U.S. NUCLEAR REGULATORY COMMISSION STAFF'S ADOPTION DETERMINATION REPORT FOR THE U.S. DEPARTMENT OF ENERGY'S ENVIRONMENTAL IMPACT STATEMENTS FOR THE PROPOSED GEOLOGIC REPOSITORY AT YUCCA MOUNTAIN

September 5, 2008

EXECUTIVE SUMMARY

Pursuant to Section 114(f) of the Nuclear Waste Policy Act (NWPA), the U.S. Department of Energy (DOE) has prepared environmental impact statements (EISs) (DOE, 2008b, c; 2002) to evaluate the potential environmental impacts associated with the construction, operation, and permanent closure of a high-level radioactive waste geologic repository at Yucca Mountain, Nevada.

The U.S. Nuclear Regulatory Commission (NRC) staff has conducted a review to determine whether it is practicable to adopt the EISs in accordance with criteria in 10 CFR § 51.109(c). This regulation states that the NRC staff will find that it is practicable to adopt any environmental impact statement prepared by DOE in connection with a geologic repository unless "[t]he action proposed to be taken by the Commission differs from the action proposed in the license application submitted by the Secretary of Energy; and [t]he difference may significantly affect the quality of the human environment; or [s]ignificant and substantial new information or new considerations render such environmental impact statement inadequate."

Based on its review and discussion presented in this report, the NRC staff has concluded the following:

- With regard to the criterion in 10 CFR § 51.109(c)(1), the NRC staff has determined that the proposed action to be taken by the Commission, and as described in the EISs (DOE, 2008b, c; 2002), is substantially the same as the proposed action described in the license application.

- With regard to the criterion in 10 CFR § 51.109(c)(2), the EISs (DOE, 2008b, c; 2002,) are generally consistent with NRC and Council on Environmental Quality regulations and NRC guidance for completeness and adequacy. The staff has identified significant and substantial considerations that render the groundwater analyses of the 2002 EIS and the Repository Supplemental EIS inadequate. The staff has not identified significant and substantial new information or considerations that would render the Rail Corridor SEIS inadequate.

The NRC staff concludes that it is practicable to adopt the EISs (DOE, 2008b, c; 2002) with supplementation. As discussed in Section 3.2.1.4.2, the NRC staff concludes that the 2002 EIS (DOE, 2002) and the Repository Supplemental EIS (DOE, 2008b) do not adequately characterize the potential impact of the proposed action on groundwater and from surface discharges. Staff concludes that supplementation is needed to ensure the 2002 EIS and the Repository Supplemental EIS are adequate.

Consistent with the NWPA and with NRC's regulations in 10 CFR § 51.109, the NRC staff's adoption review is neither a duplication of DOE's efforts nor a detailed review of all technical aspects of the analyses contained in the EISs. Further, an NRC staff determination of adoption of these EISs does not necessarily mean that NRC independently would have arrived at the same conclusions as DOE on matters of fact or policy.

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ACRONYMS/ABBREVIATIONS

BLM	Bureau of Land Management
DOE	U.S. Department of Energy
CNWRA	Center for Nuclear Waste Regulatory Analyses
CRWMS M&O	Civilian Radioactive Waste Management System Management and Operating
EIS	Environmental impact statement
EPA	U.S. Environmental Protection Agency
MTHM	Metric tons of heavy metal
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NMSS	Office of Nuclear Material Safety and Safeguards
NRC	U.S. Nuclear Regulatory Commission or Commission
NWPA	Nuclear Waste Policy Act of 1982
TAD	Transportation, Aging, and Disposal
TSPA	Total System Performance Assessment

1 INTRODUCTION

The Nuclear Waste Policy Act (NWPA) of 1982, as amended, specifies that in the United States, spent nuclear fuel and high-level radioactive waste will be disposed of in a deep geologic repository. The NWPA identifies the roles of the U.S. Department of Energy (DOE), the U.S. Environmental Protection Agency (EPA), and the U.S. Nuclear Regulatory Commission (NRC) with regard to the licensing of a geologic repository. Amendments to the NWPA in 1987 identified Yucca Mountain, Nevada, as the single candidate site for characterization as a potential geologic repository.

On June 3, 2008, DOE submitted a license application (DOE, 2008a) to NRC, seeking authorization to construct a deep geologic repository for disposal of high-level radioactive waste at Yucca Mountain, Nevada. NRC staff will docket and begin its detailed review of the license application. NRC will issue a construction authorization only if the license application demonstrates compliance with the requirements in 10 CFR § 63.31.

Roles of Different Federal Agencies in the Yucca Mountain License Review

The Nuclear Waste Policy Act (NWPA) of 1982, as amended, established Yucca Mountain, Nevada as the single candidate site for characterization as a potential geologic repository for the disposal of high-level radioactive waste. As defined in 10 CFR § 63.2, high-level radioactive waste means, "…(1) The highly radioactive material resulting from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid material derived from such liquid waste that contains fission products in sufficient concentrations; (2) Irradiated reactor fuel; and (3) Other highly radioactive material that the Commission, consistent with existing law, determines by rule requires permanent isolation."

The NWPA also defined the role for three Federal agencies in the licensing of the potential repository at Yucca Mountain, including specific aspects related to compliance with National Environmental Policy Act (NEPA) requirements:

- The U.S. Department of Energy (DOE) is responsible for designing, constructing, operating, and decommissioning a permanent geologic repository. For the purposes of compliance with NEPA, DOE is the lead agency in preparing an environmental impact statement (EIS) for the proposed repository.
- The U.S. Environmental Protection Agency (EPA) is responsible for developing environmental standards specific to Yucca Mountain for use in evaluating the safety of a geologic repository. The Energy Policy Act of 1992 directs EPA to develop these standards.
- The U.S. Nuclear Regulatory Commission (NRC) is responsible for developing regulations to implement the EPA environmental standards, and for licensing and overseeing the construction and operation of the repository. In addition, NRC would consider future DOE applications for license amendments to permanently close the repository, dismantle surface facilities, remove controls to restrict access to the site, or undertake other activities involving any unreviewed safety question. To comply with the NWPA, NRC is to adopt the DOE final EIS to the "extent practicable."

1.1 Background and General Requirements

As described in the NWPA, Section 114(f), DOE prepared a final environmental impact statement (EIS) in February 2002 to meet National Environmental Policy Act (NEPA) requirements related to the construction, operation, and closure of a potential geologic repository for high-level radioactive waste at Yucca Mountain, Nevada (DOE, 2002). This EIS accompanied the Secretary of Energy's site recommendation to the President on February 14, 2002. In July 2002, Congress passed and the President signed a joint resolution designating Yucca Mountain as the site for development as a geologic repository.

