COMPLIANCE DETERMINATION STRATEGY

RR0005 - SHAFTS AND RAMPS DESIGN

PRIMARY REGULATORY CITATION:

None

PASS ID OF THE COMPLIANCE DETERMINATION STRATEGY:

RR0005/NS0001

TYPES OF REVIEW:

Acceptance Review (Type 1)
Safety Review (Type 3)

RATIONALE FOR TYPES OF REVIEW:

Acceptance Review (Type 1) Rationale:

This regulatory requirement is considered to be License Application-related because, as specified in the License Application content requirements of 10 CFR 60.21 and the Format and Content Regulatory Guide U.S. NRC, 1990, it must be addressed by the DOE in its license application. Therefore, the staff will conduct an Acceptance Review of the License Application for this Regulatory Requirement.

Safety Review (Type 3) Rationale:

This regulatory requirement is related to radiological safety and waste isolation. Because this requirement is in 10 CFR Part 60, Subpart E, it is a requirement for which compliance is necessary to make a safety determination for construction authorization as defined in 10 CFR 60.31 (i.e., regulatory requirements in Subparts E, G, H, I and 10 CFR 60.21). Therefore, the staff will conduct a safety review of the license application to determine compliance with the regulatory elements of proof for the regulatory requirement.

There appears to be no lack of certitude as to the methodology needed to determine or demonstrate compliance with the preclosure regulatory requirements on the design of shafts and ramps for the geologic repository operations area (GROA). Factors considered in making this determination include the nature of the Yucca Mountain tuff and the available drilling and boring technologies. Therefore, the safety review for the preclosure portion of this requirement will be a Type 3 Review.

Review of the post-closure portion of this requirement, however, demands consideration of the performance of seals (and backfill materials) for shafts, ramps and boreholes, and the impact of repository-generated thermal loads on the long-term performance of these repository features. For example, in order to have confidence in applying current sealing

technology to the repository environment, two technical uncertainties relevant to the effectiveness and performance of seals remain to be resolved. These uncertainties are: (1) whether the seals will remain effective over thousands of years (seal long-term performance), and (2) whether technology exists to effectively install seals such that the intended performance of seals can be achieved.

Experience on long-term performance of seals is currently lacking. Although available observations of the performance of some seal materials (for example, low permeability cements) seem to indicate that these components may have great durability (Refs. 2 and 3), it is also uncertain what impact thermal loads will have on their performance. Also, other observations (Refs. 4 and 5) about deterioration of high quality cement grouts in dam foundations within a decade after installation seem to indicate otherwise. Considerable uncertainty exists related to the installation of seals in the underground excavations (Ref. 6). This is especially true in the areas of optimum grouting conditions and preferable grouting pressures to seal fractures around the excavations due to construction to prevent the fractured zone around the excavations from becoming dominant bypass flowpaths around the seals and thereby negating the effectiveness of the seals. At the present time, the net contribution of seals to the overall system performance of the geologic repository is yet to be established. However, preliminary assessments by the U.S. Department of Energy (DOE), based on the current knowledge of the site and simplified analyses, is that the contribution of seal performance to overall system performance of the geologic repository may not be significant (Fernandez, 1991; and U.S. Department of Energy, 1988). Therefore, the technical uncertainties mentioned above do not appear to pose a risk of noncompliance with the performance objectives based on current knowledge and, as a result, are not considered key-technical uncertainties.

Accordingly, a Type 3 Review has also been selected for the post-closure portion of this requirement based on the following assumptions:

(1) the impacts of repository-generated thermal loads on the long-term performance of seals and backfill materials will be evaluated as part of the review of compliance with the pertinent performance objectives; and

(2) that DOE preliminary assessments, that the net contribution of seals to overall system performance is negligible, will be substantiated.

Ongoing research associated with thermal loading is expected to address performance of seals for shafts and boreholes and backfill. If future research or site studies indicate that uncertainties regarding seal performance or the relative effects of thermal loads cannot be adequately bounded, the strategy for compliance determination will be revised so that a finding regarding the adequacy of shaft and borehole seals can be made with reasonable assurance.

REVIEW STRATEGY:

Acceptance Review (Type 1):

In conducting the acceptance review of the shafts and ramps design, the reviewer should determine if the information presented in the license application and its references for demonstrating compliance with the requirement is complete in technical breadth and depth as identified in U.S. NRC, 1990. The license application and its references should include all appropriate information necessary for the staff to review the potential for creating preferential pathways for either (1) the inward movement of water and water vapor to contact the waste packages or (2) the outward migration of radionuclides through shafts, ramps and boreholes to the accessible environment. In addition, the license application should include an assessment demonstrating that the design does not compromise the ability of the geologic repository to meet the performance objectives for the period following permanent closure (i.e., 10 CFR 60.112 and 60.113(a)) and for the period before permanent closure (i.e., 10 CFR 60.111(a) and 60.111(b)).

