DEVELOPMENT OF A COMPREHENSIVE RADIATION SAFETY AND HEALTH PROTECTION PROGRAM FOR SITE RESTORATION WORKERS

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ABSTRACT

This paper discusses the progress that the Environmental Protection Agency (EPA) has made towards developing and implementing an Agency-wide Radiation Safety and Health Protection Program for its employees. This effort is being managed jointly by the Office of Radiation and Indoor Air/Radiation Studies Division and the Office of Administration/Safety, Health, and Environmental Management Division, with active participation and support from the ten EPA regions. Until recently, separate radiation safety programs existed in each region and at EPA labs licensed to handle radioactive materials.

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INTRODUCTION

EPA has personnel assigned Agency-wide to permitting, site clean-up, and compliance activities at radioactively contaminated sites, including Super-fund sites. Many situations exist in which these employees could be exposed to harmful levels of radiation. EPA seeks to provide for its workers' safety and health on the job by keeping their exposure to ionizing radiation to as low as reasonably achievable (ALARA) levels. In keeping with this philosophy, the Agency has designed a radiation protection program that provides an integrated approach to training and information management. This program promotes better worker safety by providing uniform training and a consistent dose-management strategy across the Agency. It also provides management at all levels with a reporting system that easily tracks performance and quality improvement.

Among the unique aspects of the EPA program is a provision for integrating internal doses and doses derived from field exposure to radon above 8 pCi/L into the employee's cumulative exposure record, for dose management purposes. Internal doses are recorded as committed effective dose equivalents (CEDEs) and are determined from area monitoring and, where appropriate, bioassay.

As a Federal Agency, EPA is subject to "Radiation Protection Guidance to Federal Agencies for Occupational Exposure," issued by the President in 1987. This guidance, while setting a dose limit of 5 rems per year for occupational exposure to radiation, allows agencies to set lower administrative levels. After reviewing available dosimetry records for EPA employees and collecting input from regions and labs, the Agency decided to set an administrative level of 500 millirems (mrem) for EPA workers (i.e., one tenth the federal limit). This level will not apply to members of the EPA Radiological Emergency Response Team during actual emergencies. Under special circumstances, other employees may also be authorized to receive higher doses, but these exceptions are expected to be rare.

Worker safety and health, and ALARA exposure levels, will be maintained through a multi-faceted, Agency-wide program that includes written plans, policies, programs, standardized practices, and standardized procedures for radiation protection. Elements of the program include, among others: 1) training and education; 2) monitoring and dosimetry (personal and environmental); 3) medical surveillance and medical and health consultation; and, 4) a state-of-the art management information system, with emphasis on quality assurance and quality control. The EPA program will ultimately offer performance-based interactive computer training tools as well as classroom training (in some cases video-conferences using satellite down-linking) to ensure that EPA workers are well-prepared for duty in radiation areas. The program also couples a comprehensive, centrally managed radiation protection program with a powerful computer-based management information system (adapted from a system developed for the National Institutes of Health) that is always available to regional safety program managers. After Agency-wide implementation, EPA intends to offer this program as a model to states, other federal agencies, and to other private-sector and international users.

The first regional application of this initiative was a pilot program, operating in EPA Region 4 (Atlanta) since 1990, that involves about 80 workers. An on-site assessment of the pilot program's first year of operation, conducted in late 1991, resulted in modifications and additions to the program. On October 1, 1992, three additional regions (Regions 5, 7, and 8) were added. The remainder of the Agency is expected to be included by 1994. Up to 1500 EPA employees will eventually be covered by this program.

TRAINING

From its inception, the cornerstone of the EPA radiation safety program has been a state-of-the-art performance-based training program. The nature of the radiation-related work that EPA employees perform is different in many ways from the tasks facing a "radiation worker" at a licensed nuclear facility or Department of Energy (DOE) facility. The radiation worker must perform routine tasks in radiation areas and occasionally face work situations that present a potential for excessive exposure. For these reasons, radiation workers can be expected to receive significantly more radiation exposure on the job than the EPA worker whose principal responsibilities are related to oversight, inspection, or enforcement. Protection of radiation workers relies, in part, on continually updated radiation area hazard assessments and diligent health physics coverage. While similar controls are in place at EPA labs and well-characterized radiation Super-fund sites,

the Agency must also train its workers for adequately assessing potential radiation risks at uncharacterized sites.

