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FOR: The Commissioners

FROM: William D. Travers
Executive Director for Operations

SUBJECT: STAFF PLAN FOR CLARIFYING HOW DEFENSE-IN-DEPTH APPLIES
TO THE REGULATION OF A POSSIBLE GEOLOGIC REPOSITORY AT
YUCCA MOUNTAIN, NEVADA

PURPOSE:

To inform the Commission of the staff's plans to more clearly address the Commission's defense-in-depth philosophy as it pertains to the proposed 10 CFR Part 63 and to the disposal of high-level radioactive wastes in a possible geologic repository at Yucca Mountain, Nevada.

SUMMARY:

This paper provides the staff's plan to address more clearly the U.S. Nuclear Regulatory Commission's (NRC's) defense-in-depth philosophy as it relates to disposal of high-level radioactive wastes. The plan describes a 6-month staff effort that includes conducting an interactive dialogue with stakeholders. The staff plan culminates with a formal response to the Commission on the implementation of defense-in-depth in the NRC's repository regulatory program on November 30, 1999, as part of the package transmitting the proposed final rule at 10 CFR Part 63. Additional milestones beyond November 30, 1999, are identified in the plan for development of more detailed guidance pending Commission approval.

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BACKGROUND:

The Staff Requirements Memorandum, issued on April 12, 1999, directed the staff to evaluate how the NRC could more clearly address repository defense-in-depth to foster a common understanding of this concept, and to inform the Commission of its findings. This paper responds to that direction and provides the staff's plan to clarify its expectations for a demonstration of defense-in-depth for a geologic repository. The staff intends to accomplish this through responses to public comments in the draft final rule for Part 63 and through development of the Yucca Mountain Review Plan (YMRP). In completing Part 63 and the YMRP, the staff will incorporate the Commission's defense-in-depth philosophy as elaborated in the White Paper on Risk-Informed and Performance-Based Regulation, issued on March 1, 1999, and has identified specific activities to involve stakeholders.

DISCUSSION:

The Nuclear Waste Policy Act of 1982 mandated that technical criteria developed by the Commission provide for a system of multiple barriers in the design of the geologic repository. To fulfill this statutory requirement, the Commission, in promulgating its generic regulations at Part 60 (final rule published on June 21, 1983), specified three numerical subsystem performance objectives for repository performance after closure:

- 1) The length of time radionuclides should be contained in the waste packages (300-1000 years);
- 2) The rate of subsequent releases from the engineered system (one part in 100,000 per year of the inventory present at 1000 years after permanent closure); and
- 3) The pre-emplacement ground-water travel time to the accessible environment (at least 1000 years).

Under Part 60, demonstrating compliance with these numerical objectives would constitute compliance with the multiple barrier provision.

In proposing revisions to these objectives in the proposed Part 63¹, 15 years after Part 60 was promulgated, the staff noted that risk-informed, performance-based regulation of geologic disposal, together with advances in performance assessment methods, called for reexamining the imposition of specific numerical subsystem requirements as was done in Part 60. Further, it should be noted that the National Academy of Sciences (NAS) report on the "Technical Bases for Yucca Mountain Standards," published in 1995, opposed the inclusion of subsystem performance objectives. To maintain the Commission's defense-in-depth philosophy, but avoid incorporation of numerical subsystem performance objectives in its site-specific regulation, the staff recommended (SECY-97-300), and the Commission accepted, a proposed regulatory approach that includes assessment of repository barrier performance, without specifying numerical goals for subsystem performance.

¹A comprehensive review of the Commission's consideration of multiple barriers and "defense-in-depth" for Part 63 was provided as Attachment 3 to SECY-97-300, "Proposed Strategy for Development of Regulations Governing Disposal of High-Level Radioactive Wastes in a Proposed Repository at Yucca Mountain, Nevada."

Such an approach will require the U.S. Department of Energy (DOE) to provide greater transparency of how multiple barriers contribute to overall performance, and associated uncertainty. The approach does not require compliance with separate performance objectives for individual barriers that are unrelated to the U.S. Environmental Protection Agency standards. As proposed at Part 63.114, DOE must:

- 1) Identify the design features of the engineered barrier system (e.g., waste package, backfill), and natural features of the geologic setting (e.g., unsaturated zone, saturated zone), that are considered barriers important to waste isolation (63.114(h));
- 2) Describe the capability of barriers, identified as important to waste isolation, to isolate wastes, taking into account uncertainties in characterizing and modeling the barriers (63.114(i)); and
- 3) Provide the technical basis for the description of the capability of barriers, identified as important to waste isolation, to isolate waste (63.114(j)).

