to harmful chemicals and radiation as well as workplace accidents typical of all heavy labor. Bob Curtis (OSHA–Salt Lake City) noted that workers utilizing personal protective equipment (PPE) to reduce chemical and radiation exposure could be more at risk from workplace accidents and heat stress related to the PPE than from the contaminants that required the PPE! He emphasized that OSHA would prefer to utilize real-time monitors to preclude the "conservative" use of PPE and mentioned that OSHA had begun to penalize employers for specifying PPE when OSHA believed it was inappropriate. Unfortunately, as noted at the San Antonio meeting, a full complement of real-time monitors is not available at this time for all hazardous materials. That meeting included a presentation by Carla Thrall of Pacific Northwest National Laboratory who has developed a portable mass spectrometer that can perform real-time breath analysis of organic chemicals at ppb or ppt levels (6). The results are analyzed in real time with a physiologically based pharmacokinetic model that includes the unique physiology of each worker. However a representative of the DOE Office of Environmental Health mentioned at the later Columbia symposium that there was a continuing need for real time monitoring of Be at very low levels and it was noted that exposure to alpha-emitting materials, such as U and Pu, cannot now be monitored in real-time to ensure that exposures do not exceed regulatory levels. All three meetings presented evidence that more research was needed to develop more precise, rapid, and universal exposure monitors.

The San Antonio meeting noted that site characterization activities do not normally seem oriented towards worker protection as a high priority, which is odd since the first product of site characterization activities is a health and safety plan (7) to advise site remediation planners on the appropriate monitors and PPE for the job. MaryAnn Garrahan (OSHA) described an audit of exposure monitoring that was conducted at a sample of Superfund cleanup sites. It was generally found that site characterization data had not informed the monitoring program; inappropriate monitors were selected and were placed in areas where they would not be useful. Even when extensive site characterization data were available it was the general practice to be over conservative and require PPE. This again can contribute to added worker risk from heat stress or from accidents caused by the impaired mobility, vision, and hearing that can result from PPE.

The San Antonio meeting noted that new technologies can potentially tip the scales in the direction of improved worker safety by either improving PPE or by replacing currently hazardous procedures by new process that enhance worker safety. Developing new technologies that are actually useful in the field would benefit from the active participation of the workers themselves. Barbara McCabe (IUOE) described her union's product testing program, which is funded by DOE EM, and was a strong advocate of worker participation in technology development.

Record keeping

All meetings noted that workers in ER/WM programs were fundamentally different than the workers that traditionally worked in DOE facilities. These workers have potentially episodic exposures to a wide variety of hazardous materials, are likely to move from one site to another, and are unlikely to have an encyclopedic knowledge of site conditions. A common theme of each meeting was the need to develop

a reliable mechanism for documenting worker exposure at a site and ensuring that such records followed workers as they moved from site to site so that workers were maximally protected. The San Francisco meeting suggested that DOE develop a uniform format for recording exposure data and require that all contractors utilize that format. That meeting also discussed the question of who should maintain the worker exposure "database." While no firm conclusions were advanced, it was advised that DOE consider assigning the responsibility for gathering and retaining exposure data for sites to a high-level headquarters position, earmark funds for exposure analysis activities as a budget line item to improve the visibility of this activity, and to establish an external committee of regulators, scientists, and environmental stakeholders to oversee and advise DOE on this activity. The San Antonio meeting discussed the concept of a worker "passport" that chronicled the exposure history of the worker and that would be carried from site to site as the worker changed jobs. This method appeared very promising to workshop participants, perhaps because it provided a simple way to put all available data directly in the workers' hands and because it could easily be combined with other record keeping approaches. [John Moran (IUOE) mentioned that this approach was being following in Australia during his presentation at the Columbia symposium.] The San Antonio meeting also considered whether it would be appropriate for unions to maintain the worker exposure database but a disadvantage of this approach is that not all ER/WM workers are union members.

The San Antonio and Columbia meetings included descriptions of novel workplace exposure monitoring processes being adopted by the USAF. They have developed a "Homogeneous Exposure Group" approach where the exposure of workplaces, processes, and tasks are noted and then a worker's exposure history can be estimated by noting the total time spent at a cataloged activity or in a particular workplace and creating a time-weighted sum of the anticipated exposures. Questions were, however, raised about the applicability of this process to ER/WM activities where exposure levels cannot be easily characterized.

Speakers at the Columbia meeting questioned whether exposure databases, even if well managed, will be used wisely by environmental remediation managers. One speaker referred to a visit to a hazardous waste site where it was deemed necessary to institute a medical surveillance program for workers. Each worker was required to periodically visit a physician and the physician's reports were provided to the site manager. When the site manager was asked about the reports, he pointed to a shelf filled with thick binders. When asked about the content of the binders, he responded by saying, "I'm required to have my workers seen by a physician, I'm not required to read the reports!"