In October 2006, DOE published a notice of intent in the *Federal Register* (DOE, 2006a) to prepare a supplemental EIS to update the 2002 EIS (Repository Supplemental EIS). At the same time, DOE announced its intent to develop an EIS for the Nevada rail alignment (Rail Alignment EIS) and a supplement to the rail corridor analyses presented in the 2002 EIS [Rail Corridor Supplemental EIS (SEIS)]

(DOE, 2006b). The draft EIS and draft supplemental EISs were issued for public comment on October 12, 2007 (DOE, 2007a, b, c). The public comment period for the draft EIS and supplemental EISs ended on January 10, 2008, and DOE published the final supplemental EISs and the final Rail Alignment EIS on June 16, 2008 (DOE, 2008b, c, d).

DOE submitted the 2002 EIS with the license application on June 3, 2008. DOE submitted the Repository Supplemental EIS on June 16, 2008, in accordance with 10 CFR § 51.67(b). The Rail Corridor SEIS and Rail Alignment EIS were also provided on June 16, 2008.

In accordance with NWPA, Section 114(f), NRC is to adopt the DOE EIS to "the extent practicable." As described in NRC NEPA-implementing regulations in 10 CFR § 51.109(a)(1), the EIS is considered to include "…any supplement thereto." The regulations for the NRC adoption determination are set forth in 10 CFR § 51.109(c). These regulations state that the NRC staff "…will find that it is practicable to adopt any environmental impact statement prepared by the Secretary of Energy in connection with a geologic repository proposed to be constructed under Title I of the NWPA of 1982, as amended, unless:

- The action proposed to be taken by the Commission differs from the action proposed in the license application submitted by the Secretary of Energy; and the difference may significantly affect the quality of the human environment; or

- Significant and substantial new information or new considerations render such environmental impact statement inadequate."

Using these criteria, NRC may adopt the EIS and any supplements, adopt them in part indicating a supplement is needed in part, or not adopt them, requiring supplementation.

1.2 Overview of the Adoption Review Process

The NRC staff has conducted a review to determine whether it is practicable to adopt DOE's EISs. Section 1.3 discusses the EISs that are the subject of this review. The adoption review addressed the adoption criteria identified in 10 CFR § 51.109(c), including a review, pursuant to 10 CFR § 51.109(c)(2), using NRC guidance (NRC, 2003a), of the adequacy of the EIS and supplements under NRC NEPA regulations in Part 51. Council on Environmental Quality regulations and guidance were also used to inform the staff's evaluation of the adequacy of the EISs with respect to NEPA. The staff's adoption review includes input from a number of technical disciplines. This input was considered within the context of the statutory and regulatory requirements for the NRC adoption of the EISs. Appendix A lists the contributors to the review.

The classification of impact significance is discussed in NRC guidance for environmental reviews (see NRC, 2003a, and the text box at right). The NRC staff used these classifications of impacts in applying the adoption criteria of 10 CFR § 51.109(c).

Classifying Impact Significance (after NRC, 2003a)

- *Small Impact*: The environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource considered.

- *Moderate Impact*: The environmental effects are sufficient to alter noticeably, but not destabilize, important attributes of the resource considered.

- *Large Impact*: The environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource considered.

1.3 Scope and Considerations Related to Staff's Review

The DOE documents listed below are the subject of the NRC adoption review for the proposed Yucca Mountain Repository:

- "Final Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada" (2002 EIS) (DOE, 2002).

- "Final Supplemental Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada" (Repository Supplemental EIS) (DOE, 2008b).

- "Final Supplemental Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada—Nevada Rail Transportation Corridor" (Rail Corridor SEIS) (DOE, 2008c).

NRC also considered the following DOE EIS, which examines the environmental impacts associated with constructing and operating a rail line along specific alignments within the Caliente and Mina corridors:

- "Final Environmental Impact Statement for a Rail Alignment for the Construction and Operation of a Railroad in Nevada to a Geologic Repository at Yucca Mountain, Nye County, Nevada" (Rail Alignment EIS) (DOE, 2008d).

DOE published the Rail Alignment EIS together with the Rail Corridor SEIS. To the extent that the Repository Supplemental EIS and the Rail Corridor SEIS incorporate by reference the Rail Alignment EIS analyses for the Caliente alignment, these areas of the Rail Alignment EIS are also part of the staff's adoption review. Sections of the Rail Alignment EIS pertaining to the Caliente alignment that were not specifically incorporated by reference were considered a potential source of new information, but are not specifically part of the NRC adoption review scope. Figure 1-1 illustrates the interrelationships among the different listed documents.

Consistent with the NWPA's intention to eliminate duplication and with NRC's regulations in 10 CFR § 51.109, the NRC staff's adoption review is neither a duplication of DOE's efforts nor a detailed review of all technical aspects of the analyses contained in these EISs. Further, an NRC staff determination of adoption of these EISs does not necessarily mean that NRC would have independently arrived at the same conclusions as DOE on matters of fact or policy. The staff recognizes that DOE, as the lead agency for implementing the NEPA process for the proposed repository, may reach conclusions that are different from those others might make.

Consistent with NUREG–1748 ("Environmental Review Guidance for Licensing Actions Associated with NMSS Programs"), the NRC staff considers that the use of a regulatory requirement to limit an analysis of impacts is not necessarily appropriate in the context of NEPA. As discussed further in Section 3.2.1.4.2, the NRC staff concludes that the discussion regarding the environmental impacts on groundwater requires further supplementation.

