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U.S. Nuclear Regulatory Commission  
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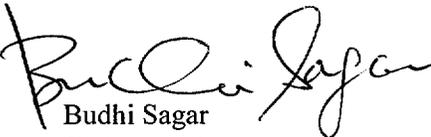
Subject: Programmatic review of an abstract

Dear Mrs. DeMarco:

Enclosed is a paper entitled "A Risk-Informed, Performance-Based High-Level Waste Review Plan," to be presented at the IHLRWM Conference on April 29–May 2, 2001, in Las Vegas, Nevada. The paper describes staff plans to prepare guidance for a licensing review for the proposed repository at Yucca Mountain, Nevada. Development of risk-informed, performance-based review methods and acceptance criteria is stressed. Recognizing that 10 CFR Part 63 must be promulgated before the review plan can be published, the paper is written to reflect staff intentions for review plan development. Please advise me of the results of your programmatic review, so that we can submit the paper for publication in a timely manner.

If you have any questions regarding this paper, please feel free to contact Pat Mackin at (210) 522-5054.

Sincerely yours,

  
Budhi Sagar  
Technical Director

BS/PCM/lis  
Enclosure

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## **A RISK-INFORMED, PERFORMANCE-BASED HIGH-LEVEL WASTE REVIEW PLAN**

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**Jeffrey Ciocco—U.S. Nuclear Regulatory Commission**

**David Turner—CNWRA**

### **INTRODUCTION**

Geologic disposal of high-level radioactive waste (HLW) requires a U.S. Nuclear Regulatory Commission (NRC) license. The Yucca Mountain Review Plan (YMRP) will be guidance to the NRC staff for a consistent and high-quality review of any U.S. Department of Energy (DOE) license application for an HLW repository. The Commission has directed staff to implement risk-informed, performance-based (RIPB) regulatory programs. Proposed regulations for HLW disposal are RIPB because risk of health effects measured in terms of mean annual dose to the average member of a critical group is one of the postclosure performance objectives in those regulations. Preclosure performance objectives are also based on radiation dose limits. NRC will base its licensing decision on whether the DOE safety case demonstrates compliance with the performance objectives, thereby implementing an RIPB regulatory approach.

The YMRP will have sections for review of general information, preclosure repository safety, postclosure repository safety, the research and development program to resolve safety questions, the performance confirmation program, and administrative and programmatic requirements. Each YMRP section will contain areas of review, review methods, acceptance criteria, evaluation findings, and references. The YMRP structure is presented in figure 1.

### **WORK DESCRIPTION**

The staff is using five principles in developing the YMRP. The first is to follow Commission guidance to implement RIPB regulatory programs. Second, the YMRP will reflect the difference between NRC and DOE responsibilities for HLW disposal: DOE must demonstrate the adequacy of its

safety case, and NRC staff must justify its review findings. Third, regulations governing HLW disposal and the associated review plan will be RIPB. Fourth, the YMRP will facilitate a total system, technically integrated licensing review. Finally, the YMRP will incorporate knowledge gained during the preclicensing period and avoid unnecessarily prescriptive acceptance criteria.

The following paragraphs describe how each major YMRP section will incorporate RIPB principles.

#### **Review of General Information**

Guidance for review of the general information section of the license application, which will contain overview material, is provided in this section of the YMRP. Review of the physical protection plan and material control and accountability sections will be based on existing, successful NRC regulatory programs, and no new RIPB principles will be incorporated in these sections.

#### **Review of Repository Safety Prior to Permanent Closure**

The review of the preclosure safety analysis will evaluate DOE's demonstration of compliance with preclosure performance objectives to limit radiation doses to workers and the public. DOE will demonstrate compliance using a preclosure safety analysis. The preclosure safety analysis will systematically examine the site; design; and potential hazards, initiating events, event sequences, and potential dose consequences to workers and the public. The preclosure safety analysis will consider the probabilities and uncertainties of potential hazards. The preclosure review will focus on DOE's demonstration that repository design, construction, and operation will meet the performance objectives (exposure limits). The staff will emphasize review of high safety/risk significant structures, systems, and components (SSCs) that have been determined to be important to safety. DOE will define event sequences, and these human-induced and natural event sequences will be used to calculate consequences of potential failures of SSCs in terms of radiation doses. These calculated doses will be compared to allowable doses to establish the importance of SSCs. The SSCs that must be functional for compliance

with the performance objective dose limits will be identified as SSCs important to safety. The rigor of review for SSCs important to safety will depend on relative safety/risk significance. No prescriptive design criteria will be imposed in the YMRP, because proposed regulations allow DOE to develop design criteria and demonstrate their appropriateness. Thus, YMRP acceptance criteria will allow DOE flexibility to use any codes, standards, and methodologies it can demonstrate to be applicable and appropriate. The RIPB review process will focus on determining compliance with performance objectives as demonstrated by DOE's preclosure safety assessment.

