ENVIRONMENTAL STANDARDS FOR MANAGEMENT AND DISPOSAL OF SPENT NUCLEAR FUEL AND HIGH-LEVEL AND TRANSURANIC RADIOACTIVE WASTES

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ABSTRACT

The Environmental Protection Agency (EPA) plans to promulgate the environmental standards for management and disposal of spent nuclear fuel and high-level and transuranic radioactives wastes (40 CFR Part 191) this summer. This paper reviews the different types of provisions (i.e., long-term containment requirements, qualitative assurance requirements, ground water protection requirements, and implementation guidelines) that are being considered in developing 40 CFR 191. Many of the recommendations made by the EPA's Science Advisory Board (SAB), the National Academy of Sciences, and the public comments on both the proposed rule and the SAB report are discussed in conjunction with their implications for the final rule. The paper also describes preliminary results of EPA's assessments of the long-term performance of different types of mined geologic repositories, which show that many options available within the national program should comfortably achieve the exceptionally good environmental protection called for by 40 CFR 191.

INTRODUCTION

The Environmental Protection Agency (EPA) has nearly completed its program to develop generally applicable environmental standards for the management and disposal of spent nuclear fuel and high-level and transuranic radioactive wastes (40 CFR Part 191). This effort was begun as part of the expansion of the national high-level waste program directed by President Ford in October 1976, and it is being conducted under the Atomic Energy Act authorities assigned to EPA by Reorganization Plan No. 3 of 1970. In Section 121 of the Nuclear Waste Policy Act of 1982 (NWPA), Congress reiterated this responsibility and called for promulgation of these standards by January 7, 1984. Although the Agency has not met this deadline, the extra time taken is felt to be appropriate because of the importance of these standards to the overall program.

The environmental standards that EPA is developing will provide the basis of the Federal regulations that guide the process of selecting and evaluating the disposal sites for these wastes, as well as those that govern the design, construction, licensing, and operation of mined geologic repositories at these sites. Specifically, 40 CFR 191 will constitute the "system guideline" (section 960.4-1) of the Department of Energy's (DOE) "General Guidelines for the Recommendation of Sites for Nuclear Waste Repositories" (10 CFR Part 960). Similarly, the Agency's standards will constitute the "overall system performance objective" (section 60.112) of the Nuclear Regulatory Commission's (NRC) technical criteria for disposal of high-level wastes in geologic repositories (10 CFR Part 60).

THE PROPOSED STANDARDS

The Agency published these standards for public review and comment on December 29, 1982, a few days before the NWPA was enacted. The proposed rule contained two subparts. Subpart A addressed waste management and storage operations, while Subpart B contained standards that would apply once the wastes were ultimately disposed of (e.g., upon final backfilling and sealing of a mined geologic repository). Within Subpart B, there were two complementary sets of requirements that the Agency believed were essential for appropriate protection.

One set, the "containment requirements," consisted of numerical limits on radionuclide releases to the accessible environment for the first 10,000 years after disposal. These release limits were intended to limit population risks to no more than 1,000 extra fatal cancers over this 10,000 year period from disposal of the wastes from 100,000 metric tons of reactor fuel. Releases from both expected disposal system performance and from unlikely events and processes were addressed by these containment requirements.

The second set of provisions, the "assurance requirements," provided seven qualitative principles that the Agency believed were essential--in view of the inherent uncertainties of analytical projections over thousands of years--to provide confidence that the desired level of protection would be achieved. Examples of these principles were a limitation on long-term reliance on active institutional controls and a call for use of disposal systems with multiple barriers, both engineered and natural, to isolate these wastes.

INFORMATION CONSIDERED FOR THE FINAL RULE

A public comment period of 120 days was established for review of the proposed rule, ending on May 2, 1983. After this comment period, two public hearings were held to solicit information both on the proposed rule and on a number of suggested revisions discussed in the comments received to that time. Finally, the comment period was extended until June 20, 1983 to insure adequate time for interested parties to evaluate the information discussed at the public hearings.

In parallel with this notice-and-comment process, the Agency's Science Advisory Board (SAB) conducted an independent review of the technical basis of the proposed standards. A 13-member panel, chaired by Dr. Herman Collier, met nine times between

January and October of 1983 to prepare an evaluation that was approved by the Executive Committee of the SAB and transmitted to the Administrator in February 1984[1]. In May 1984, the Agency also sought public comment on the recommendations contained in this SAB report.

