EPA's ENVIRONMENTAL STANDARDS FOR HIGH-LEVEL RADIOACTIVE WASTE DISPOSAL

(40 CFR Part 191)

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ABSTRACT

The Environmental Protection Agency recently published proposed standards for disposal of high-level radioactive waste (40 CFR Part 191) for public review and comment. These standards include quantitative limits on projected releases to the environment for 10,000 years after disposal as well as qualitative requirements to assure that these long-term containment requirements are met. The Nuclear Waste Policy Act of 1982 requires that these standards be promulgated by January 7, 1984. This paper summarizes the proposed standards, reports on the status of the Agency's rulemaking process, discusses the technical analyses considered in developing the numerical containment requirements, and reviews several key issues associated with the proposed rule.

THE RULEMAKING PROCESS

On December 29, 1982, the Agency published 40 CFR Part 191, "Environmental Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes," in the Federal Register for public review and comment (47 FR 58196). Comments on this proposed rule must be received by May 2, 1983. After this comment period ends, we will hold two public hearings to explore information and issues raised in the responses we receive. These hearings are scheduled for May 12-14, 1983 in Washington, D.C., and for May 19-21, 1983, in Denver. Detailed arrangements and procedures for these hearings will soon be announced in the Federal Register.

In addition to this public review of the proposed 40 CFR 191, the Agency's Science Advisory Board--through a Subcommittee chaired by Dr. Herman Collier--is conducting an independent review of the technical analyses supporting the proposed standards (48 FR 509). This Subcommittee is holding a series of meetings that are open to the public and are announced in the Federal Register. At each of these meetings there is an opportunity for members of the public to make relevant technical information available for consideration by the Subcommittee. The next two meetings of the Subcommittee are tentatively scheduled for March 24-25, 1983, in San Francisco, and for May 2-3, 1983 in Washington, D.C.

Shortly after we published these standards for public review and comment, the Nuclear Waste Policy Act of 1982 was signed by President Reagan on January 7, 1983 (Public Law 97-425). Section 121 of the Act requires the Agency to promulgate these standards not later than one year after enactment of this legislation--or January 7, 1984.

THE PROPOSED STANDARDS

Our proposed standards include two Subparts. Subpart A would limit the radiation exposure of members of the public from management and storage of spent fuel or waste, prior to disposal, to the same levels that the Agency established for the uranium fuel cycle in 40 CFR 190. Management and storage operations for high-level wastes from national defense activities would be covered as well as those from commercial facilities. Subpart B of the proposed rule would establish both quantitative containment requirements for high-level waste disposal systems and qualitative assurance requirements to ensure that these long-term containment requirements will be met. Subpart B also contains procedural requirements to ensure that appropriate analytical procedures are used to apply the containment requirements to specific disposal systems.[1]

The containment requirements for disposal systems would limit the amount of radioactivity projected to enter the environment for 10,000 years after disposal. We selected 10,000 years as a regulatory period by balancing two considerations. First, this period is long enough to encourage good site selection by requiring assessment of typical groundwater pathways to the environment. On the other hand, it is short enough for the likelihood and characteristics of geologic events to be reasonably predictable. We believe that the projected risks to future generations from high-level waste disposal systems complying with our proposed containment requirements should be no greater--on a generic basis--than the risks from the equivalent amount of unmined uranium ore used to create these wastes.[2,3]

The qualitative assurance requirements of Subpart B would provide seven criteria necessary for developing confidence that the long-term containment requirements will be complied with.[1] These criteria call for well-designed, multiple-barrier disposal systems that would not rely on active institutional controls for maintenance for more than a few hundred years, and that would not be located near potentially valuable resources. The criteria would also require that future generations be provided information about the location and dangers of the wastes and an option to recover and relocate them if they need to.

THE LEVEL OF PROTECTION

We selected a level of protection to base the proposed containment requirements on by balancing two perspectives: (1) the degree of protection that appears to be reasonably achievable through disposal

methods being pursued within the national program, and (2) comparisons of the potential residual risks from high-level waste disposal with the risks to future generations from other sources of radiation exposure. From this balancing, we came to the conclusion that--through the use of expected engineering control technology at carefully chosen disposal sites, and without substantial effects on waste management costs[4]--mined geologic repositories could keep the long-term risks to present and future generations to levels no greater than those from equivalent amounts of unmined uranium ore. Thus, disposal of these wastes appears to be readily achievable without causing any increase in risk to future generations.