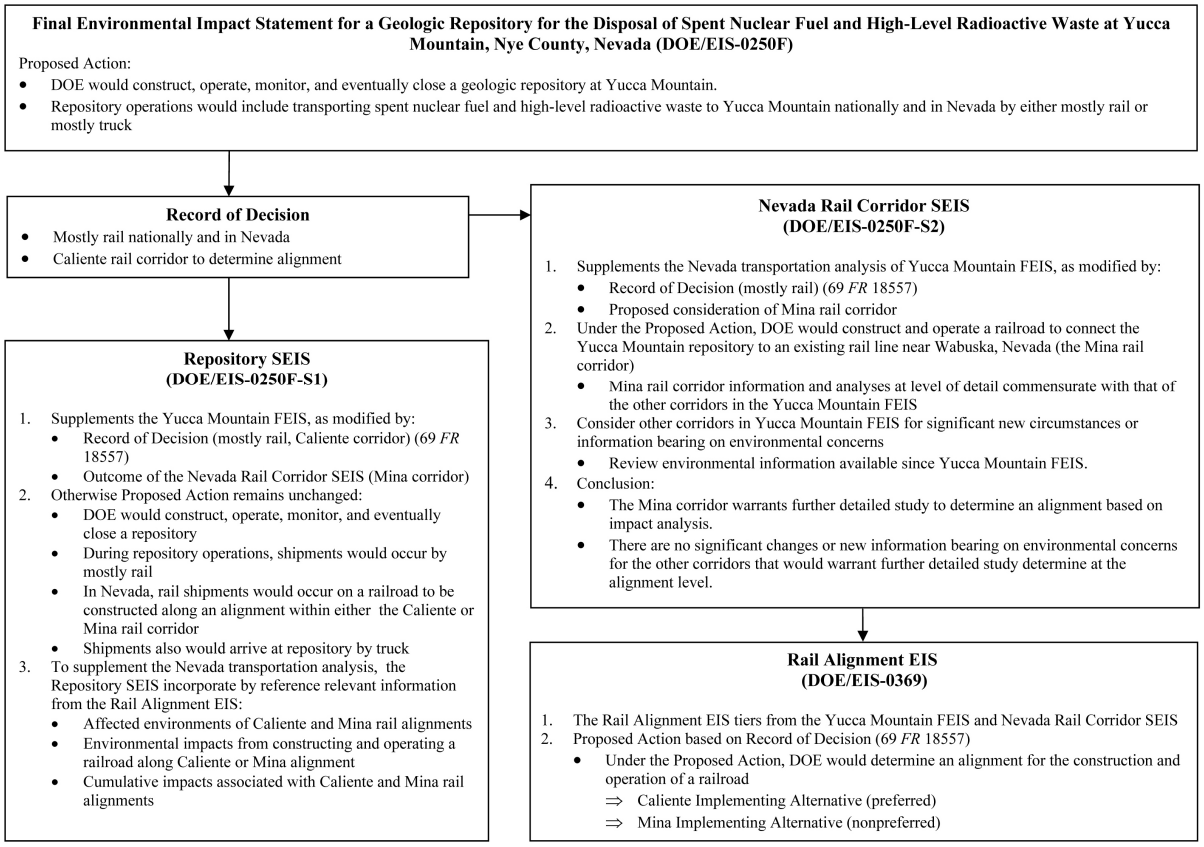

Figure 1-1. Relationship Between DOE NEPA Analyses for a Proposed Geologic High-Level Radioactive Waste Repository at Yucca Mountain, Nevada (From DOE, 2008b, Foreword)

In its EISs, DOE has identified and described the status of permitting and consultation processes and additional investigations. Some of the bases for EIS impact analyses and proposed mitigation measures include the anticipated results of these processes or investigations that are still ongoing. DOE commits in various sections of its EISs to resolving these ongoing activities, examples of which are discussed further in Section 3.2.1.4.1 of this report.

Section 1 of this report provides background, describes the DOE NEPA documents under review, and establishes the scope of the NRC review. Section 2 presents the NRC staff assessment of the consistency between the proposed action described in the EIS and the action proposed to be taken by the Commission. Section 3 provides the results of the NRC staff assessment of whether there are significant and substantial new information or new considerations that would render the EIS inadequate. As part of this assessment, the NRC staff addresses the completeness and adequacy of DOE's EISs with respect to the applicable NRC NEPA regulations and guidance. Section 4 summarizes NRC responsibilities with respect to other environmental laws, and Section 5 summarizes the staff's conclusions.

1.4 Relationship to License Application Reviews

In addition to the EIS adoption review, NRC staff conducted a separate acceptance review (or docketing review) of the license application. NRC staff will docket the license application for the proposed repository and begin its detailed review pursuant to 10 CFR § 63.31(a). The purpose of the detailed review of the license application is to determine if DOE's proposal for repository design, performance, and operation complies with the NRC regulations in Part 63 for the issuance of a construction authorization. This review will examine and evaluate the scientific and engineering basis DOE presents in its license application (NRC, 2003b). An NRC staff determination on the practicability of adopting the EISs is without prejudice on the outcome of the review under Part 63.

2 SIMILARITY OF PROPOSED ACTIONS [10 CFR § 51.109(c)(1)]

Under 10 CFR § 51.109(c)(1), the NRC staff must determine whether there are any differences between the proposed action to be taken by the Commission and as described in the EISs (DOE, 2008b, c; 2002) and the proposed action described in the license application (DOE, 2008a) and evaluate whether any differences may significantly affect the quality of the human environment. The action proposed to be taken by the Commission is the potential issuance to DOE of an authorization to construct a repository, the subsequent potential issuance of a license to receive and possess waste (operate and monitor the repository), and potential issuance of an amendment to close the repository (Figure 2-1). NRC's proposed action for the repository does not include any NRC regulatory actions that may be associated with the transportation of waste.[1] DOE proposes in its license application to construct, operate, monitor, and eventually close a geologic repository at Yucca Mountain (DOE, 2008a).

2.1 Review Methods

The staff reviewed and compared sections of the 2002 EIS and the Repository Supplemental EIS and license application that discuss DOE's proposal. The results of this review are

