

COMPLIANCE DETERMINATION STRATEGY

RR2002 POTENTIALLY ADVERSE CONDITION -- FLOODING [10 CFR 60.122(c)(1)]

PRIMARY REGULATORY CITATION:

10 CFR 60.21(c)(1)(ii)(B)

PASS ID OF THE COMPLIANCE DETERMINATION STRATEGY:

RR2002/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 - DG-3003 (NRC, 1990), it must be addressed by 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 (Technical Criteria), 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 elements of proof for the regulatory requirement.

For this potentially adverse condition (PAC), flooding of the underground repository and the possible effects on waste isolation are primarily preclosure concerns as discussed in the Statements of Consideration for the final rule (48 FR 28212). PAC's related to postclosure flooding of the underground repository are addressed by 10 CFR 60.122(c)(2) & (3) for manmade and natural effects, respectively. The Statements of Consideration for the final rule also suggest that the facility be designed to preclude massive inflows of water. Flooding from a surface water source through unsealed boreholes and shafts could easily result in massive inflows of water to the repository.

At Yucca Mountain, the effect of preclosure flooding on waste isolation is not as pronounced as it may be for other potential repository sites. In

a salt repository, for example, massive inflows of water could result in dissolution of the host rock; causing problems with waste retrieval and eventually, problems with isolating the unretrieved waste. In the welded tuff at Yucca Mountain, extensive flooding is more likely to result in increased moisture levels and a possible perched water table. However, these effects could still reduce the confidence in the waste isolation capability of the geologic setting.

Conceivable postclosure sources of surface water which could induce flooding of the repository will be investigated as part of the analyses for other PACs and parts of the regulation. One such source is surface water ponding coupled with failure of borehole and/or shaft seals. Postclosure ponding, if it occurs, would be the result of natural processes such as erosion and deposition (10 CFR 60.122(c)(16) and 60.122(c)(122)(b)(5), respectively); geologic phenomena such as landslides, subsidence, and volcanism (10 CFR 60.122(c)(3)); or human activities such as construction of surface impoundments (10 CFR 60.122(c)(2)). The adequacy of the design of seals for shafts and boreholes will be part of the review for 10 CFR 60.134.

The general design criteria in 10 CFR 60.134 require that "Seals for shafts and boreholes shall be designed so that following permanent closure they do not become pathways that compromise the geologic repository's ability to meet the performance objectives for the period following permanent closure." Another possible source of postclosure surface water related to repository flooding is surface ponding coupled with enhanced infiltration through fractures or other pathways. Evaluation of the PACs dealing with unusual rock or groundwater conditions (10 CFR 60.122(c)(20)), water table rise (10 CFR 60.122(c)(22)), and future perched water bodies (10 CFR 60.122(c)(23)) will address the likelihood of enhanced infiltration of ponded surface water. However, DOE is expected to minimize the potential for postclosure flooding through the siting of boreholes and shafts, and adequate seal design.

A review of the topography of the Yucca Mountain site indicates that flooding from extreme rainfalls will, at most, be limited to small portions of the site. Therefore, the degree to which flooding is present, as a potential adverse condition, is dependent on the locations chosen for shafts and access openings. A review of the region in which the site is located also indicates that there are no manmade surface water impoundments, the failure of which, could impact the site or waste isolation within the controlled area.

A conventional analysis of flood flows and levels in on-site channels for floods up to the probable maximum flood (PMF) can be expected to meet the intent of the requirements. The fact that the flooding analysis will be tied to the engineering design for preclosure operations rather than the overall performance assessment eliminates the need to determine probabilities for extremely rare floods (beyond the PMF). The conservatism inherent in standard flood determination procedures and design criteria will also assure that the requirements are met.

If the applicant chooses to depend on engineered protection to prevent flooding of shafts and access openings, the review may require a Type 4 review to address debris transport including the likelihood of increased water levels due to debris transport and deposition. This part of the analysis would primarily support the demonstration of compliance with the requirements in 10 CFR 60.133. Input to overall performance assessment from the analysis of this PAC is not expected.

In summary, selecting a Type 3 review is based on the following assumptions:

- (1) The applicant will probably choose to show compliance with this regulatory requirement by locating shafts and openings out of flood-prone areas of the site;
- (2) No unusual engineered protection will be relied on, and debris transport and damming effects will be conservatively accounted for or minimized in the design; and
- (3) Postclosure sources of surface water-induced flooding of the repository will be evaluated within other PAC's and regulatory requirements.

REVIEW STRATEGY:

Acceptance Review (Type 1):

In conducting the acceptance review of this PAC [Flooding -- 10 CFR 60.122(c)(1)], the reviewer should determine whether the information presented in the license application and its references for demonstrating compliance with the flooding PAC requirement is complete in technical breadth and depth as identified in DG-3003 (NRC, 1990). All appropriate information necessary for the staff to review the likelihood and effect of flooding on site performance should be presented.

The information in the license application and references should be presented in a manner such that the 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 NRC staff objections to the license application that apply to this requirement or provided all the information requested in Section 1.6 of DG-3003 for unresolved objections. The reviewer should evaluate the effect of any unresolved objections, both individually and in combination with others, on: (1) the reviewer's ability to conduct a meaningful and timely review; and (2) the Commission's ability to make a decision regarding construction authorization within the three-year statutory time period.

