DEVELOPMENT OF EPA RADIATION SITE CLEANUP REGULATIONS

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ABSTRACT

This paper summarizes the EPA program to develop radiation site cleanup regulations and identifies many of the issues related to that effort. The material is drawn from portions of the Agency's *Issues Paper on Radiation Site Cleanup Regulations* (EPA 402-R-93-084).

INTRODUCTION

The Problem

No one knows exactly how many sites in the U.S. are contaminated with radionuclides, but the number may run in the thousands. Site contamination often consists of all types of radioactive materials and may extend to all environmental media (soil, air, surface water, and groundwater). The materials include source, byproduct, and special nuclear materials as well as naturally occurring or accelerator-produced radioactive material (NARM). The sites range from corners of laboratories contaminated with small amounts of short-lived low-level wastes to sprawling former nuclear weapons facilities replete with long-lived transuranic and high-level wastes.

Site cleanups have been limited and slow because of uncertainties about the nature and extent of contamination and the lack of regulations intended specifically for radiation site clean-up.* The absence of Federal radiation cleanup regulations has contributed to confusion and public concern as well as delays in accomplishing necessary cleanup objectives. The United States Congress, Federal agencies, state and local governments, and the regulated community have recognized the pressing need to identify consistent cleanup standards and requirements for radioactive sites.

Purpose and Scope of the Cleanup Regulations

To remedy the lack of consistent radiation cleanup standards, the U.S. Environmental Protection Agency (EPA) is developing regulations that will establish *cleanup levels* for radioactive sites. The Agency also is developing regulations that will address the management of radioactive waste generated during site remediation. EPA will also explore the feasibility of recycling or reusing site structures, equipment, and metals after cleanup.

The site cleanup regulations will be designed to protect human health and the environment and to facilitate the cleanup of sites. EPA believes that developing specific cleanup standards for radionuclides will ensure consistent, protective, and cost-effective site remediation. They will apply to all Federal facilities such as those operated by the U.S. Department of Energy (DOE), the U.S. Department of Defense (DoD), and sites licensed by the U.S. Nuclear Regulatory Commission (NRC) and its "Agreement States."**

Regulation Development Steps

As part of the regulation development process, EPA has published:

- *Issues Paper on Radiation Site Cleanup Regulations* (EPA 402-R-93-084) to facilitate and focus discussion by examining regulatory issues and approaches for developing the radiation site cleanup regulations.
- An Advance Notice of Proposed Rulemaking (58 FR 54474) announcing the Agency's intent to prepare cleanup regulations and soliciting comments, information, and data that may apply to the rulemaking effort.

INTERAGENCY COORDINATION AND PUBLIC PARTICIPATION

EPA is coordinating this regulation development effort with all interested parties. These include other Federal agencies, state and local government agencies, American Indian tribes, environmental groups, industry and trade associations, and public interest groups. EPA provides these organizations and groups with extensive opportunity to comment on proposed regulations. The Agency considers all significant comments when establishing final regulations. In addition to the public comment period, most rulemakings involve an extensive public information process. For rules with significant public interest, the Office of Radiation and Indoor Air (ORIA) provides other communications avenues such as a telephone hotline and electronic bulletin board to answer questions and provide information on rulemaking activities and available documents.

EPA will provide opportunities for public involvement during the rulemaking and during individual site cleanup deliberations. In addition, EPA will make a special effort to involve American Indian Tribes, environmental groups, industry groups, private citizens, and grassroots organizations. Federal, state, and local governments are major participants in the site cleanup rulemaking process. Those Federal agencies most directly involved include NRC, DoD, and DOE. EPA has also organized an internal workgroup drawn from

* The exception is EPA standards for cleanup of uranium mill tailings and properties contaminated with uranium mill tailings under the Uranium Mill Tailings Radiation Control Act.

** EPA and NRC have signed a Memorandum of Understanding (57 FR 54127) to foster cooperation between the two agencies in protecting public health and safety and the environment on issues relating the regulation of radionuclides in the environment. The Memorandum of Understanding states that "EPA's decisions to impose or not impose other regulations regarding NRC licensed materials or facilities will be based upon a determination as to whether NRC's regulatory program achieves a sufficient level of protection of the public health and environment."

various program offices to oversee development of the radiation site cleanup regulations within the Agency.