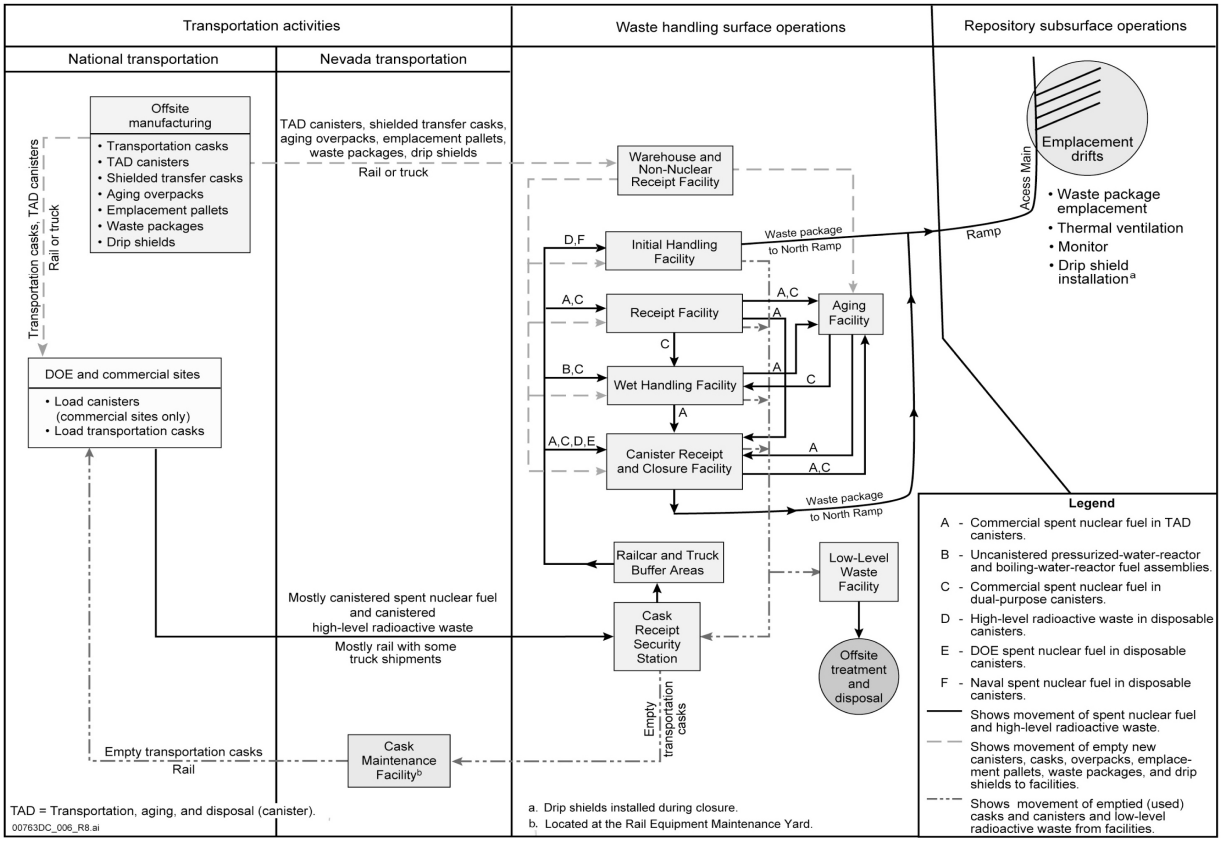

Figure 2-1. Overview of the DOE Proposed Action for Constructing, Operating, Monitoring, and Closing a Geologic Repository for High-Level Radioactive Waste at Yucca Mountain, Nevada (From DOE, 2008b, Section 2.1)

[1] DOE must transport waste in casks approved by NRC through a separate regulatory process.

presented in Section 2.3. The review considered the nature and extent of proposed operations at the site and facilities that could be constructed, modified, or impacted as a result of the proposed action; it was not a detailed technical comparison of all of the activities associated with the proposed action. If the results of the comparison indicated that there are differences between the descriptions of the proposed action (i.e., differences between the proposed action in the license application and that in the EISs), then the staff determined whether those differences could result in significant environmental impacts. The staff also reviewed mitigation actions proposed in the EISs to determine whether they would affect the comparison of proposed action descriptions.

2.2 Review Areas

The NRC staff reviewed sections of the Repository Supplemental EIS (DOE, 2008b) that describe DOE's proposed action, including Sections 1.2, 1.3 and 1.4 of Chapter 1; Section 2.1 of Chapter 2; and Section 4.2 of Chapter 4 (addressing impacts from retrieval). The staff also reviewed the 2002 EIS (DOE, 2002), specifically focusing on those sections that the Repository Supplemental EIS indicated as relevant to its current proposal (e.g., retrieval of wastes). The Repository Supplemental EIS description of the proposed action (DOE, 2008b, Section 2.1.7) includes a general summary of the proposed action from the Rail Alignment EIS (DOE, 2008d), and this was also reviewed as part of the NRC review scope. The Rail Corridor SEIS (DOE, 2008c) and Rail Alignment EIS (DOE, 2008d) were not part of this comparison of the proposed actions, since NRC's proposed licensing action for the repository does not include regulating construction or operation of the rail line.

The NRC staff compared the proposed action described in the EISs to relevant sections of the license application (DOE, 2008a). Areas of the DOE license application that NRC staff determined to be relevant for this comparison are applicable subsections of the General Information portion of the license application, Sections 1.1, 1.2, and 2 and applicable subsections of Safety Analysis Report Sections 1.1, 1.2, 1.3, 1.4, 1.5, 1.11, 1.12, and 4.1.

2.3 Assessment Results

The EIS describes the proposed actions at the geologic repository in adequate detail to enable an understanding of proposed facilities, construction schedule, operations, monitoring, and facility closure (DOE, 2008b, c).

The license application (DOE, 2008a, Safety Analysis Report) presents detailed information required to demonstrate compliance with the performance objectives in Part 63 and, therefore, presents the most detailed information on structures and systems important-to-safety. The license application presents less detailed information on structures and systems not important-to-safety and for certain other activities, such as aggregate and engineered fill material borrow areas and ancillary or support facilities. However, the descriptive information on these activities and facilities is consistent and adequate to assess the environmental impacts.

Following are some minor differences the NRC staff has identified in the descriptions of the proposed actions:

- The license application states that the Native American Interaction Program would be the method used to evaluate Native American requests to access the repository site and geologic repository operations area (DOE 2008a, Safety Analysis Report,

Section 5.9.1.1). In the Repository Supplemental EIS, DOE commits to use this program, but does not explicitly state that the program would be used to evaluate access requests by Native Americans. In fact, other methods to regulate land use are identified in the EIS. The Repository Supplemental EIS (DOE, 2008b, Section 4.1.1.1) indicates land use would be regulated by the Federal Land Policy and Management Act of 1976, the conditions of the permanent legislative withdrawal set forth by Congress, and other applicable laws (also see DOE 2008b, Volume III, response to Comment RRR000657/0014, page CR-307). Because DOE commits in its license application to using the Native American Interaction Program to evaluate access requests, the NRC staff assumes that the lack of a similar specific commitment in the EIS is not intended to indicate that DOE will not engage in this program.

- As stated in the Repository Supplemental EIS (DOE, 2008b, Section 4.2), DOE does not consider retrieval as part of the proposed action. However, retrieval capability is required under the NWPA and Part 63, and the EIS addresses the impacts of retrieval of emplaced waste as a contingency to demonstrate compliance with NRC regulations in 10 CFR § 63.111(e). DOE states (DOE, 2008b, Section 4.2) that the concept for retrieval has not changed from that which DOE analyzed in the 2002 EIS, and that the analyses reported in that EIS (2002, Section 4.2) continue to represent potential impacts during retrieval. The waste retrieval storage area identified in the 2002 EIS (DOE, 2002, Figure 4-5) does not appear to have the same layout as the area identified in the license application (DOE, 2008a, Safety Analysis Report, Figure 1.11-1). However, DOE appears to have assumed the same basic constraints (i.e., retrieval and surface storage for up to 70,000 metric tons of heavy metal within the withdrawal area). For this reason, the NRC staff concludes that the differences related to retrieval would not be significant. Any retrieval of emplaced waste, a contingent future activity that could occur before permanent closure of the repository, may require NRC approval pursuant to 10 CFR § 63.45 and may require additional consideration under NEPA.

- The Repository Supplemental EIS provides a general discussion of the spent fuel and waste types planned for disposal in the proposed repository, but does not include an analysis of each type of fuel such as may be found in the license application (DOE, 2008a, Safety Analysis Report). DOE states that it identified accident scenarios for the EIS using scenarios developed for the repository design and provides several references to reports used to support the license application (DOE, 2008b, Section E.2). For this reason, the staff assumes that the fuel types used in the EIS accident analyses are consistent with the fuel types proposed for disposal in the license application.

With the exception of the discussions above, the information in the 2002 EIS and the Repository Supplemental EIS on surface and subsurface facility descriptions, operations, monitoring, and closure activities is consistent with that in the license application.