Regulatory framework

ER/WM activities occur throughout the world on a variety of sites. Many have been contaminated through industrial pollution, others through activities of the military, and others through the activities of other governmental agencies. The activities of the DOE and its predecessor agencies (i.e., the Atomic Energy Commission (AEC), the Energy Research and Development Administration, and the "Manhattan Project" activities that predate the formation of the AEC) as well as similar agencies in other nations have created uniquely hazardous remediation sites that combine very toxic chemicals (e.g., Be) with radiation and physical hazards.

Regulations sometimes prescribe exposure scenarios, the chemicals of interest, and the thresholds of compliance. The regulations are often developed for the specific purposes and needs of each regulatory agency. However, the exposure guidelines from different regulatory agencies can vary by orders of magnitude for the same chemical, depending upon whether the exposed individual is a worker or a member of the public. The San Francisco workshop concluded that the unique hazards at DOE sites can lead to exposure situations that do not, in some circumstances, fit well within existing regulations developed by the U.S. regulatory bodies (e.g., the Environmental Protection Agency, OSHA, NRC) and that DOE should work with those agencies to develop more consistent exposure assessment regulations as well as regulations that better address some of the unique situations that will arise within the DOE cleanup.

The Columbia symposium included a presentation by a NAPA representative regarding a study they had performed, sponsored by DOE and OSHA, to determine the most appropriate regulatory approach for ensuring worker safety and health at DOE facilities. The study found (8) that worker safety and health at DOE facilities was not meeting the standard set by the most sophisticated industrial firms (e.g., DuPont, Dow, etc.) and that it would be best for DOE to cede authority for regulation of worker health and safety at its sites to OSHA. An OSHA spokesman at the meeting noted that his agency would not be able to accept the burden of overseeing the worker safety and health at DOE sites without an infusion of new funds to increase staffing levels and training to enable its inspectors to understand the particular hazards associated with radiation at DOE sites. At one point the NAPA study considered whether it made sense to divide responsibility for worker health and safety at DOE sites between NRC and OSHA so that regulators knowledgeable about radiation were assigned appropriately but decided that the added complexity of coordination would overwhelm any benefits from have both regulators on-site. It would be better, they concluded, to vest all responsibility with OSHA.

Policy considerations

An issue presented prominently in both the San Antonio and Columbia meetings was the impact of "privatization" within DOE on worker safety and health. A representative of the Office of Environmental Health described advice he had received from DOE legal staff that, to prevent liability to DOE, it should not oversee the safety provided by DOE contractors but should instead insert contractual language that mandates that the contractors follow applicable safety and environmental regulations. Worker representatives noted that "OSHA-free" zones were beginning to appear at DOE sites where it wasn't certain what regulations would be followed; at these sites, workers were very concerned about who was looking out for their safety and health.

Participants in both workshops raised concerns that the move to subcontracting and fixed-price contracts could produce disincentives for adequate worker training and supervision as well as proper use of safety equipment, which could increase hazards to workers. Several speakers were particularly concerned with the capabilities of lower-tier subcontractors to enforce adequate worker safety and health standards. Several approaches to fixed-price subcontracts that would ensure that worker safety and health was maintained at high standards were suggested. These fell into three general categories: contracts, training, and achieving cost-effective performance with workplace safety.

- Contract language should explicitly state expectations for worker training and the proper use of safety equipment. Some current subcontracts simply state that the subcontractor should "be safe" without any firm guidance about what that means. Explicit language would enable DOE to meet high safety standards and will allow private companies to consider the costs of implementing those standards during the bidding process. Participants advocated that health and safety specialists should participate in the writing of contracts for environmental restoration work to help ensure that the appropriate language was used. It was also suggested that subcontracts be audited to ensure that the requirements for training and safety are met and should include penalty clauses that emphasize the importance of maintaining worker health and safety to DOE. The contracts should also offer rewards to contractors who demonstrate "best-in-class" worker safety performance.

- Subcontracts should specify the training required for different classes of workers, should require documentation of training, and should ensure that training is appropriate for the job. Participants noted that well-targeted and pertinent safety training is essential to prevent both contractors and workers from ignoring information on important hazards. It was noted that training is often redundant in that when a worker moves from one job to another it is often necessary for him to repeat training received on a previous worksite. The worker "passport" mentioned previously in the context of exposure record keeping could also be used to maintain a record of the training that workers have received so that redundant training would be less of an issue. These training record should be jointly owned by the worker and the employer.

- Participants felt that better communication about worker-safety issues between site personnel, workers, and contractors would result in more cost-effective and safe operations at ER/WM sites. Encouraging worker input would promote "working smart" rather than simply working in compliance with regulations. It was suggested here that improved workplace monitors that could reduce the need to don PPE would reduce ER/WM costs since workers can work more efficiently when they are not encumbered.