Interagency Steering Committee on Radiation Site Cleanup Standards

EPA organized an Interagency Steering Committee on Radiation Site Cleanup Standards to ensure that appropriate resources and priority are given to the regulation's development. EPA's Director of the Office of Radiation and Indoor Air chairs the committee, which comprises senior managers from DOE, DoD, NRC, and other EPA program offices. An Interagency Workgroup is examining specific technical issues related to developing and implementing radiation site cleanup standards.

Involvement by CRCPD and NACEPT

EPA is working with the Conference of Radiation Control Program Directors (CRCPD) Committee on Decontamination and Decommissioning as the Agency develops the rulemaking. Additionally, the Agency has established a subcommittee under the National Advisory Council for Environmental Policy and Technology (NACEPT). (NACEPT is chartered under the Federal Advisory Committee Act to provide environmental policy information and advice to the EPA Administrator and other Agency officials.) These joint efforts with CRCPD and NACEPT are designed to foster scientific and technical objectivity, and public openness. To further ensure a balanced perspective, the NACEPT subcommittee includes representatives from government and the private sector.

Coordination with the NRC's Decommissioning Regulations

EPA is also coordinating with the NRC, which is developing separate regulations governing the decommissioning of NRC-licensed facilities. A Memorandum of Understanding (MOU) signed between EPA and NRC discusses how the two agencies will avoid overlapping regulations affecting NRC license holders. EPA will exclude NRC-licensed facilities from coverage under its rulemaking based upon a determination as to whether NRC's regulatory program achieves a sufficient level of protection of public health and the environment. EPA and NRC regularly share information that pertains to their respective rulemaking efforts. An example of this cooperative effort was EPA's recent participation in NRC's Enhanced Participatory Rulemaking Workshops. The Agency believes this parallel approach will ensure that EPA's cleanup regulations and NRC's decommissioning standards will be consistent, fully protective of public health, and issued in a timely manner.

CURRENT REGULATORY CONTROLS

Several Federal and state agencies regulate radioactive materials under the authority of a number of environmental statutes, but few of the current standards expressly govern the cleanup of radioactive sites and structures.

Federal Programs

Federal agencies with primary authority for regulating radioactive materials are EPA, NRC, DOE, and DoD. Several other Federal agencies, such as the Department of Transportation (DOT), also have programs governing radioactive materials, but they are much narrower in scope than those of EPA, NRC, DOE, and DoD. Each agency's program applies to different types of radioactive materials and sites. Although the standards, advisories, and guidance of various agencies are designed to be consistent with each other, they often overlap in scope and purpose. Few of the current regulations cover all radioactive materials or all radiation sites, and few are directly applicable to the cleanup of radioactively contaminated sites.

State Programs

Each state has its own authority and regulations for managing certain types of radioactive material and waste. Twenty-nine states (known as Agreement States) have signed agreements with NRC in which the Commission relinquishes to the state its authority over source, byproduct, and small quantities of special nuclear material (as defined in Section 274 of the AEA).

The Conference of Radiation Control Program Directors (CRCPD) has prepared Part N draft radiation regulations relating to Naturally Occurring Radioactive Material (NORM) for states to consider. The draft regulations specify criteria, in terms of concentration and surface contamination limits, for the handling and disposal of NORM-contaminated oil and gas production equipment. Several state agencies also are developing NORM policies, regulations, and requirements. Examples of the state programs include the following:

- Louisiana has promulgated final regulations similar to the CRCPD's draft regulations.
- Texas has issued an interim policy establishing guidelines for the disposal of NORM in pipe scale. The guidelines also address radiation protection measures for workers.
- Mississippi has drafted radiation protection standards for the possession, use, transfer, transport, storage, and disposal of NORM which address the introduction of NORM into several materials, products, and environmental media.
- New Jersey is proposing regulations that specify limits and waste management requirements for concentrations and volumes of NORM for four categories of waste generators. The regulations also set a residential indoor air concentration limit for radon.
- New Hampshire is modifying existing regulations to address the disposal of water treatment wastes containing NORM.
- Wisconsin is revising its regulations that currently govern the application of radium-contaminated sludge on agricultural fields. The regulations specify limits on radium concentrations, frequency, and application rates, and also require that the sludge be analyzed to determine the presence and levels of NORM.
- Illinois and EPA have signed an MOU regarding the management of materials contaminated with radium. The MOU addresses the disposal of radium-contaminated waste in landfill facilities, land spreading, and for other unrestricted uses.
- Thirty-two states and one territory have been authorized to regulate mixed waste under RCRA.