Review methods and acceptance criteria for review of plans for retrieval and alternate storage of radioactive wastes will also allow DOE flexibility in demonstrating compliance—an RIPB approach.

The acceptance criteria for review of plans for permanent closure and decontamination, or decontamination and dismantlement of surface facilities will prescribe only that features incorporated into the design that may facilitate permanent closure be described. The YMRP will also reference review guidance for NRC decommissioning plans which is being developed consistent with RIPB regulation.

#### **Review of Repository Safety After Permanent Closure**

DOE will conduct a performance assessment to demonstrate compliance with postclosure performance objectives (radiation exposure limits based on radiation health effects). A performance assessment systematically analyzes what can happen, its likelihood, and its consequences. The staff will review the DOE performance assessment by using risk information to focus on those items most important to performance. The staff will examine the DOE identification of natural and engineered barriers important to waste isolation. The staff will also use risk insights from previous performance assessments for the Yucca Mountain site, detailed process-level modeling efforts, laboratory and field experiments, and natural analog studies to support its review. The staff will then evaluate the DOE scenario analysis to confirm that it considers the risk information for identified barriers and includes the identification, classification, screening, and construction of scenarios from the features, events, and

processes of the Yucca Mountain site. Finally, the performance assessment review will examine information on the important model abstractions. The important abstractions were identified from engineered, geosphere, and biosphere subsystems shown to be most important to performance based on previous performance assessments and knowledge of site characteristics and repository design. Since it is unlikely that each of the model abstractions will have equal safety/risk significance, the staff review will emphasize those with the greatest risk to repository performance (i.e., important to meeting the radiation exposure performance objective).

This sequence of review provides for risk information to (i) be assessed at a general level (identification of important barriers), (ii) focus specific reviews (scenarios and model abstractions), and (iii) support evaluation of compliance with the overall performance objective and with reliance on multiple barriers.

#### **Review of Research and Development Program to Resolve Safety Questions**

The review of the DOE research and development program for resolving safety questions will apply to SSCs important to safety and to engineered or natural barriers important to waste isolation. The DOE program must identify, describe, and address safety features or components that require further information to confirm the adequacy of design. This will be an RIPB review because it will focus on those items most important to safety or waste isolation.

#### **Review of Performance Confirmation Program**

The review of the performance confirmation program will examine DOE's program of tests, experiments, and analyses to verify the information used to demonstrate compliance with the performance objectives. A performance confirmation program is necessary due to uncertainties in estimating repository performance over thousands of years. This review will be RIPB because it will focus on parameters and engineered and natural barriers important to performance.

## **Review of Administrative and Programmatic Requirements**

Proposed regulations provide no performance objectives for the administrative and programmatic requirements section of the YMRP. Existing successful NRC regulatory programs will be the basis for acceptance criteria and review methods in this section. In developing this section, the staff is considering the expected operations and associated risks, while taking advantage of opportunities to limit prescriptive requirements. The quality assurance program section of the YMRP will contain review methods and acceptance criteria to support a review of either a graded or nongraded program. The staff will conduct an RIPB review for a graded quality assurance program if one is proposed by DOE. The review provisions for the other programmatic and administrative requirements sections will be nonprescriptive, referencing other NRC guidance documents where appropriate, but not specifying the standards or practices DOE must use to demonstrate compliance. Rather, these sections will require DOE to (i) identify any standards, programs, and procedures that will be used; (ii) demonstrate that those standards, programs, and procedures are appropriate; and (iii) commit to implement them properly. In most cases, DOE has not yet committed to specific administrative and programmatic procedures, and the level of detail in these sections of the YMRP will be minimal. Existing NRC guidance will be identified in the YMRP, but selection of the compliance demonstration approach will be a DOE responsibility.