Besides these formal Agency processes, three other sources of information have been particularly significant in developing the final rule. First, the states being considered for high-level and transuranic waste repository sites generally agreed that the assurance requirements were an essential part of the disposal standards, and many of them followed up their formal comments with letters from their respective Governors to the Administrator urging retention of these qualitative provisions. Second, the Waste Isolation Systems Panel (WISP) of the National Academy of Sciences (NAS) published a study on geologic disposal of high-level wastes in April 1983[2]. This report, which was referred to in several of the public comment letters, includes an extensive review and critique of many of the provisions of the proposed standards. Finally, as the Agency develops the final rule, this effort is being coordinated with those of the NRC and DOE to insure appropriate integration of the three agencies' respective authorities and responsibilities within the national program.

DEVELOPMENT OF THE FINAL RULE

Over the last year, the Agency has been evaluating all of these sources of information as it proceeds with developing a final rule. During this process, several working drafts of the standards have been made available in the public docket for this rulemaking. The latest of these, which is called "Working Draft No. 5," was dated March 21, 1985. The remainder of this paper reviews some of the provisions of this working draft; however, it must be emphasized that neither the Agency's formal review process nor the Office of Management and Budget review called for by Executive Order 12291 has been completed. Therefore, any of these provisions is subject to change before 40 CFR 191 is promulgated as a final rule.

Containment Requirements

The general structure of the containment requirements in the working draft is similar to the approach in the proposed rule. However, several specific changes have been made in response to public and SAB comments. The most important of these are changes in the radionuclide-specific release limits and in the definition of the "accessible environment" boundary at which the release limits apply.

The SAB recommended a number of technical changes in the Agency's calculations of the population risks which could result from releases of radioactivity to the environment. Many of these changes concerned areas where the SAB found particularly conservative assumptions that tended to overestimate population risks. The Agency generally agreed with these SAB recommendations and has revised the environmental pathway and health effect analyses. Therefore--while this working draft retains the same population risk objective (1,000 premature cancers over 10,000 years) used for the proposed rule--the corresponding radionuclide release limits have changed.

Table I illustrates the previous and current release limits for several key radionuclides. It should be noted that, although the trend is generally to larger release limits, the release limits for some radiionuclides have either remained constant or have decreased from those in the proposed rule. These changes do not reflect an intention to alter the stringency level of the containment requirements. Instead, they reflect improvements in the technical basis used to derive the release limits.

TABLE I

Revised Release Limits in
40 CFR 191 Containment Requirements

Selected Radionuclides	Proposed Rule	Working Draft 5
Americium-241	10	100
Americium-243	4	100
Carbon-14	200	100
Cesium-137	500	1000
Iodine-129	500	100
Plutonium-239	100	100
Radium-226	3	100
Strontium-90	80	100

The second major change in the containment requirements involves the definition of the boundary of the "accessible environment." The proposed rule defined this term to include all of the atmosphere and all land surfaces and surface waters. However, the lithosphere and any ground water included within it was defined as part of the accessible environment only when it was ten kilometers or more away from the waste placed in a disposal system. Many of the public comments received were critical of this definition, with most of these arguing that the ten kilometer distance was too large. After considering these comments and evaluating the feasibility of using a shorter distance, a boundary of not greater than two kilometers has been chosen for this working draft. This change would encourage substantially greater long-term isolation of the wastes by sharply reducing the area over which the wastes would be allowed to migrate through ground water over 10,000 years.

To assess the feasibility and potential impacts of such changes in the containment requirements, the Agency is preparing revised performance assessments of model repositories in several different geologic settings. In accordance with the SAB findings, many of the very conservative assumptions in the analyses supporting the proposed standards have been relaxed. Also, data that is more representative of sites now being considered by DOE has been used whenever possible. Even with these changes, however, the Agency believes that most of assumptions made to simply these performance assessments tend to overestimate the long-term risks that would actually be expected once information is available to support more sophisticated modelling. Thus, the Agency believes that these performance assessments probably bound the risks from geologic repositories, rather than representing "expected" values.

Figure 1 displays a preliminary summary of some of the Agency's revised performance assessments. The integrated population risks over 10,000 years from all release mechanisms are depicted for repository

systems in models of the Hanford basalt and the Palo Duro and Paradox bedded salt settings. Compliance with the engineered barrier performance requirements of NRC's 10 CFR Part 60 is assumed.