2.4 Conclusions

Pursuant to 10 CFR § 51.109(c)(1), the NRC staff has determined that the proposed action as described in the 2002 EIS and Repository Supplemental EIS is substantially the same as the proposed action described in the license application. For the reasons stated in Section 2.3, minor differences in the proposed action descriptions do not indicate the potential for significant environmental impacts not already evaluated in the EIS.

3 SIGNIFICANT AND SUBSTANTIAL NEW INFORMATION OR CONSIDERATIONS [10 CFR § 51.109(c)(2)]

Under 10 CFR § 51.109(c)(2), the NRC staff must determine whether significant and substantial new information or considerations have arisen that were not considered in the 2002 EIS, the Repository Supplemental EIS, or the Rail Corridor SEIS, and would render the 2002 EIS, as supplemented, inadequate.

As part of its determination of whether there are any significant and substantial new information or considerations that would render the EIS inadequate, the NRC staff evaluated the completeness and adequacy of the relevant portions of the DOE EISs (DOE, 2008b, c; 2002) with respect to the requirements of NEPA. As noted in Section 1.3 of this report, the scope of the adoption review also includes only those portions of the Rail Alignment EIS (2008d) that are specifically incorporated by reference.

3.1 Review Methods

3.1.1 Completeness and Adequacy

NRC staff reviewed the 2002 EIS, the Repository Supplemental EIS, and the Rail Corridor SEIS to determine if they meet NRC NEPA requirements in Part 51. Sections of Part 51 that are relevant to an assessment of completeness and adequacy for a final EIS are 10 CFR § 51.91, "Final Environmental Impact Statement—Content," and 10 CFR Part 51, Subpart A, Appendix A, "Format for Presentation of Material in Environmental Impact Statements."

The staff reviewed the EISs to determine whether:

- DOE considered the key topics necessary to adequately evaluate potential impacts from the proposed action;
- The final EISs (DOE, 2008b, c, d; 2002) include responses to public comments on the draft EISs (DOE, 2007a, b, c; 1999);
- Opposing views are documented in the EISs;
- The descriptions of the proposed action and the affected environment are sufficient to support DOE conclusions regarding environmental impacts; and
- DOE assessments of potential impacts have technical bases to support the impact conclusions documented in the NEPA analyses.

The staff used the following NRC Office of Nuclear Material Safety and Safeguards (NMSS) guidance documents to assess the completeness and adequacy of the EISs:

- The Division of High-Level Waste Repository Safety Director's Policy and Procedures Letter 011, "Adoption Determination Review of the U.S. Department of Energy's Final Environmental Impact Statement for the Proposed Geologic Repository at Yucca Mountain for Issuance of a Construction Authorization, Revision 1" (Kokajko, 2008)

- NUREG–1748, “Environmental Review Guidance for Licensing Actions Associated With Nuclear Material Safety and Safeguards (NMSS) Programs” (NRC, 2003a, Chapter 5)

The NRC staff’s review was also informed by Council on Environmental Quality regulations and guidance, as well as guidance from other agencies (e.g., Environmental Protection Agency, Department of Interior, National Park Service) to evaluate specific resource areas.

The following sections include a summary of NRC staff’s overall assessment of completeness and adequacy of the EISs.

3.1.2 Significant and Substantial New Information or Considerations

The staff review sought to identify new information or considerations and to document the substance and source of the information. The staff then evaluated whether the new information or considerations could affect the conclusions and call into question the adequacy of the 2002 EIS, as supplemented (DOE, 2008b, c; 2002). The staff performed the following reviews:

- The staff determined whether DOE explicitly identified new information or new considerations in the license application (DOE, 2008a) or EISs (such as information associated with repository design). In addition to information DOE may have identified, the staff reviewed, where applicable, other new information or new considerations that could be considered significant or substantial.

- The staff reviewed the impacts addressed in the EISs (DOE, 2008b, c; 2002) in light of relevant information in the license application (DOE, 2008a) to determine whether the EISs reasonably encompass the impacts of actions described in the license application.

- The staff determined whether there are significant differences in the methodology and analytical approach between the license application (DOE, 2008a) and the EISs (DOE, 2008b, c; 2002). The staff then determined whether any significant differences could result in a significant difference in the environmental impacts evaluated in the EISs.

- The staff reviewed public comments on DOE’s draft EISs to determine whether the comments identify significant and substantial new information that is not adequately considered in the EISs.

- The staff determined whether significant and substantial new information or considerations exist that are associated with relevant court cases under the NWPA.

- The staff determined whether relevant DOE records of decision not already considered in the EISs may raise significant and substantial new information pertaining to the proposed repository.

The following section discusses the results of the staff’s reviews for completeness and adequacy and for significant and substantial new information or considerations.

3.2 Assessment Results

3.2.1 Completeness and Adequacy

3.2.1.1 Comparison of the Format of EISs to NRC Requirements in 10 CFR Part 51, Subpart A, Appendix A

Appendix A of Part 51, Subpart A, describes the format for an EIS. The specific sections are:

- Cover Sheet;
- Summary;
- Table of Contents;
- Purpose of and Need for Action;
- Alternatives including the proposed action;
- Affected Environment;
- Environmental Consequences and Mitigating Actions;
- List of Preparers;
- List of Agencies, Organizations, and Persons to Whom Copies of the Statement are Sent;
- Substantive Comments Received and Responses;
- Index; and
- Appendices.

NUREG–1748 (NRC, 2003a, Chapter 5) provides more detailed information on the technical content of these sections. The EISs comply with Appendix A and are generally consistent with NUREG–1748 for the technical content of an EIS.

In preparing the supplemental EISs, DOE incorporated certain analyses by reference. For example, DOE incorporated by reference portions of the 2002 EIS related to the no-action alternative (DOE, 2002, Volume I, Chapter 7) into the Repository Supplemental EIS (DOE, 2008b, Chapter 7). In addition, DOE incorporated some sections of the Rail Corridor SEIS (DOE, 2008c, Volume I, Sections 3.2 and 3.4) and the Rail Alignment EIS (DOE, 2008d, Sections 3.2, 3.3, and Chapters 4, 5, 7, and 8) by reference throughout the Repository Supplemental EIS (DOE, 2008b). This incorporation by reference meets Part 51, Subpart A, Appendix A and is consistent with the techniques described in Council on Environmental Quality regulations at 40 CFR § 1502.21.

Additional detailed analyses are included as appendices. As described below, the EISs include separate volumes that summarize and respond to comments received on the draft EISs. The appendices are compliant with Part 51, Subpart A, Appendix A, and are generally consistent with NUREG–1748 (NRC, 2003a, Chapter 5).