It is important to note that we did not rely on either of these two perspectives by itself in selecting the level of protection. For example, our containment requirements clearly do not require anything like "best available technology." In making our assessments of repository performance, we tended to make cautious analyses that should overestimate the long-term risks from our generic models of repositories. Even with this conservatism, our assessments indicate that long-term risks at least an order of magnitude lower than those associated with the proposed containment requirements are probably achievable without major effects on the national program.[2]

On the other hand, we did not chose the level of protection merely by judging what risks might be "acceptable" based upon comparisons with other societal risks, or based upon the costs and benefits of the activities that produced these wastes. Approaches of this type have often been suggested to us. (Their advocates usually imply that these approaches would argue for less stringent requirements than those we have proposed.) However, no specific scheme to select an "acceptable" level of residual risk--independently of considerations of cost and achievability--has received enough support for practical application. And broad support of the environmental regulations for this activity is particularly important, because many governments, organizations, and other constituencies will be involved in the process of identifying, evaluating, and selecting sites for disposal of these wastes.

Thus, we have proposed containment requirements that should be quite straightforward to achieve through careful comparison of alternative disposal sites and engineering controls, and we hope they will be the basis for a broad consensus that such disposal will be both "safe" and "adequate." We are, of course, particularly interested in comments on this aspect of our proposal, which involves broad societal judgements as well as technical findings. However, it must be emphasized that we do not intend that our decisions about the appropriate level of protection for high-level waste disposal should set precedents for decisions about other types of waste disposal or for decisions about other environmental protection activities. (For example, we do not intend that "no increased risk to future generations" should become a basic principle of standard-setting--the technological, economic, and societal aspects surrounding each particular issue should be overriding.)

EPA PERFORMANCE ASSESSMENTS

As part of developing the containment requirements, we evaluated expected and accidental releases of radioactivity from generic models of geologic repositories in five different media.[2] We examined the capabilities of waste cansiters, waste chemical forms, repository design, and the surrounding geologic media to prevent or delay the release of radionuclides.[5] For accidental releases, we estimated the probabilities of events that could lead to the releases.[5] We then estimated the long-term population risks from these releases through the use of very general models of environmental pathways and a linear, non-threshold relationship between radiation exposure and human health effects.[6]

An important result of these performance assessments was our conclusion that the geochemical and hydrological characteristics of a disposal site were substantially more important to long-term environmental protection than the capabilities of a repository's engineering controls.[2] (In turn, among the categories of engineering controls, waste form performance appears to be more important than canister lifetime.) Thus, we believe that careful site selection--from a broad variety of alternatives--must be a major part of the national program. And we hope these standards can help build the public confidence in the program that will be necessary for a diversity of sites to be available for evaluation.

THE NEED FOR QUALITATIVE REQUIREMENTS

The qualitative assurance requirements are a very important part of our proposed standards. These seven criteria address and compensate for the uncertainties that necessarily accompany plans to isolate these wastes from the environment for a very long time. No matter how promising analytical projections of disposal system performance appear to be, these wastes should be disposed of in a cautious manner that reduces the likelihood of unanticipated releases. Our assurance requirements call for a prudent and "common-sense" approach to disposal that provides the necessary context for application of our containment requirements; we believe that these criteria are essential for developing the needed confidence that the long-term release limits will be met. Furthermore, we believe that the assurance requirements will substantially reduce the likelihood that individuals might inadvertently receive large exposures by intruding into the underground formations surrounding a repository.

Two basic concepts support these qualitative criteria. First, we believe that the isolation of these wastes should not depend upon active participation or sustained vigilance from future generations for very long. Therefore, wastes should be disposed of promptly rather than maintained in indefinite storage, reliance on institutional controls should be minimized, and sites with resources that might attract future exploration should be avoided. Second, we believe disposal systems should be designed with the understanding that expectations of system behavior over thousands of years may be incomplete or wrong. Thus, disposal systems should be made tolerant of potential mistakes in engineering design or site selection by using multiple, partly redundant barriers, and future generations should have the option to recover the wastes if new information indicates that some unforeseeable error was made.