The staff believes that these requirements for multiple barriers, when combined with requirements for active and passive institutional control, are sufficient to provide for defense-in-depth for post-closure repository performance². However, the staff anticipated that comments would be received on the requirements for defense-in-depth in the proposed Part 63, because they represent a substantially different approach from that taken in Part 60.

In the statement of considerations for the proposed rule, the staff noted that, in parallel with the rulemaking, staff was developing review guidance in the form of a YMRP. The purpose of these statements was to recognize the need to develop additional guidance on how to evaluate compliance with these requirements. Also noted in the proposed rule was the fact that the staff was considering a number of approaches to evaluating DOE's license application including, but not limited to: (1) sensitivity analyses; (2) modeling the behavior of individual barriers; (3) quantifying how individual barriers contribute to performance; and (4) delineating the capability of barriers to isolate waste. Although various approaches exist for aiding the definition of the capability of individual barriers to isolate waste, the identification of which approach or combination of approaches is acceptably transparent in defining the waste isolation attributes of the repository system, without placing undue or non-productive burdens on DOE, is inherently complex. Consequently, developing a common understanding of these complex issues within a risk-informed, performance-based framework will require considerable deliberation and interaction with stakeholders. Therefore, to facilitate development of a common understanding on an acceptable approach(es), the staff has planned a program that includes substantial stakeholder involvement.

The staff's plan focuses on developing detailed guidance for conducting its review of a geologic repository at Yucca Mountain in the YMRP. Interaction with the DOE, the Advisory Committee on Nuclear Waste (ACNW), the Office of Nuclear Reactor Regulation, the Office of Nuclear

²It is expected that defense-in-depth for pre-closure operations would be achieved in a manner similar to that for other operating nuclear facilities.

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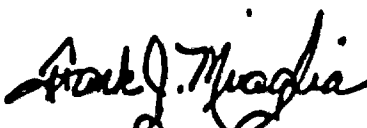
Regulatory Research, the State of Nevada and Affected Units of Local Government, possibly the Joint Advisory Committee on Reactor Safeguards (ACRS)/ACNW Subcommittee on Risk-Informed Regulation in NMSS, and other stakeholders will occur as the YMRP is developed. The staff intends to include the annotated outline of the review plan when the proposed final Part 63 is submitted to the Commission.

RESOURCES:

The activities described above are part of the efforts to finalize Part 63 and complete Rev. 0 of the YMRP in FY1999 and beyond. Resources to accomplish these activities are included in the current budget.

COORDINATION:

The Office of the General Counsel has reviewed this paper and has no legal objection. The Office of the Chief Financial Officer has reviewed this paper for resource implications and has no objection.


for William D. Travers
Executive Director
for Operations

Attachment: As stated

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STAFF APPROACH TO CLARIFYING DEFENSE-IN-DEPTH FOR THE POSSIBLE GEOLOGIC REPOSITORY AT YUCCA MOUNTAIN, NEVADA

WHAT ARE THE UNDERLYING BASES FOR IMPLEMENTING DEFENSE-IN-DEPTH?

- The Commission's "White Paper on Risk-Informed and Performance-Based Regulation," (issued on March 11, 1999) defined the concept of defense-in-depth as follows:

Defense-in-depth is an element of the NRC's Safety Philosophy that employs successive compensatory measures to prevent accidents or mitigate damage if a malfunction, accident, or naturally caused event occurs at a nuclear facility. The defense-in-depth philosophy ensures that safety will not be wholly dependent on any single element of the design, construction, maintenance, or operation of a nuclear facility. The net effect of incorporating defense-in-depth into design, construction, maintenance, and operation is that the facility or system in question tends to be more tolerant of failures and external challenges.

- The Proposed 10 CFR Part 63:

As reflected in the statement accompanying proposed 10 CFR Part 63, DOE will demonstrate that the natural barrier and the engineered barrier system will work in combination to enhance overall performance of the repository.

In Part 63, a barrier is defined as any material or structure that prevents or substantially delays movement of water or radioactive materials.

Requirements in Part 63 are that the U.S. Department of Energy (DOE) must: 1) identify those design features of the engineered barrier system, and natural features of the geologic setting, that are considered barriers important to waste isolation (e.g., waste package, drip shield, unsaturated zone limiting moisture flux, and saturated zone retarding radionuclide migration); 2) describe the capability of these barriers to isolate waste, taking into account uncertainties in characterizing and modeling the barriers; and 3) provide the technical basis for the description of the capability of these barriers.

HOW WILL STAFF CLARIFY ITS EXPECTATIONS FOR DEMONSTRATING MULTIPLE BARRIERS?