Workers as stakeholders

At San Antonio, participants discussed the various roles that workers need to play in ER/WM activities. While it might seem obvious that workers participate by "working," it is appropriate to consider them in other roles. First, workers should be treated in the same manner as other important stakeholders (e.g., site owners, regulators, environmental groups, the public) in the decision-making process. However, meeting participants reported that workers are sometimes excluded from decisions in remediation and decontamination and decommissioning (D&D) decisions. DOE and other Federal agencies should recognize that the every changing work scope of D&D and environmental restoration work demands that workers be empowered to work creatively to complete jobs safely and efficiently. In no instance should workers start a job without a full understanding of the range of hazards that might be encountered and in no instance should workers be expected to subject themselves to physical danger against their will.

CONCLUSIONS

The cleanup of sites contaminated by hazardous materials balances risks to the environment, the public, and workers involved in the site cleanup. Clearly, a rational cleanup plan would appropriately and fairly balance the risks that each party to the cleanup must accept. However, it appears that reduction of risks to the environment and the public is the primary motivation for remedial actions and the risks that are incurred by workers during the different phases of a project are seldom considered. While environmental restoration is driven by the need to protect against hypothetical risks in the future, less weight is given to protecting workers against real and immediate risks to their person. An stark example of this was provided at the San Antonio meeting. Shortly before that meeting, at an unnamed DOE facility, a hydrogen fluoride tank failed and a cloud of hydrogen fluoride drifted towards a guard station. The guards were denied permission to leave their posts, were enveloped in a cloud of hydrogen fluoride, and three were later hospitalized for respiratory distress caused by the corrosive gas. Such situations must be contrasted against the hypothetical risk to the public from exposure to part-per-billion levels of hazardous chemicals drifting off DOE sites.

As DOE's D&D and environmental remediation projects shift to a faster pace, worker health and safety risks need to be afforded a more explicit assessment. Such assessments could indicate the need, in some cases, to seek alternative courses of action or more appropriate cleanup technology options. It is possible that decisions could be made to defer certain cleanup activities with particularly high risks to workers until a later date when better technology options are available. For example, some DOE facilities may contain Be contamination that could expose workers during D&D operations. At present, it isn't clear that sufficiently sensitive technologies are available to monitor worker exposure to Be. A proper accounting of worker risk in the D&D of such structures could determine that these D&D operations be postponed until a better monitoring technology became available.

The DOE has recently determined that it will not be able to completely remediate many of the contaminated sites it owns and is setting a long-term stewardship (LTS) policy in place (9) to protect the public and the environment against the residual hazards that will remain at incompletely cleaned sites. If worker risk were competently evaluated it could be used as one metric to determine when cleanup activities were suspended and LTS entered. Of course, as better technologies become available in the future, it would be possible to revisit the site and remove additional contamination without placing workers' health and safety in jeopardy.

An ever present danger to worker safety and health is that both management and workers themselves do not sufficiently value safety. DOE facilities have in the past always given precedence to production over safety. The new DOE emphasis on safety has failed to reach the shop floor level; many line supervisors still believe in production (be it nuclear materials or research) first. Training may be given at inappropriate times and may not be relevant to the job. One worker at the San Antonio meeting asked, "How come when I am on midnights they always train me at the last hours before I get off?" Another worker said that training is often done on overtime, after working a full shift. Often the training is not relevant to the job and is presented by trainers who are unfamiliar with the workplace ... much of the training is provided by "canned programs" purchased by outside suppliers. Regarding trainers, one worker asked, "How can someone who could not even get into my building train me to run my piece of

equipment?" There is a general feeling that, "the only thing that matters is that they have my name on a piece of paper."

The above describes residual situations at DOE facilities noted in 1997 by employees of the prime contractors. Even after several years during which DOE has made safety and health of the workforce a prime concern, there are still "hold-out" areas. This suggests the difficulties that DOE faces in the future when moving to subcontractors under extreme pressure to work quickly under fixed-price contracts.

Workers at DOE facilities have enjoyed higher wages than their private sector counterparts and, in time, become too complacent with workplace hazards. When considering whether to continue ER/WM work with conventional and risky methods, DOE and their contractors will rarely be faced with a workforce unwilling to accept risk if it means foregoing a paycheck.

How DOE balances its current ethical responsibilities to workers with its responsibility to protect the public and the environment against future risks from DOE sites needs to be addressed in the near future. The Standards Steering Group believed that risk concepts could provide a reasonable mechanism for striking this balance and convened the three meetings described in this report to enhance

communications among active participants in this decision-making process. Even though the meetings were held over three years ago, their insights remain of interest today.

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