State governments and nuclear-related organizations such as the CRCPD are closely following the ongoing NRC

and EPA activities related to the development of radiation site cleanup regulations.

International Programs

The International Atomic Energy Agency (IAEA) has issued *Principles for the Exemption of Radiation Sources and Practices from Regulatory Safety* (Safety Series No. 89). This guidance states that an individual effective dose of 1 to 10 mrem per year would result in relatively insignificant risks. However, based on the possibility of multiple exposures from several exempted practices, the guidance recommends an annual *de minimis* dose of 1 mrem. The IAEA is also preparing a technical report that pertains to the decommissioning of nuclear facilities and a research document concerning the recycling of contaminated solid radioactive materials.

ISSUES AND APPROACHES FOR DEVELOPING RADIATION SITE CLEANUP REGULATIONS

Significant Issues

EPA must address a number of broad issues before it can adopt a strategy for developing radiation site cleanup regulations. These issues and more specific policy or technical questions related to them are described below:

Selecting a Statutory Authority

EPA is evaluating the appropriate statutory authority to use in developing the radiation site cleanup regulations. CERCLA and the AEA are among the statutes being evaluated.

Determining Acceptable Cleanup Levels

The Agency must also weigh several factors to determine an acceptable cleanup level and the level of risk that should be achieved. Radioactivity is a known human carcinogen, and any level of exposure to it (no matter how small) may pose some cancer risk. Establishing lower risk levels would be more protective of health and the environment and could lead to the release of more sites for other uses; but applying lower risk levels would also result in costlier cleanups for site owners, higher radiation exposures to remediation workers, and more remediation waste requiring disposal.

> *Related policy and technical questions:* 1) What risk level should EPA adopt given the existence of established risk levels in a number of environmental cleanup/corrective action programs and in view of the fact that existing radiation protection regulations provide a wide range of risk levels? 2) Can a very low risk level be implemented when available measurement techniques may not be sensitive enough to allow the detection of corresponding radiation levels?

Future Uses of Cleaned-Up Sites

A third issue involves EPA's goal of considering future uses for sites when specifying cleanup levels. EPA may want to develop regulations that allow the sites to be released for such uses as residential, recreational, or agricultural and commercial/industrial. However, releasing certain sites (particularly the more contaminated ones) for some uses may not be possible or appropriate.

> *Related policy or technical questions:* 1) Will it be practical to develop standards that consider a range of site uses? For example, a site containing a waste storage bunker or low levels of residual radioactive contamination may be suitable for industrial use but not for a school. Precedents for considering land use are available. EPA risk assessment guidance for Superfund, for example, specifies determination of current and future land uses when characterizing potentially exposed populations.* Another precedent for varied usage exists in NRC guidance for cleaning up sites contaminated with uranium and thorium.** 2) Will the environmental and economic costs of waste disposal and the scarcity of licensed radioactive waste disposal capacity create incentives for interim, onsite storage of remediation wastes?

Additive Effects

A fourth issue is the need to determine how several additive risks will be handled. EPA must consider the combined risks of exposure to multiple radionuclides, multiple exposure pathways, and multiple radionuclide release sources at contaminated sites. A complicating factor is that ionizing radiation is not the only carcinogenic contaminant present at many of the sites since a significant fraction also contain hazardous chemical wastes.

> *Related policy or technical questions:* 1) How should risks be "added" to ensure that appropriate, measurable, implementable levels result? 2) Should risks from indoor radon exposures be considered? 3) Should risks from radiation exposures be added to risks of chemical exposures when mixed waste is involved?

Target Individuals and Populations to be Protected

A fifth issue is the need to determine whether the regulations will be focused to protect individuals, whole populations, or both. Most radiation protection standards currently apply only to individuals. Standards that apply to populations (i.e. collective dose standards) sum all the individual doses received over a designated time frame by a certain population.