- Based on public comments, we will consider refining regulatory requirements, as needed, to show that multiple barriers are acceptably covered by 10 CFR Part 63 (described under the second bullet under "Proposed 10 CFR Part 63"). However, the goal of avoiding imposition of numerical subsystem performance objectives will be maintained.
- We will describe an acceptable approach(es) for demonstrating the capabilities of multiple barriers to isolate waste in the Yucca Mountain Review Plan (YMRP). Specific

quantitative approaches that will be considered include, but are not limited to sensitivity analyses, importance analysis, and presentation of intermediate modeling results (e.g., model results that are calculated in support of dose estimates such as waste package lifetime).

WHEN AND HOW WILL CLARIFICATIONS BE MADE AVAILABLE TO STAKEHOLDERS?

- We have presented information on the defense-in-depth regulatory requirements in Part 63 at the DOE/U.S. Nuclear Regulatory Commission (NRC) Technical Exchange (public meeting) on May 26, 1999. The DOE is currently working on approaches to meeting the multiple barriers requirements in Part 63 and presented some of their ideas at the technical exchange.
- We will coordinate with the Advisory Committee on Nuclear Waste (ACNW) on this topic, as we did in briefing the Committee in June of this year on this plan. We will also coordinate with the Offices of Nuclear Reactor Regulation and Nuclear Regulatory Research, and the Joint ACRS/ACNW Subcommittee on Risk-Informed Regulation in NMSS.
- We will hold a public meeting in Las Vegas. In the meeting, we will further clarify the requirements of Part 63 by: 1) discussing our proposed resolution of public comments on defense-in-depth; and 2) presenting example calculations that demonstrate the effectiveness of multiple barriers.
- Based on these interactions, we will finalize guidance in Rev. 0 of the YMRP, due to be completed in March 2000.

WHAT IS THE SCHEDULE OF PLANNED ACTIVITIES FOR CLARIFYING REPOSITORY DEFENSE-IN-DEPTH?

Activity	Completion Date	Purpose
1. DOE/NRC Total System Performance Assessment Technical Exchange at the Center for Nuclear Waste Regulatory Analyses	May 26 - 27, 1999	Preliminary discussion with DOE on the proposed regulatory requirements for multiple barriers (other stakeholders present as observers)
2. Concept Paper on Defense-in-Depth (this Commission Paper)	July 2, 1999	To present the staff's plan for the repository defense-in-depth concept as proposed in Part 63 (in response to the SRM dated April 12, 1999)

Activity	Completion Date	Purpose
3. Presentation to the ACNW	June 28 - 30, 1999	To brief the ACNW on the staff's proposed plan for clarifying the acceptance criteria and review plans for the license application
4. Interactions with the Office of Nuclear Reactor Regulation, Office of Nuclear Regulatory Research, and possibly Joint ACRS/ACNW Subcommittee on Risk-Informed Regulation	July/August 1999	To ensure an appropriately consistent approach for risk-informed and performance-based requirements
5. Meetings with DOE and Public Meetings on Repository Defense-in-Depth in Nevada	August/September 1999	To solicit comments on the staff's approach to repository defense-in-depth; to present possible technical approaches
6. Total System Performance Assessment and Integration Issue Resolution Status Report	September 30, 1999	To provide preliminary draft guidance on possible technical approaches to demonstrate repository design meets applicable regulatory requirements. This guidance will become part of the Yucca Mountain Review Plan (YMRP) or be referenced by the YMRP.
7. Presentation to ACNW	September (after public comment period is over, but before Part 63 is finalized)	To brief the ACNW on staff's proposed positions and strategies on addressing public comments and on the annotated outline of the YMRP
8. Draft final 10 CFR Part 63 to Commission along with Annotated Outline of YMRP	November 30, 1999	To finalize the rule and summarize the approach to defense-in-depth in the YMRP
9. Public meetings in Nevada after finalizing Part 63	January 2000	To present and clarify the final Part 63 and the YMRP, including the requirements for repository defense-in-depth
10. Interactions with DOE	January 2000	To present and clarify the final Part 63 and the YMRP, including requirements for repository defense-in-depth

Activity	Completion Date	Purpose
11. YMRP Rev. 0 (postclosure only)	To the Commission March 31, 2000	To submit to the Commission a risk-informed performance-based YMRP which includes technical guidance and acceptance criteria for conducting the review
12. Future Revisions of YMRP	September 30, 2000; September 30, 2001	To update the YMRP on an annual basis. The last revision would be published 6 months before the current expected Yucca Mountain License Application submission date (March 1, 2002).