COMPLIANCE DETERMINATION STRATEGY
RRT 3.2.2.3
FAVORABLE CONDITION: GROUNDWATER TRAVEL TIME SUBSTANTIALLY EXCEEDING 1000 YEARS

APPLICABLE REGULATORY REQUIREMENTS:

10 CFR 60.122(b)(7)
10 CFR 60.21(c)(ii)(B)
10 CFR 60.21(c)(ii)(F)

TYPES OF REVIEW:

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

RATIONALE FOR TYPES OF REVIEW:

Acceptance Review (Type 1) Rationale:

This regulatory requirement topic is considered to be license application-related because, as specified in the license application content requirements of 10 CFR 60.21(c) and the regulatory guide "Format and Content for the License Application for the High-Level Waste Repository" (FCRG), it must be addressed by the U. S. Department of Energy (DOE) in its license application. Therefore, the staff will conduct an Acceptance Review of the license application for this regulatory requirement topic.

Safety Review (Type 3) Rationale:

This regulatory requirement topic is considered to be related to waste isolation. It is a requirement for which compliance is necessary to make a safety determination for construction authorization as defined in 10 CFR 60.31(a) (i. e., regulatory requirements in Subparts E, G, H, and I). Therefore, the staff will conduct a Safety Review of the license application to determine compliance with this regulatory requirement.

This regulatory requirement topic concerns one of the favorable conditions of 10 CFR 60.122(b), groundwater travel time (GWTT) from the disturbed zone to the accessible environment substantially exceeding 1,000 years. It focuses on DOE's demonstration, through appropriate investigations and evaluations, of the evidence of (or against) the presence of this favorable condition at the Yucca Mountain site. The travel time of groundwater incorporates particular properties of the geologic setting, such as porosity, permeability and hydraulic gradient, that are considered an indication of how well the geologic setting can isolate wastes. Implicit in this favorable condition is the generic assumption that the longer GWTTs are, the greater the confidence in achieving compliance with regulatory requirements related to total system performance. However, the necessity of having the geologic setting exhibit GWTTs that substantially exceed 1,000 years in order to quantitatively comply with the total system performance objective is specific to a particular geologic repository.

Evidence of GWTT from the disturbed zone to the accessible environment substantially exceeding 1,000 years is to be characterized by DOE. DOE is expected to look at the geologic record for evidence of

GWTTs substantially exceeding 1,000 years by identifying naturally-occurring, geologic indicators from which substantially long GWTTs could be reasonably inferred. Use of geologic evidence, however, is not sufficient to determine the GWTT of a specific site. The staff believes it is necessary to use numerical models to predict GWTT, quantify, and bound some aspects of hydrogeologic variability. Numerous models used to compute GWTT through either the unsaturated or the saturated zone are available, however, none of these models has been successfully applied with universal acceptance to the site of a proposed geologic repository (Green et. al., 1991).

Predicting GWTT involves some general areas of technical uncertainty. In brief, these include:

(1) Developing a conceptual model of the hydrogeologic conditions that are representative of the geologic setting;

(2) Developing a mathematical model of the hydrogeologic conditions that are representative of the geologic setting;

(3) Demonstrating the validity of predicted GWTT;

(4) Determining the fastest path of likely radionuclide travel from the disturbed zone to the accessible environment; and

(5) Determining the extent of the disturbed zone.

By association, these uncertainties pose an obvious risk of being unable to demonstrate, with reasonable assurance, compliance with the geologic setting performance objective (the regulatory requirement for a minimum, 1,000 year GWTT specified in 10 CFR 60.113(a)(2)). As a result, they have been identified as Key Technical Uncertainties and are discussed in more detail in Review Plan 3.3 (Assessment of Compliance with the groundwater travel time performance objective).

DOE's strategy for demonstrating compliance with this favorable condition is to test the hypothesis that the favorable condition is present at the Yucca Mountain site, or more specifically, the extent to which this favorable condition is present, i. e., the extent to which the groundwater travel time exceeds 1,000 years (DOE, 1988; p. 8.3.5.17-95). The staff has not yet reached any conclusions as to the presence or absence of this favorable condition at the Yucca Mountain site. However, the staff has concluded that a Safety Review (Type 3) of DOE's demonstration of compliance with this regulatory requirement is sufficient, even though considerable technical uncertainty exists in predicting GWTT. This conclusion is based on the staff belief, at this time, that the absence of this favorable condition at the Yucca Mountain site would not necessarily result in a high risk of noncompliance with the overall system performance objective (i. e., the presence of this favorable condition is not a necessary condition to meet the overall system performance objective). However, as noted in the preceding paragraph, technical uncertainty in predicting GWTT, if unresolved, will likely result in a high risk of being unable to demonstrate, with reasonable assurance, compliance with the performance objective for the geologic setting. Therefore, the staff review strategy for the GWTT performance objective will identify and describe in detail Key Technical Uncertainties as well as describe the compliance review to be used to evaluate these Key Technical Uncertainties (refer to Review Plan 3.3). The staff is aware that a quantitative demonstration of compliance with both this regulatory requirement topic and the GWTT performance objective will involve consideration of a common set of technical uncertainties. However, the staff intends that the information provided by, and the evaluations accomplished with respect to, the staff review of the GWTT