Preparing the EPA work force for dealing with the hazards of radiation requires a thorough understanding of the possibilities for on-the-job exposure. The following categories describe the most common radiation-related situations facing EPA workers:

1. Routine inspection and enforcement activities. As a regulatory agency, EPA personnel are occasionally required to visit facilities where radiation hazards exist (e.g., for RCRA or NESHAPS inspections). These employees are generally escorted by on-site personnel who are health physics technicians or otherwise familiar with radiation areas. Exposures to this group are generally low.
2. Site restoration activities. At radiation Super-fund sites, EPA On-Scene Coordinators (OSCs) and other EPA personnel assigned to the site are at risk of receiving radiation exposures.
3. Site discovery activities. Abandoned sites under initial EPA investigation may have undocumented radiation hazards. Workers need to know what precautions to take to determine whether radioactivity is present. The risk of internal contamination is a special concern in situations in which hard-to-detect alpha-emitters are present (e.g., in sealed drums or as rapidly released aerosols).
4. Indoor radon remediation activities. EPA has an aggressive program to identify homes in the U.S. containing high levels of radioactive radon gas. Staff with radiological expertise from EPA regions, labs, and headquarters are often called on to investigate these homes and, in some instances, demonstrate radon mitigation techniques. Protecting these workers from radon exposure and assessing the doses they receive in these homes present special problems.
5. EPA Radiological Emergency Response Team actions. Members of this team are expected to respond to serious radiation accidents that could cause any increase in exposure to the American public. While team members have not received any significant team-related exposures to date, they could receive the highest doses of any EPA personnel. Their training needs are considerably more extensive than those for the other categories mentioned here.

Obviously, the training needs of these groups vary considerably. To meet this demand, EPA designed a core course (two 2-hour sessions) that all workers enrolled in the program must take. This introductory-level material covers:

- The administrative aspects of the program (where to pick up and return badges, when dosimetry reports are issued, where to go to have radiation concerns or questions addressed, etc.).
- The basics of radiation detection (e.g., how to use survey meters and thermoluminescent dosimeters).
- Radiation protection principles (i.e., time, distance, and shielding).
- Elementary physics (including types and penetrating ability of alpha, beta, and gamma radiation).
- EPA's philosophy of radiation protection (i.e., justification for any job-related exposure, the ALARA principle, EPA administrative and action dose levels, and the federal dose limits).

Additional information is provided to all employees on recommended reproductive and fetal protection measures.

After completion of the core course, special job-specific training is required, depending on the employee's responsibilities. The Super-fund program offers a 40-hour radiation safety course for workers assigned to site characterization or restoration activities. The Radiological Emergency Response Team has an introductory 40-hour course plus periodic field training exercises. Providers of other specialized courses for EPA inspectors will be integrating the core course material just described into their training as appropriate.

All of the core course material for the Radiation Safety and Health Protection Program is being developed with a performance-based approach. Before the classroom portion of the introductory training is offered, the program enrolle is given written training material and an accompanying floppy disk. After reading the introductory material, the student can load the simple-to-operate computer program on any available personal computer. The student is then quizzed and prompted through an iterative process that explains why a wrong answer is wrong and hints at the right answer. The session ends when the student answers all the questions correctly.

As the program expands to include EPA labs and remaining regions, new training needs will be identified and addressed. As with the other components of this program, training materials are constantly reviewed and updated in keeping with the Agency commitment to continuous improvement as embodied by the Total Quality approach.

PERSONNEL MONITORING AND DOSIMETRY

The simplest and most straightforward method for monitoring worker radiation exposure is to measure external gamma radiation with either a thermoluminescent dosimeter (TLD) or a film badge. At a minimum, all workers enrolled in the EPA program will be monitored with TLDs. These TLDs are currently supplied through an agreement with the Public Health Service (PHS), although the PHS in turn receives them from a commercial provider. Suppliers of monitoring and dosimetry services are expected to be NVLAP or DOELAP accredited. As a quality control check, ORIA labs will be providing exposed and blank controls that will be submitted along with employee detectors. For routine situations, the TLDs will be collected and measured quarterly. Special provisions have also been made for immediate collection and 24-hour read-out.

As a precautionary measure, EPA is planning to collect a baseline bioassay, and in some cases a whole-body count, from each employee at the time of enrollment in the program. The isotopes to be analyzed for, typically through urinalysis, will be determined individually based on prior work history and the isotopes expected to be present during EPA field assignments.

EPA has designed its program to be fully compatible with the Nuclear Regulatory Commission (NRC) revised 10 CFR Part 20, which reflects the recommendations of the International Commission on Radiological Protection (ICRP). ICRP recommends assessing internal contamination as a 50-year committed effective dose equivalent (CEDE) assigned to the year of intake. If an inhaled or ingested quantity of a long

half-life isotope contributes 100 microsieverts (10 mrem) per year in each of the ensuing 50 years, then a CEDE of 5 millisieverts (500 mrem) is assigned to the year of intake. Since EPA has adopted an administrative level of 500 mrem per year, this intake would result in the employee's reaching the annual allowable exposure, even though the federal limit is 10 times higher. To help assure that the 500-rem level is not exceeded, the EPA program recommends a 50-rem per quarter action level as a signal to the safety manager that a "real" radiation exposure has occurred.

Unfortunately, modern bioassay techniques are often incapable of detecting a 50-year CEDE of 50 mrem for many of the isotopes encountered. In these instances, EPA must rely on external controls to assure against internal contamination. The most common source of internal contamination is from inhalation of airborne radioactivity (especially since eating and drinking is prohibited in radiation areas). By taking frequent air samples and requiring respiratory protection when airborne radioactivity is detected, internal contamination is assumed to be prevented.