> *Related policy or technical questions:* 1) Should the regulations be designed to protect the average individual, or only individuals most sensitive to radiation exposure (e.g., children)? 2) Should the regulations be designated to protect members of the general public, remediation workers, or both?

Protection of the Environment

A sixth issue involves the need for assurances that the regulations will provide effective protection for both people and the environment. Most research on the effects of radiation exposure has focused on humans only. However, EPA also will consider cleanup levels that protect the environment as

* **Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part A)**, Interim Final, (EPA 540/1-89-002) December 1989.

** "Disposal or On-site Storage of Thorium From Past Operations," Branch Technical Position, 46 FR 52061, October 23, 1981.

well. The level of safety required for the protection of all human individuals from radioactive hazardous wastes is generally regarded as adequate to protect other species. This is not necessarily the case for nonradioactive portions of mixed hazardous wastes where adverse environmental effects may occur at or below levels that protect human health.

Related policy or technical question: 1) Should the radiation site cleanup regulations provide flexibility for determining environmental effects on a case-by-case basis?

Time Frame to be Considered

A seventh issue involves the need to identify realistic time frames when calculating individual doses. Some radionuclides are long-lived, and some radiation protection standards are designed to protect human health and the environment for 10,000 years (e.g., EPA's high-level waste regulations in 40 CFR Part 191). The radiation community has traditionally assumed that individuals are exposed to a particular source of radiation over their entire lifetime. EPA's Superfund program, however, has recognized that people no longer spend their entire lives living or working at the same location.

Related policy or technical questions: 1) Should the regulations consider that area residents may not always spend their entire lives at the site? 2) Should the radiation exposure of multiple generations be considered since many radionuclides are very long-lived? 3) Should the regulations be predicated on the fact that workers and members of the public are generally exposed to radiation for different durations, depending on the land use (e.g., residential versus industrial)?

Technological Feasibility

The eighth issue is technological feasibility. The feasibility of any cleanup approach will depend on the availability of technologies that can achieve the desired cleanup levels. EPA has reviewed and will continue to evaluate technologies that could be used to remediate soil, water, and structures at sites contaminated with radioactive materials. A 1990 study by the EPA Office of Emergency and Remedial Response (OERR) and the Office of Radiation and Indoor Air (ORIA) showed that a number of technologies show potential for addressing radioactive contamination and merit further study. They include soil washing, chemical extraction, physical screening, classification, gravity concentration, flotation, vitrification, and solidification. A joint ORIA-EPA Control Technology Center report indicates that incineration of radioactive and mixed waste, as a volume-reduction process, is a viable treatment technology.

Related Policy or Technical Questions: Will research and technical studies be able to produce definitive results on technological feasibility that involve: 1) the applicability of a number of technologies for radiation contamination problems and 2) the performance and cost of technologies appropriate for addressing different types of contamination problems?

The availability of measurement and modeling techniques to demonstrate compliance with cleanup levels is another important consideration. It is not clear that available measurement techniques are sufficiently sensitive to demonstrate compliance with certain radiation risk limits (e.g., 10^{-6}). Developing procedures and criteria to help standardize dose and risk estimates may be necessary.

Related policy or technical questions: 1) Should EPA select from among several existing models that could be used directly or adapted for the cleanup regulations? 2) Should EPA develop new and improved pathways models that might be costly and time consuming to implement? 3) Should owners and operators have the freedom to choose and apply pathway models on their own, or should EPA prescribe models and procedures?

Regulatory Approaches for the Cleanup Regulations

EPA's issues paper presents four basic approaches for the site cleanup regulations and evaluates these approaches against several criteria such as protectiveness, ease of promulgation and implementation, and compatibility with other regulations. All four approaches would accommodate NORM contaminants, but only some of them would be able to accommodate mixed waste. The four approaches are:

Dose or Risk Limit

EPA could promulgate regulations that define an acceptable level of risk. For example, the regulation could require sites to be cleaned up so that members of the public would not be subject to a lifetime cancer risk of more than 1×10^{-X}. Compliance with this risk would have to be demonstrated with a combination of measurement and estimation techniques. EPA could also promulgate a regulation that requires sites to be cleaned up so that members of the public would receive no more than a certain radiation dose, expressed in mrem per year. The exact nature and extent of the cleanup activities would not be dictated by EPA, as long as compliance with the limit was demonstrated. Another approach would be to set a range of dose or risks (e.g., 10^{-4} to 10^{-6}, as used for CERCLA clean-ups).