performance objective be referred to, rather than duplicated, in the Safety Review of this regulatory requirement topic. The review strategy will be revised if new information causes the staff to conclude that the presence of this favorable condition is a necessary condition to meet the total system performance objective.

REVIEW STRATEGY:

Acceptance Review:

In conducting the Acceptance Review of this favorable condition, the reviewer should determine if the information presented in the license application and its references for demonstrating compliance with the applicable regulatory requirements is complete in technical depth and breadth as identified in Section 3.3.2 of the regulatory guide "Format and Content for the License Application for the High-Level Waste Repository" (FCRG). The reviewer should also determine whether Section 3.1 of the license application contains all appropriate information, identified in Section 3.1 of the FCRG, that the staff needs to support the Safety Review described below.

The information presented in the license application should be presented in such a way that the assumptions, data, and logic lead to a clear demonstration of compliance with the requirements. The reviewer should not be required to conduct extensive analyses or literature searches. The reviewer should also determine whether a range of alternative interpretations and models has been described.

Finally, the reviewer shall determine if the U. S. Department of Energy (DOE) has either resolved all the NRC staff objections that apply to this regulatory requirement topic or provided all the information requested in Section 1.6.2 of the FCRG, for unresolved objections. The reviewer will evaluate the effects 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 period.

Safety Review:

This Safety Review is limited to consideration of the regulatory requirement related to groundwater travel time substantially exceeding 1,000 years. It is not directly concerned with the DOE's demonstration of compliance with the groundwater travel time subsystem performance objective that will be addressed in Section 3.3 of the license application. Evaluations performed by the staff during the review of Section 3.3 of the license application will be referenced by the staff in their review of this favorable condition and will not be independently repeated.

In conducting the Safety Review, the reviewer will, at a minimum, determine the adequacy of the data and analyses presented in the license application to support DOE's demonstrations regarding 10 CFR 60.122(b)(7). Specifically, DOE will need to: (1) provide information to determine whether and to what degree this favorable condition is present; (2) assure the sufficiency of field data collection; and (3) evaluate the information presented under Item (1) using assumptions and analysis methods that adequately describe the presence or absence of the favorable condition. Additional aspects of the license application on which the reviewer will focus are described below, and the Acceptance Criteria are identified in Section 3.0 of this review plan.

The reviewer should focus on data which can refine knowledge of whether the groundwater travel time (GWTT) at the Yucca Mountain site substantially exceeds 1,000 years, and should perform, as necessary, additional analyses to confirm the resolution capabilities of the methodologies. It is incumbent upon the reviewer to be familiar with evaluations performed during the review of Section 3.3 of the license application and the resolution of Key Technical Uncertainties related to the evaluation of the GWTT performance objective. It is also incumbent upon the reviewer to have acquired a body of knowledge regarding these and other critical hydrologic and geologic considerations in anticipation of conducting the review to assure that DOE's program to determine GWTT is sufficient in scope and depth to provide the information to resolve the concerns.

In order to conduct an effective review, the reviewer will rely on staff expertise and independently acquired knowledge, information, and data such as the results of research activities being conducted by the NRC's Office of Nuclear Regulatory Research, in addition to that provided by DOE in its license application.

RATIONALE FOR REVIEW STRATEGY:

Not applicable

Contributing Analysts:

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Date of Analysis: 6/8/93

APPLICABLE REGULATORY REQUIREMENTS FOR EACH TYPE OF REVIEW:

Type 1:

10 CFR 60.122(b)(7)
10 CFR 60.21(c)(1)(ii)(B)
10 CFR 60.21(c)(1)(ii)(F)

Type 3:

10 CFR 60.122(b)(7)

REFERENCES:

Green, R. T., M. P. Miklas, and G. W. Wittmeyer, 1991, *Options paper on Groundwater Travel Time as the Performance Measure of the Geologic Setting of a High-Level Radioactive Waste Geologic Repository*, San Antonio, TX: Center for Nuclear Waste Regulatory Analyses, (unpublished).

U. S. Department of Energy, 1988, *Site Characterization Plan, Yucca Mountain Site, Nevada Research and Development Area, Nevada*, U. S. Department of Energy, Office of Civilian Radioactive Waste Management, Washington, D. C., December 1988.