The information in the license application should be presented in a manner such that the assumptions, data, and logic leading to a demonstration of compliance with the requirement are clear and do not require the reviewer to make extensive analyses and literature searches. The reviewer should also determine that controversial information and appropriate alternative interpretations and models have been adequately described and considered.

Finally, the reviewer should determine if DOE has either resolved all the NRC staff objections to the license application that apply to this requirement or provided all the information requested in Section 1.6 of U.S. NRC, 1990, for unresolved objections. The reviewer should evaluate the effect of any unresolved issues, both individually and in combinations with others, on (1) the reviewer's ability to conduct a meaningful and timely review and (2) on the Commission's ability to make a decision regarding construction authorization within the three-year statutory period.

Safety Review (Type 3):

In conducting the safety review, the reviewer will, as a minimum, determine the adequacy of the data and analyses presented in the license application to determine DOE's compliance with this regulatory requirement. In general, the reviewer will assess the adequacy of DOE's analyses of the design of shafts and ramps with respect to the performance objectives.

Of primary interest is the performance of the seals for shafts, ramps and boreholes. For determining compliance with other regulatory requirements, it is expected that current technology is sufficient. The reviewer will assess the adequacy of DOE's evaluation of the degree to which the shafts and ramps and their seals may be preferential pathways for the movement of groundwater to contact the waste packages, as specified in 10 CFR

60.134(b)(1). DOE's evaluation should include a demonstration that the degree to which groundwater movement is impeded by the shafts and ramps and their seals and backfill is equal to or greater than the degree to which groundwater movement is impeded by the undisturbed geologic setting. DOE's evaluation of the design of seals for shafts and boreholes should also demonstrate that, following permanent closure, the seals do not become pathways that compromise the geologic repository's ability to meet the performance objectives, per 10 CFR 60.134(a). In addition, DOE must demonstrate that the materials and placement methods for seals for shafts, ramps, and boreholes must reduce to the extent practicable radionuclide migration through existing pathways, as specified in 10 CFR 60.134(b)(2). Factors which should be considered are methods of construction and the dimensions and properties of the resulting disturbed zone along with materials and placement methods for seals. Also, if the seals for shafts, ramps, and boreholes are made much better than the adjacent geologic media, any potential negative effects of low permeability zones in the presence of high permeability zones of the geologic setting should be investigated.

Other design criteria, which derive from citations in 10 CFR Part 60 other than 10 CFR 60.134, result in acceptance criteria generally related to ensuring that performance objectives will be met. The reviewer should determine compliance with these other design criteria from the perspective of the design of shafts and ramps. For example, for determining compliance with 10 CFR 60.130, the reviewer will determine that the design includes any safety features needed to achieve the 10 CFR Part 60 performance objectives. For determining compliance with 10 CFR 60.131(a) and 10 CFR 60.131(b), the reviewer will determine that the shafts and ramps designs meet the general design criteria for the GROA, respectively. For 10 CFR 60.137, the reviewer will determine whether or not the shafts and ramps designs will permit the implementation of the performance confirmation program.

Those specific aspects of the license application on which a reviewer will focus are discussed in U.S. NRC, 1990, and the detailed acceptance criteria will be identified in Section 3.0 of this review plan.

In order to conduct an effective review, the reviewer will rely on his or her own expertise and independently acquired knowledge, information, and data in addition to that provided by the DOE in its license application. Therefore, it is incumbent upon the reviewer to have acquired a body of knowledge regarding critical considerations in anticipation of conducting the safety review.

The information in this section of the license application will be cross-referenced to information and analyses submitted for the sections 60.111(a) [Protection Against Radiation Exposure and Releases of Radioactive Material], 60.111(b) [Retrievability of Waste], 60.112 [Overall System Performance Objective After Permanent Closure], and 60.113 [Engineered Barrier System Performance After Permanent Closure].

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Date of Analyses: 08/20/92

RATIONALE FOR REVIEW STRATEGY (OPTIONAL):

Not applicable.

APPLICABLE REGULATORY ELEMENTS OF PROOF:

Type 3:

REOP

RR0005/EP0100
RR0005/EP0200
RR0005/EP0300
RR0005/EP0400
RR0005/EP0500

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