In addition to these external and internal assessments, this program will include an assessment for field exposures to radon and radon decay products when the ambient air concentration of radon exceeds 8 picocuries per liter (pCi/L). Although Rn-222 is the main concern, consideration will also be given to thoro (Rn-220) when elevated levels are present. EPA labs and offices have already been tested for radon; and corrective actions were taken where appropriate. Therefore, only field assessments for radon are considered in the radiation safety program. Using the National Council on Radiation Protection and Measurement (NCRP) recommended conversion from pCi/L-days to whole-body dose equivalent, 8 pCi/L of Rn-222, if breathed for 40 hours per week for 50 weeks (i.e., a work-year), equates to a dose of around 500 mrem per year. Calculated doses from field exposures to radon will be included in the quarterly dose assessments for EPA workers. If adequate respiratory protection is worn, then doses will not be assessed.

For EPA workers not using respiratory protection while participating in field demonstrations of radon mitigation techniques, exposure to radon will be determined using real-time radon detectors. These detectors will provide integrated exposure data for the period of time that mitigation work is underway. Since radon is quickly dispersed in the atmosphere, it is generally only a concern indoors. Some situations, such as uncovered uranium mill tailings piles, may present outdoor radon hazards that need to be considered. At any site contaminated with Ra-226, radon monitoring should be conducted during characterization or remediation activities and precautions should be taken when the level is elevated.

MEDICAL SURVEILLANCE AND CONSULTATION

The radiation monitoring and dosimetry data collected for each enrolled employee, including data from former employers, will become a part of each Agency employee's medical records. This data is subject to the restrictions of the Privacy Act and will be maintained on a secured system (described in the following section).

When employees are concerned about past or potential radiation exposure, it is important to provide them with expert opinion and advice. Examples of employee concerns include the effects of past or potential high radiation exposures, existing health conditions when the employee suspects that radiation may have caused or exacerbated the condition, and questions related to planned or existing pregnancy. When the local safety and health manager or radiation program manager do not feel qualified to answer employee concerns, or when the employee requests additional outside consultation, EPA has negotiated with the Radiation Emergency Assistance Center/Training Site (REAC/TS) in Oak Ridge, TN, to provide this service. REAC/TS can give advice to the local safety manager, to the employee's physician, or, with a supervisor's approval, directly to the employee. Also, REAC/TS has trained over 600 physicians from around the country at their Oak Ridge facility. These local physicians may also be consulted as necessary.

MANAGEMENT INFORMATION SYSTEM

In the past, EPA radiation safety programs have been separately maintained in individual regions and labs. Data management practices have varied, and there has been no reliable and easy method for comparing worker exposures and program improvements among them. To improve this situation, the new Agency-wide program includes a centralized management information system. The principal utility of this system is its reporting capabilities. Managers and enrolled employees regularly receive reports tailored to their interests. The system easily processes special requests for sorted data or comparisons of summary data across regions.

The system operates on a DEC computer (VAX 4000 Model 200 Timesharing System) and is designed to provide 24-hour access for authorized users through telephone linkage to all participating regions and labs. Information is stored on a powerful records management software application developed by NIH and specially adapted by EPA. The program is written in a fourth-generation computer language called Powerhouse, which is a proprietary product of Cognos Corporation.

Through an array of relational screens, the system can store current and cumulative personal monitoring and dosimetry data, environmental monitoring data, lab and field area survey data, employee training records, and other specialized data. It can sort and analyze data by virtually any defined parameter. This system will support on-line day-to-day program management, allow periodic trend analyses, provide long-term epidemiological and quality improvement data, and generate quarterly dosimetry reports to all enrolles.

SUMMARY

The EPA National Radiation Safety and Health Protection Program has been designed to be the model program for other safety and health programs at the Agency (e.g., asbestos, chemical hazards in the work-place, and biohazard). The philosophy behind this program is to provide a consistent, uniform foundation that supports local program management and local decision-making with the strength and resources of a centrally maintained infrastructure. No individual component of the program is unique. In fact, the tools relied on to protect workers are commonplace (training, monitoring, personal dosimetry, etc.). What is unique is its emphasis on the uniform collection of useful information and its dissemination to managers and workers. For managers, data is readily available to support risk-based decision making. For employees,

quarterly dose reports instill confidence in the effectiveness of the program.

When this program moves from the current pilot phase to Agency-wide implementation in 1994, EPA intends to offer it to states, other federal agencies, and foreign entities. While this program has been constructed for a work force that is expected to receive relatively low occupational radiation exposure, its philosophy and framework can be easily adapted to other situations. For instance, for site restoration applications, the EPA administrative dose level may prove too restrictive for those actually performing the hands-on cleanup activities. In this case, the EPA program can be easily adapted by adjusting this level to realistic appraisals of what on-site ALARA doses should be and by adding site- and job-specific training modules.