3.2.1.2 Comparison of the Content of EISs to NRC Requirements in 10 CFR § 51.91

The DOE final EISs incorporate separate volumes that contain responses to written and oral comments received on the draft EISs (DOE, 2002, Volume III; DOE 2008b, Volume III; DOE, 2008c, d, Volume VI). In the comment-response volumes of the EISs, DOE has identified each comment and prepared responses. In some cases where the comments were similar, DOE summarized the comments and provided a single response. The DOE final EISs also include summaries of changes made to the draft EISs in response to public comments. For example,

the Repository Supplemental EIS (DOE, 2008b, Section 1.5.2b) provides examples of changes in response to public comments received on the draft Repository Supplemental EIS (DOE, 2007a), and changes in the text are marked in the margins of the final EISs.

DOE's methodology in responding to comments meets the requirements of 10 CFR § 51.91(a) and is generally consistent with guidance in NUREG–1748 (NRC, 2003a, Section 4.4.5). The substance of the DOE responses to comments is compliant with NRC requirements and consistent with NRC guidance (NRC, 2003a). In its comments on the draft EISs, NRC staff noted that clarity and consistency could be improved among the different analyses (Weber, 2007). In addition, the staff provided comments concerning transparency and traceability of the technical bases. DOE responded that these comments were taken into consideration in revising the draft EISs (e.g., DOE, 2008b, Volume III, Section 1.15). The staff noted instances, however, where DOE did not respond to staff comments[2]. DOE's failure to adequately address certain NRC comments did not affect the overall adequacy of the EISs, with the exception of comment RRR000524/0030, as discussed below in Section 3.2.1.4.2. Staff comments on the draft EISs that warrant further discussion in the context of the adoption review are discussed further in Section 3.2.1.4 of this report.

The EISs also document opposing viewpoints and identify DOE's preferred alternatives or options (e.g., DOE, 2008b, Sections 2.5 and 4.1.5.1.2), thus meeting the requirements in 10 CFR § 51.91(b) and (d). Section 51.91(c) requires an EIS to state how the alternatives considered in it and decisions based on it will or will not achieve the requirements of sections 101 and 102(1) of NEPA and of any other applicable environmental laws and policies. The EISs do not appear to contain explicit statements that would address 10 CFR § 51.91(c). However, with respect to alternatives, under Section 114(f)(6) of the NWPA, NRC is not required to consider alternatives to geologic disposal or alternative sites to the Yucca Mountain site. The NRC staff concludes, therefore, that DOE is not required to meet 10 CFR § 51.91 for a discussion of alternatives. With respect to decisions that may be based on the EISs, the staff concludes that the EISs' discussions of DOE efforts to assess cumulative impacts, consult with other governments, develop mitigation measures, assess the irretrievable commitment of resources, and develop best management practices address the intent of Section 101 of NEPA. In accordance with Section 102(1) of NEPA, the EISs list applicable Federal, state and local laws that would apply to its proposed action (Chapter 11 of DOE, 2008b; 2002). DOE also discusses compliance with other relevant and applicable environmental laws and policies.

3.2.1.3 Compliance with Other NRC Requirements

The regulation in 10 CFR § 63.321(c) requires that DOE provide in the EIS for Yucca Mountain the results of its analysis and technical basis for the human intrusion scenario, if not projected to occur before 10,000 years following disposal. Similarly, 10 CFR § 63.341 requires that DOE provide in the EIS the results of its analysis and technical basis for the projected individual peak dose that would occur after 10,000 years following disposal but within the period of geologic stability. DOE provided the information required by these regulations in the 2002 EIS and updated the information in the Repository Supplemental EIS. NRC has since proposed removing these requirements in revisions to Part 63 (70 FR 53313), which implement a dose standard after 10,000 years; these revisions to Part 63 are not yet final.

[2] For example, DOE did not address NRC comments RRR000524/0009, concerning referencing, and RRR000524/0034, concerning consistency among the EISs.

The regulation in 10 CFR § 51.67(a) states that DOE must submit any final EIS prepared in connection with any geologic repository and that the statement must include, among the alternatives under consideration, denial of a construction authorization or license. As discussed in Section 1 of this report, DOE submitted with its license application the 2002 EIS and subsequently submitted its final Repository Supplemental EIS. These EISs both consider the no action alternative, which addresses denial of a construction authorization or license, and thus comply with this regulation.

The regulation in 10 CFR § 51.67(b) states that DOE may be required to supplement its final EIS if it makes a substantial change in its proposed action or identifies significant new concerns or information bearing on the proposed action or its impacts. DOE has not identified a substantial change in its proposed action or significant new concerns since submitting its license application on June 3, 2008.

The regulation in 10 CFR § 51.67(c) states that DOE must inform the Commission of the status of any civil action for judicial review initiated pursuant to Section 119 of the NWPA. The status report must state whether the courts have found the EIS to be adequate or inadequate and must identify any issues relating to the adequacy of the EIS that may remain subject to judicial review. On June 16, 2008, DOE submitted a letter with its Repository Supplemental EIS providing the status report discussed above (Boyle, 2008). This letter describes the State of Nevada's challenge to the 2002 EIS and the 2004 decision of the U.S. Court of Appeals for the District of Columbia Circuit. It also discusses that court's 2006 decision concerning Nevada's separate challenge to DOE's transportation analyses and resulting Record of Decision. Based on the court's rulings, the DOE letter concludes:

> Other than the issues that the United States Court of Appeals for the D.C. Circuit indicated in its 2004 and 2006 decisions were not ripe for review, there are no remaining issues that may be subject to judicial review relating to the 2002 FEIS. To date, there have been no petitions for review filed concerning the SEIS.

The NRC staff concludes that DOE's letter report satisfies the requirements in 10 CFR § 51.67(c).

3.2.1.4 Adequacy of Analyses with Respect to NEPA

The DOE EISs comply with NRC NEPA regulations and guidance for completeness and adequacy (DOE, 2008b, c; 2002), with the exception of the groundwater analysis, which is discussed in section 3.2.1.4.2. In addition, NRC staff identified areas related to the analyses in the EISs that warrant further discussion in this report, but are not found to be inadequate. DOE's in-process activities are discussed in section 3.2.1.4.1, and the additional areas are discussed in sections 3.2.1.4.3-3.2.1.4.6.

3.2.1.4.1 In-Process Activities

In its Repository Supplemental EIS and Rail Alignment EIS, DOE has identified and described the status of permitting and consultation processes and additional investigations. Some of the bases for the impact analyses and proposed mitigation measures include the anticipated results of these activities that are still in process. DOE commits in various sections of its EISs to resolving these in-process activities, and examples of these are discussed further below. NRC regulations at 10 CFR § 51.71(c) require that an EIS "…list all Federal permits, licenses, approvals, and other entitlements that must be obtained in implementing the proposed action

and will describe the status of compliance with those requirements." As indicated in NUREG–1748 (NRC, 2003a, Section 5.1.4), an EIS should describe the most current status of the required permit applications and consultations, but it is not necessary that all permitting and consultation activities be completed before publication of the final EIS. Additionally, Council on Environmental Quality regulations at 40 CFR § 1502.22 state that an EIS may document incomplete or unavailable information provided that the EIS clearly indicates such information is lacking. The staff concludes, therefore, that DOE's discussions of these activities meet NRC regulations and are consistent with Council on Environmental Quality regulations and NRC guidance.