Advantages and Disadvantages: Dose and risk limits would be relatively easy to promulgate and would not require EPA to consider different exposure scenarios. A dose limit would also be consistent with other radiation regulations, most of which are expressed in terms of radiation dose, and either dose or risk limits could be applied to all types of radioactive contamination including NORM. Disadvantages involve potential difficulties with implementing and enforcing a regulation with dose and risk limits, or demonstrating compliance with these limits.

Table of Radionuclide Concentrations

A second approach is for EPA to develop default exposure scenarios for radioactively contaminated sites and use them to calculate maximum concentrations that are acceptable for specific media and contaminants. Site owners or operators would determine what radionuclides are at the site and then look up the concentration limit in a table to determine the extent of cleanup required.

Advantages and Disadvantages: The chief advantage to employing a "look up" table is that implementation of, and compliance with, the concentration limits would be relatively straightforward. The approach would address all categories of radioactive materials, and site owners would be required to clean up to

these specific concentrations, regardless of individual site characteristics or total volumes of contaminated materials. A major disadvantage involves the difficulty of developing a table that would apply to all sites and that would cover the combined cancer risks of radionuclides and chemicals at mixed-waste sites. There are also drawbacks with required hypothetical modeling that could result in limits that are unnecessarily low for some sites and excessively high for others.

Table of Radionuclide Concentrations With a Pathways Model

A third regulatory approach is to combine a table of radionuclide concentration levels with a standardized pathways model to derive radionuclide- and medium-specific concentrations based on site-specific conditions. Equations, data, assumptions, and variables could be developed by EPA and used by the regulated community to derive site-specific cleanup concentrations.

Advantages and Disadvantages: A primary advantage of this approach is flexibility since it would allow the use of alternative concentration levels that would be protective on a site-specific basis. The addition of a pathways model would eliminate the possibility that concentrations would be unnecessarily low or high given site-specific conditions. A major disadvantage is that it will generally be more difficult to develop and enforce than the other approaches and may involve more effort and higher costs to implement.

Technology-Based Approach

A technology-based approach would involve the use of a prescribed cleanup technology (or technologies) for specified conditions and materials. This would generally be the easiest approach to implement and enforce since the standard would be met if the specified technology were used; it would not be necessary to determine concentration or risk levels.

Advantages and Disadvantages: A technology-based approach could be applied to all types of radionuclides. It would spell out clearly the cleanup methods required so it would generally be easier to implement, enforce, and demonstrate compliance with than would be the other approaches. However, there are serious disadvantages since this approach would not allow cleanup actions to be tailored to site-specific conditions, which are likely to vary greatly. A technology-based approach would also be the most difficult to promulgate because EPA would have to perform extensive studies and analyses to determine an appropriate range of technologies, and to stay abreast of the rapid technological advances needed to keep the regulation up to date. Such an approach might also inhibit the adoption of waste minimization and pollution prevention measures.

CONCLUSION

EPA has published an Advanced Notice of Proposed Rulemaking in the *Federal Register* and has made the issues paper discussed above available to interested parties. EPA continues to work with the Interagency Committee on Radiation Site Cleanup Standards and the CRCPD Committee on Decontamination and Decommissioning in the development of the rule. EPA also will continue to coordinate with the NRC as the Commission develops its decommissioning rulemaking. Finally, EPA will provide the public with the opportunity to comment on the alternatives considered.

EPA welcomes participation and comment from interested parties, especially states, throughout the rulemaking process. EPA believes that public comment and debate on the complex issues to be addressed in the cleanup regulations will allow the Agency to achieve its goal of protecting human health and the environment in a timely and cost-effective manner. For further information on the development of the radiation site cleanup regulations, please contact Barbara Hostage or Jamie Burnett in the Radiation Studies Branch, Radiation Studies Division, Office of Radiation and Indoor Air, U.S. Environmental Protection Agency, Washington, D.C. 20460, (202) 233-9237.