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Safety Review (Type 3):

In conducting the safety review, the reviewer will, as a minimum, determine the adequacy of data and analyses presented in the license application to determine DOE's compliance with the PAC for flooding (10 CFR 60.122(c)(1)). Specifically, DOE will need to: (1) provide information to determine whether and to what degree the PAC is present; (2) provide information to determine to what degree the PAC is present, but undetected; (3) assure the sufficiency of the lateral and vertical extent of data collection; and (4) evaluate the information presented under the first two items above, with assumptions and analysis methods that adequately describe the presence of the PAC and ranges of relevant parameters. For this PAC, the above items can be satisfied by proper site and facility characterization, calculation of the design basis flood, and determination of water levels and velocities. Guidance for such determinations is presently provided in nuclear power reactor Standard Review Plan sections 2.4.1, 2.4.2, and 2.4.3 (NRC, 1981); Regulatory Guide 1.59 (NRC, 1977); and ANS 2.8-1981 (ANS, 1981).

The first step in the NRC review will be to evaluate the DOE analysis to determine if the basic assumptions contained in the type, selection rationale have been met. These are:

- (1) The applicant will locate shafts and openings out of flood-prone areas; and
- (2) No unusual engineering protection will be relied on, and debris transport and damming effects will be conservatively accounted for or minimized in the design; and
- (3) That postclosure flooding of the underground repository has been adequately addressed by the applicant in response to other regulatory requirements.

If these assumptions are met, the review will consist primarily of evaluating calculated flows and water levels and verifying that the flood-prone areas of the site are properly delineated. If these assumptions are not met, the review may require independent confirmation of hydraulic calculations, including debris transport.

Reviews of DOE models will be required in either case. A model review should consist of: (1) a determination that the quantitative hydraulic models chosen are appropriate (for example, steady vs. unsteady flow); (2) a check of input data to confirm that they are representative of the site; (3) confirmation that DOE models reflect the natural system; (4) assurance that assumptions used are valid and applicable to the site; and (5) determination that the conclusions presented are consistent with the model outputs. At the reviewer's discretion, simple confirmatory calculations may be performed using appropriate procedures. Finally, a brief site visit will allow the staff to verify that DOE's analyses accurately reflect the conditions at the site.

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Contributing Analysts:

NRC Staff: Rex G. Wescott

CNWSA Staff: Gordon Wittmeyer

Date of Analysis: 06/04/92

RATIONALE FOR REVIEW STRATEGY (OPTIONAL):

Not applicable.

APPLICABLE REGULATORY ELEMENTS OF PROOF:

Type 3:

REOP

RR2002/EP0100

REFERENCES CITED:

American Nuclear Society, "Determining Design Basis Flooding at Power Reactor Sites," ANSI/ANS-2.8-1981, 1981.

Nuclear Regulatory Commission, "Design Basis Floods for Nuclear Power Plants," Office of Standards Development, Regulatory Guide 1.59 (Rev. 2), August 1977.

Nuclear Regulatory Commission, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants (Rev. 2)," Office of Nuclear Reactor Regulation, NUREG-0800, July 1981.

Nuclear Regulatory Commission, "Disposal of High-Level Radioactive Wastes in Geologic Repositories: Final Rule," *Federal Register*, Vol. 48, No. 120, June 21, 1983, pp. 28194-28229.

Nuclear Regulatory Commission, "Draft Regulatory Guide DG-3003 -- Format and Content For the License Application for the High-Level Waste Repository," Office of Nuclear Regulatory Research, November 1990.

ATTACHMENT

COMPLIANCE DETERMINATION STRATEGY

RR2002 ADVERSE CONDITION -- FLOODING [10 CFR 60.122(c)(1)]

PRIMARY REGULATORY CITATION:

10 CFR 60.21(c)(1)(ii)(B)

PASS ID OF THE COMPLIANCE DETERMINATION STRATEGY:

RR2002/NS0001

TYPES OF REVIEW:

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

RATIONALE FOR TYPES OF REVIEW:

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eventually, problems with isolating the unretrieved waste. In the welded tuff at Yucca Mountain, extensive flooding is more likely to result in increased moisture levels and a possible perched water table. However, these effects still could ~~be~~ reduce the confidence in the waste isolation capability of the geologic setting.

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REVIEW STRATEGY:

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Safety Review (Type 3):

In conducting the safety review, the reviewer will, *as* at a minimum, determine the adequacy of data and analyses presented in the license

(3) That post-core flooding of the underground repository has been adequately addressed by the applicant in response to other reg. reqs.

application to determine DOE's compliance with the PAC for flooding (10 CFR 60.122(c)(1)). Specifically, DOE will need to: (1) provide information to determine whether and to what degree the PAC is present; (2) provide information to determine to what degree the PAC is present, but undetected; (3) assure the sufficiency of the lateral and vertical extent of data collection; and (4) evaluate the information presented under the first two items above, with assumptions and analysis methods that adequately describe the presence of the PAC and ranges of relevant parameters. For this PAC, the above items can be satisfied by proper site and facility characterization, calculation of the design basis flood, and determination of water levels and velocities. Guidance for such determinations is presently provided in nuclear power reactor Standard Review Plan sections 2.4.1, 2.4.2, and 2.4.3 (NRC, 1981); Regulatory Guide 1.59 (NRC, 1977); and ANS 2.8-1981 (ANS, 1981).

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Contributing Analysts:

NRC Staff: Rex G. Wescott

CNWR Staff: Gordon Wittmeyer

Date of Analysis: 06/04/92

important 3.1.2.3

appropriate

In publicizing release, distribute to the NRC

RATIONALE FOR REVIEW STRATEGY (OPTIONAL):

Not applicable.

APPLICABLE REGULATORY ELEMENTS OF PROOF:

Type 3:

RR2002/EP0100

*Please fix
reference
↓*

REFERENCES CITED:

American Nuclear Society, "Determining Design Basis Flooding at Power Reactor Sites," ANSI/ANS-2.8-1981, 1981.

Nuclear Regulatory Commission, "Design Basis Floods for Nuclear Power Plants," Office of Standards Development, Regulatory Guide 1.59 (Rev. 2), August 1977.

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