The in-process activities may be grouped into those that require consultation or coordination with other Federal agencies or other governments and those that require action only by DOE. Examples of in-process activities that involve other government entities include, but may not be limited to, the following:

- On March 4, 2008, DOE submitted a right-of-way application to the U.S. Bureau of Land Management (BLM) to construct those portions of a proposed railroad from Caliente, Nevada, to Yucca Mountain that will cross public land administered by BLM (DOE, 2008d, Rail Alignment EIS, Section 1.5.1).

- On March 13, 2008, DOE submitted a "Biological Assessment of the Effects on Threatened and Endangered Species of Constructing and Operating a Railroad from Caliente, Nevada, to Yucca Mountain," to the U.S. Fish and Wildlife Service and requested initiation of formal consultation as required by Section 7 of the Endangered Species Act (DOE, 2008d, Rail Alignment EIS, Appendix B, Section B.2.1). A biological opinion has not yet been issued.

- DOE activities that might discharge dredge or fill into surface waters of the United States or lead to loss of wetlands may require a permit from the U.S. Army Corps of Engineers under the Clean Water Act, Section 404. DOE has been consulting with the U.S. Army Corps of Engineers to discuss potential permit requirements. On October 16, 2007, DOE submitted a request for jurisdictional determination for the Caliente rail alignment to the U.S. Army Corps of Engineers (DOE, 2008d, Rail Alignment EIS, Appendix B, Section B.2.2.1).

- On March 17, 2008, DOE filed an application with the Surface Transportation Board seeking authorization to obtain a certificate of public convenience and necessity to construct and operate a rail line from Caliente, Nevada, to Yucca Mountain (DOE, 2008c, Rail Corridor SEIS, Section 1.4.2). The Surface Transportation Board has docketed the application, but has not yet reached a decision whether to grant or deny the permit or grant the permit with environmental conditions (Surface Transportation Board, 2008).

- DOE is consulting with the Nevada State Historic Preservation Office and the Advisory Council on Historic Preservation to develop a programmatic agreement for the proposed repository that covers potential impacts on cultural and historical resources (DOE, 2008b, Table 11-4).

- DOE has indicated its intent to have continuing discussions with Native American tribes through the Native American Interaction Program to determine best management

practices and mitigation measures to address tribal perspectives (DOE, 2008d, Rail Alignment EIS, Section 7.1.2). DOE has also proposed establishing one or more Mitigation Advisory Boards with governmental entities (Federal, local) to identify concerns pertaining to mitigation of adverse impacts.

- In accordance with 10 CFR § 63.121, DOE must obtain the water rights needed to accomplish the purpose of the geologic repository operations area. As discussed in the Repository Supplemental EIS, DOE filed a water appropriation request with the Office of the Nevada State Engineer on July 22, 1997, for permanent rights to 530,000 cubic meters (430 acre-ft) of water annually from five wells located in the Fortymile Canyon–Jackass Flat Hydrographic area within the land withdrawal boundary to meet the projected water demands for the proposed action (DOE, 2008b, Section 11.2.3.4). The Nevada State Engineer has denied the DOE water appropriation permit applications for these five wells. DOE has appealed this decision in U.S. District Court (DOE, 2008b, Section 11.2.3.4). A court ruling has not been issued for this case.

- In the Rail Alignment EIS, DOE stated it does not anticipate needing borrow pits for the Caliente alternative, because of the relatively close balance of cuts and fills during construction (DOE, 2008c, d, Volume VI, response to Comment RRR000524/0014, page CRD3-95). Borrow pits are subject to BLM approval under 43 CFR Part 3600. If such activities are determined to be necessary for the Caliente alignment, DOE commits to obtaining the necessary free-use permits for production of saleable minerals from BLM in accordance with regulations in 43 CFR Part 3604.

- DOE's proposed action includes the use of transportation, aging, and disposal (TAD) canisters. The TAD canisters require NRC certification for transportation in accordance with Part 71 and an NRC license for surface storage at commercial sites in accordance with Part 72 (DOE, 2008b, Section 2.1.1). The TAD canister design has not been finalized, nor have certification/license applications been submitted to NRC. DOE's expectation under the proposed action is that potentially as much as 90 percent of commercial spent nuclear fuel would be packaged in TAD canisters by the operators at generator sites (DOE, 2008a, Section 2.1.1). In response to public comments, DOE included in the Repository Supplemental EIS an analysis of transportation and repository impacts if 75 percent of spent fuel is packaged in TAD canisters at generator sites and the remaining 25 percent at the repository (DOE, 2008b, Appendix A, Section 2).

Examples of in-process activities that involve continuing DOE processes or investigations include, but may not be limited to, the following:

- DOE anticipates and concludes that residual adverse effects associated with a rail alignment would be "small" to "moderate" (DOE, 2008d, Rail Alignment EIS, Section 4.2.13.4), because DOE expects its future consultation and historic/cultural resource management processes to resolve such impacts. Because these processes are ongoing, DOE does not present conclusions regarding specific impacts or mitigation measures that might be implemented.

- DOE has proposed a number of management actions related to mitigation of potential adverse impacts. These DOE actions include a commitment to implementing an environmental management system program to monitor the effectiveness of mitigation measures and modify them as necessary, developing of a mitigation action plan to

identify specific mitigation commitments, and chartering one or more mitigation advisory boards to be led by governmental entities along the Nevada transportation corridor to identify potential adverse impacts and mitigation measures (DOE, 2008b, Section 9.2.2).

- DOE describes geotechnical investigations that are still needed to assess historical mining locations that may intersect with the proposed Caliente rail alignment (DOE, 2008d, Rail Alignment EIS, Section 3.2.1.2.3).

- DOE states that the Repository Supplemental EIS analysis of the impacts from manufacturing repository components assumes that all manufacturing would occur at one representative site, but that this is an unlikely scenario (DOE, 2008b, Section 4.1.14.1). DOE further states that it did not perform a site-specific analysis of impacts, because the locations of specific facilities are unknown until the competitive bidding process is complete.

As discussed above, the staff concludes that DOE's discussions of these activities meet NRC regulations and are consistent with Council on Environmental Quality regulations and NRC guidance.