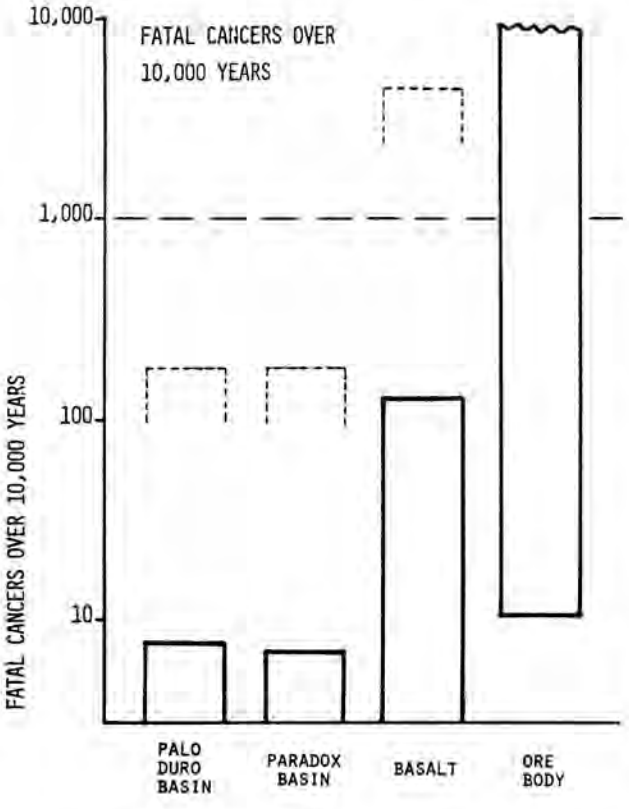

Fig. 1. Preliminary Results of Revised EPA Performance Assessments of High-Level Waste Repositories.

These risk estimates can be compared with three different benchmarks in Figure 1. First, the set of dotted lines represent the corresponding estimates from the analyses used to support the proposed 40 CFR 191[3]. The decrease in estimated risks resulting from the analytical changes recommended by the SAB is evident. Second, the revised estimates are generally near or below the lower end of the range of risks associated with the amount of uranium ore used to create the wastes if the ore had not been mined. This perspective is consistent with the analyses supporting the proposed rule even though the ore body risks have decreased because of lower risk estimates associated with radium-226. Finally, the revised repository risk estimates reinforce the Agency's view that the societal risk level associated with the proposed disposal standards is readily achievable without significant cost or programmatic impact on the national program.

Assurance Requirements

The assurance requirements in the proposed rule were a particularly contentious issue in the public comment record. As discussed above, many commenters--including the States--agreed with the Agency that these qualitative principles were an essential part of the disposal standards. On the other hand, the NRC claimed that the assurance requirements were not properly part of EPA's responsibilities and that they should be deleted from the final 40 CFR 191. Instead, the Commission argued that the issues addressed by the assurance requirements fell within its responsibility to implement EPA's generally applicable standards.

Since the comment period, the two agencies have worked closely to resolve this issue. In particular, the respective staffs have agreed on potential modifications of 10 CFR 60 that should capture the intent of the assurance requirements--revised as appropriate in response to public comments. The current plan, as reflected in the working draft of 40 CFR 191, is for the Commission to formally propose these changes to Part 60 at the same time as the Agency promulgates 40 CFR 191. In return, the final version of 40 CFR 191 would not apply the assurance requirements to NRC-licensed disposal facilities, although the assurance requirements would remain in the EPA rule to cover disposal facilities not regulated by NRC. The Commission would then proceed to finalize the revised language in Part 60 as soon as possible. Although new public comments on the Part 60 replacements to the assurance requirements would be sought, the existing strong endorsements of these qualitative principles in the 40 CFR 191 rulemaking would be provided to the Commission for its rulemaking.

With two exceptions, the revised assurance requirements to be replaced by Part 60 language are similar to those in the proposed rule. The first departure is a new provision calling for long-term monitoring that was strongly advocated by the States. Expansions of existing 10 CFR 60 provisions have been developed to reflect this principle. The second change concerns the proposed "as low as reasonably achievable (alara)" assurance requirement. In response to comments on this provision, the Agency developed alternative language focused on encouraging selection of the most protective disposal sites from the alternatives examined in accordance with the NWPA. [The engineered barrier requirements in Part 60 are felt to adequately address "alara" for those parts of disposal systems.]