## **CONCLUSIONS AND DISCUSSION**

Implementing RIPB regulations requires a clear separation of the responsibilities of the regulator and the license applicant. NRC's responsibility is to justify its licensing decision rather than to define prescriptive acceptance criteria that DOE must meet. DOE has flexibility in making its safety case provided it demonstrates compliance with regulatory requirements. The YMRP is being prepared with deliberate adherence to this approach. NRC will use those aspects of the repository that are most important to safety or to waste isolation to focus its licensing review and to evaluate whether the performance objectives have been met.

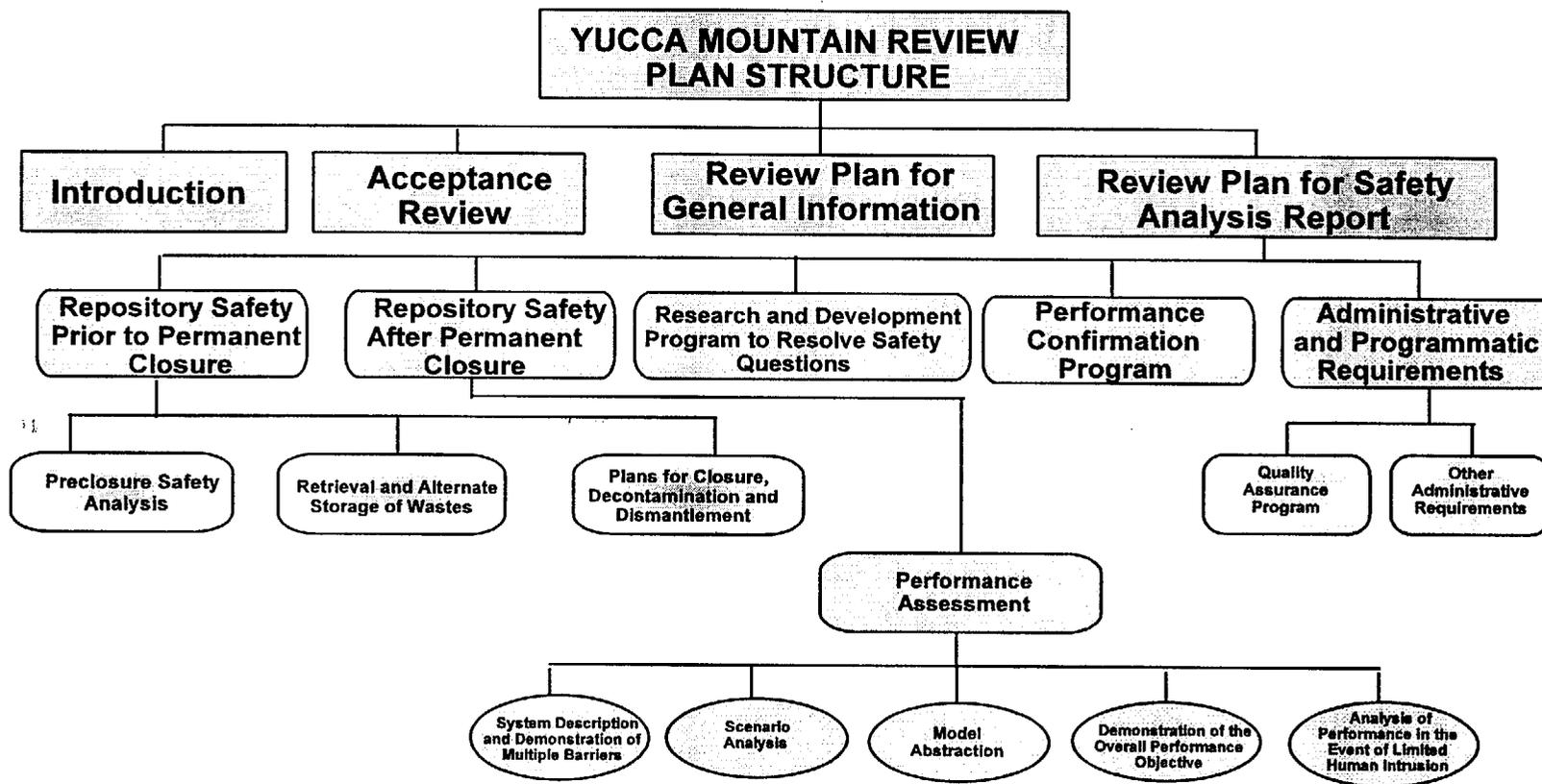


Figure 1. Structure of the Yucca Mountain Review Plan