Some have argued that these assurance requirements may unduly restrict the flexibility available to disposal system designers. Indeed, the concept of allowing maximum flexibility to achieve specific environmental protection goals (saying "what to do", not "how to do it") can be both effective and

efficient in many situations. However, we do not believe we should rely upon it in this particular case because of the unusually large uncertainties inherent in designing disposal systems to isolate wastes for at least 10,000 years. Again, this proposed rule should not be considered as a precedent that will extend to the Agency's other regulatory activities.

AN INDIVIDUAL EXPOSURE STANDARD?

One of the alternatives to our proposal that we are particularly seeking comment on is the use of an individual exposure standard for disposal systems. This might either supplement or replace our proposed containment requirements. As we developed 40 CFR 191, we frequently considered including an individual exposure limit in Subpart B, but we could not develop a framework that: (1) was reasonable to implement, (2) appeared achievable by the disposal technologies we were considering, and (3) would have significantly increased environmental protection compared to our proposed approach. Instead, we chose to rely upon our qualitative assurance requirements to protect individuals from large exposures.

Others often suggest that we use individual exposure standards for the disposal phase. The basis for such suggestions usually includes one or more of the following rationales: (1) individual exposure limits are a traditional form of radiation protection standard, (2) the proposed containment requirements are too stringent, or (3) standards should not be so closely linked to population risks derived from the linear, non-threshold, dose-effect relationship that the Agency considers for radiation exposures. All of these rationales are worthy of discussion, but I will not take the time to review them here.

Instead, I will concentrate on a fourth rationale for an individual exposure limit: that our proposed Subpart B may not provide adequate environmental protection. We believe that such a criticism ignores the protection afforded by several of our qualitative assurance requirements. The criteria regarding markers and records and avoidance of sites with resources are intended to greatly reduce the chance that someone might intrude into a repository while looking for something else, and the criteria regarding multiple barriers and institutional controls should reduce the consequences if an individual did inadvertently intrude (e.g., by exploratory drilling, which could bypass much of the protection afforded by good site selection). Against this background, we particularly seek comments showing how individual exposure limits might afford more protection by leading to practical disposal systems significantly different from those that would comply with our proposed Subpart B.

SUMMARY

These are some of the key issues that we expect and encourage comment on as we proceed to develop our final standards for disposal of high-level radioactive wastes. We are sure that there will be a variety of other comments as well, and we look forward to hearing a diversity of viewpoints--both on our proposed rule and on the technical analyses that support it. We believe that 40 CFR 191 has a key role to play in the nation's progress towards solving a problem that has gone unresolved for far too long. Accordingly, we particularly encourage comments that focus on the specifics of this issue--rather than broad extrapolations to many other problems--and that come with practical suggestions about how to help us make this proposed rule better.

REFERENCES

1. U.S. Environmental Protection Agency, "Draft Environmental Impact Statement for 40 CFR 191: Environmental Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes," U.S. Environmental Protection Agency, EPA 520/1-82-025, December 1982.

2. Smith, C.B., D.J. Egan, W.A. Williams, J.M. Gruhlke, C-Y. Hung and B. Serini, "Population Risks from Disposal of High-Level Radioactive Wastes in Geologic Repositories, Draft Report," U.S. Environmental Protection Agency, EPA 520/3-80-006, December 1982.

3. Williams, W.A., "Population Risks from Uranium Ore Bodies," U.S. Environmental Protection Agency, EPA 520/3-80-009, October 1980.

4. U.S. Environmental Protection Agency, "Draft Regulatory Impact Analysis for 40 CFR 191: Environmental Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes," U.S. Environmental Protection Agency, EPA 520/1-82-024, December 1982.

5. Arthur D. Little, Inc., "Technical Support of Standards for High-Level Radioactive Waste Management, Volumes A, B, C and D and Addendum," U.S. Environmental Protection Agency, EPA 520/4-79-007A,B,C,D and E.

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