The NRC staff felt that such a site-selection oriented provision would not be appropriate for 10 CFR 60. However, it was agreed that the comparisons of isolation capability it called for would fit the objectives of DOE's site selection guidelines (10 CFR 960). Therefore, all three Federal agencies cooperated to develop wording that has since been finalized as Section 3-1-5 of 10 CFR 960.

With this revision of 10 CFR 960, and upon completion of appropriate modifications to NRC's Part 60, the Agency's objective of a Federal regulatory structure that embodies all the principles of the proposed assurance requirements will be satisfied.

Ground Water Protection Requirements

Another pair of issues that received considerable attention during the comment period concerned the lack of provisions in the proposed

disposal standards to either: (1) limit exposures to individuals after disposal; or (2) provide explicit protection for ground water in the vicinity of a disposal system. In particular, the NAS review of the EPA standards criticized the lack of individual exposure limitations. The Agency's SAB recommended that stringent provisions protecting potential ground water users be included in the standards for 500 years after disposal. Throughout the several rounds of public comment, EPA sought recommendations on appropriate approaches to balance the long-term protection of both populations and individuals in a context that would not allow reliance on institutional controls to prevent unplanned exposures.

In response to these comments, the working drafts of the final rule have included a new section of "ground water protection requirements." In their latest formulation, these provisions would limit exposures to people using ground water from significant aquifers in the accessible environment to the levels allowed by the Agency's drinking water standards (40 CFR 141). These limitations would apply only to undisturbed performance of a disposal system (i.e., with no consideration of disrupting events like intrusion or faulting) and would apply for 1,000 years after disposal. Furthermore, very important sources of ground water, such as the "Class I" aquifers considered by the Agency's recently released Ground-Water Protection Strategy[4], would receive comparable protection even within the "controlled area" that denotes the "accessible environment."

Alternative Provisions for Existing Wastes

Another new section in the working drafts of the final rule has addressed the possibility that certain existing high-level and transuranic wastes may not be practically disposed of in accordance with all of the anticipated provisions of 40 CFR 191. Currently available information is not sufficient to even determine whether this possibility exists, and it certainly is not adequate to support development of appropriate alternatives. Therefore, this "alternative provisions" section merely lays out procedural requirements that the Agency must follow in order to amend these standards for any future circumstances that prove to require special consideration.

Any such revisions would have to be accomplished through the formal rulemaking process, and this new section would require that any such revisions be pursued in conjunction with public hearings and a comment period of no less than 90 days. The Agency believes that setting such procedural requirements that exceed the minimums called for by the Administrative Procedures Act is appropriate because of the important role that public involvement plays in formulating waste disposal policy.

Guidance for Implementation

Finally, the "procedural requirements" in the proposed 40 CFR 191 have been restructured as "guidance for implementation" in the working drafts of the final rule. Because the analyses needed to determine compliance with the numerical disposal standards will be both complex and uncertain, the Agency believes that it is vital to understand the context within which EPA intends the standards to be applied. The proposed procedural requirements attempted to do this, but the NRC objected that setting such requirements infringed upon its authority for implementation. However, several other commenters expressed concern that such instructions were necessary to guard against misapplication of the numerical standards.

In response, the Agency has both expanded its expression of intent and changed its status to that of an informational appendix that would be published in the Code of Federal Regulations along with the rule itself. Thus, although the implementing agencies would not be bound to follow these instructions, they would be preserved in the public record for consideration as related issues may arise.

REMAINING RULEMAKING PROCESS

All of these provisions of the final standards are now being evaluated in the final stages of EPA's regulation development review process. After this has been completed--together with any necessary modifications--and the Administrator determines that the rule is ready for promulgation, the standards will be forwarded to the Office of Management and Budget for the regulatory review called for by Executive Order 12291. Upon completion of this last review, 40 CFR 191 will be promulgated as a final rule. Although resolution of the issues associated with disposal of these wastes has often taken longer than expected, the Agency is optimistic that promulgation will be accomplished this summer.

REFERENCES

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2. NATIONAL RESEARCH COUNCIL, "A Study of the Isolation System for Geologic Disposal of Radioactive Wastes," Waste Isolation Systems Panel, Board on Radioactive Waste Management, National Academy Press, April 1983.

3. 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," Office of Radiation Programs, U.S. Environmental Protection Agency, EPA 520/1-82-025, December 1982.

4. U.S. ENVIRONMENTAL PROTECTION AGENCY, "Ground-Water Protection Strategy," Office of Ground-Water Protection, U.S. Environmental Protection Agency, August 1984.