3.2.1.4.2 Impacts on Groundwater and from Surface Discharge of Groundwater

NRC's NEPA regulations (10 CFR § 51.109(c)(2)) provide that it will not be practicable to adopt any environmental impact statement prepared by DOE for a geologic repository if there is "significant and substantial new information or new considerations [that would] render such environmental impact statement inadequate." As discussed in the following sections of the report, staff finds that the failure of the EISs to completely and adequately characterize potential contaminant release to groundwater and from surface discharge is a significant new consideration that renders the EISs inadequate. DOE's analysis of the postclosure behavior of the repository recognizes that the release of contaminants to groundwater can be expected over the long term (DOE, 2008b, Chapter 5). The NRC staff concludes that this is a reasonably foreseeable outcome for a repository. The EISs consider impacts to groundwater, but the analysis does not provide adequate discussion of the cumulative amounts of radiological and non-radiological contaminants that may enter the groundwater over time, and how these contaminants would behave in the aquifer and related environment. The discussion of groundwater impacts in the EISs is not consistent with NRC regulations for completeness and adequacy of the discussion of environmental consequences of the proposed action [e.g., 10 CFR Part 51, Appendix A(7)]. In this instance, the incomplete and inadequate characterization itself constitutes a significant consideration, irrespective of the magnitude of potential impacts. Given the importance of groundwater as a natural resource in the arid Yucca Mountain region, staff concludes that supplementation is needed to ensure the 2002 EIS and the Repository Supplemental EIS are adequate.

The following sections of the report summarize the characterization of groundwater impacts in the EISs, discuss the two specific aspects that the staff finds to be inadequate, and describe the additional information needed to complete the consideration of impacts.

3.2.1.4.2.1 Characterization Provided in the EISs

Environmental impacts of the proposed action over the long-term are considered in Volume 1, Chapter 5 of the 2002 EIS and the Repository Supplemental EIS. Discussion of potential impacts on groundwater, and on human health through a groundwater pathway, comprises

much of these chapters. Impacts on groundwater come from the modeled release of material (both radioactive and non-radioactive) from the repository as components of the engineered barrier system slowly corrode and lose their capability to contain their contents.

The repository lies above the water table, in the unsaturated zone. The EISs state that water-borne releases from the repository are likely to travel near vertically to groundwater below the repository site. A regional groundwater flow model is discussed in the 2002 EIS and the Repository Supplemental EIS (Section 3.1.4.2 of each). In the regional flow model, this groundwater flows to the south-southeast within an unconfined aquifer of volcanic rocks and alluvium. The EISs state that water from the volcanic-alluvial aquifer can potentially discharge to the surface at Alkali Flats (Franklin Lake Playa), along the Amargosa River, and in springs in the Furnace Creek area of Death Valley, but that this water does not feed springs in Ash Meadows or Devil's Hole (DOE, 2008b, Sections 3.1.4.2.1, 5.4).

DOE's principal means of assessing the effects of release and transport processes is its Total System Performance Assessment (TSPA), which considers those features, events, and processes of the engineered and natural system that affect repository performance (DOE, 2008a, Safety Analysis Report, Chapter 2). TSPA is a probabilistic model, in that the results are generated by multiple runs with different values of input parameters as a way to account for uncertainties.

The EISs use the human dose calculated in TSPA as the principal measure of radiological impacts on groundwater. This dose is calculated using a model of well withdrawal of contaminated groundwater for drinking and irrigation, and including inhalation of surface dust potentially contaminated by well water, at a location ~18 km (11 mi) south of the repository. The results are given for calculated time-steps over the million-year period following permanent closure of the repository. In addition to the human dose, TSPA similarly calculates results for the 10,000-year period following closure for radionuclides in groundwater. The EISs compare the calculated results to the regulatory performance objectives and note that the results are well below the regulatory standards.

The EISs consider impacts on groundwater at other locations beyond ~18 km (11 mi) to be no greater than those calculated in TSPA for the ~18-km (11-mi) location. In the Repository Supplemental EIS, DOE states that the contaminant plume, as currently modeled, is sufficiently narrow that well withdrawal would capture the entire plume at and at all locations beyond the ~18-km (11-mi) locale (DOE, 2008b, Section 5.1.1.4). In the 2002 EIS, fractional "scaling factors" as multipliers of the TSPA results at ~18 km (11 mi) were calculated for more distant locations (including Alkali Flats), to account for increased dispersion of a contaminant plume down flow from the ~18-km (11-mi) location (DOE, 2002, Section 5.4.1; Appendix I.4.5).

The EISs indicate possible surface discharge at Franklin Lake Playa (DOE, 2002, Section 5.9; 2008b, Section 5.10). The discussion in these sections of impacts from potential discharges is limited to a statement that no detrimental radiological impacts on plants and animals are expected.

The EISs describe non-radiological impacts on groundwater for the release of chemically toxic materials. The releases considered are from the corrosion of materials of the engineered barrier system within the repository. The Repository Supplemental EIS provides concentrations for three corrosion-derived elements. These are calculated from annual mass-dissolution rates of exposed engineered material in the repository using methods for well water withdrawal analogous to those used in TSPA for radioactive contaminants in groundwater (DOE, 2008b,

Section 5.7, Appendix F.5). DOE considers the calculated concentrations as bounding for groundwater at all locations.

3.2.1.4.2.2 NRC Staff Evaluation

The NRC staff concludes that the information provided in the EISs does not adequately characterize how potential contaminants may affect groundwater resources in the volcanic-alluvial aquifer, and the potential effects from surface discharge. In the EISs, impacts on groundwater are discussed principally as those defined for regulatory compliance. NRC's NEPA regulations in Part 51 and guidance in NUREG–1748 indicate that compliance with regulatory requirements does not necessarily satisfy the need to consider the environmental impacts of the proposed action. The regulations and guidance recognize that further analysis and discussion may be needed [e.g., 10 CFR § 51.71; 10 CFR Part 51, Subpart A, Appendix A(7)]. For impacts on groundwater and from surface discharge, the staff concludes that additional analysis is necessary and EIS supplementation is needed.

Two distinct, but related aspects of potential impacts on the groundwater system are insufficiently characterized in the EISs and require supplementation. These are (1) the nature and extent of the repository's cumulative impact on groundwater in the volcanic-alluvial aquifer; and (2) the potential impacts of discharge of potentially contaminated groundwater to the surface. The limitations of the approach presented in the EISs and the specific needs for supplementation are discussed for each in turn.

Need for Supplementation 1: Impacts on Groundwater

The volcanic-alluvial aquifer is part of the internally-drained Great Basin, and potential contaminants have limited means of leaving the aquifer (radioactive decay is a principal means for lowering the levels of many of the radiological contaminants). The EISs characterize radionuclide impacts on groundwater by calculating doses and concentrations for an annual contaminant release captured by well withdrawal of a given volume of groundwater. This methodology assumes that the full amount of contaminants released each year is removed by groundwater withdrawal, to avoid possibly underestimating annual peak doses or radionuclide levels for regulatory compliance with 10 CFR 63. Because the yearly flux of contaminants is assumed to be removed, the extent of contamination and accumulation in the aquifer of releases over multiple years is not fully considered. Similar reasoning is used in the EISs for estimating impacts on groundwater from non-radiological contaminants. The calculation provided in the EISs is presented as bounding for the quantity of non-radiological material that may be released in a year. This calculation does not consider more than a single year's amount of contaminant in groundwater. For both radiological and non-radiological contaminants, the EISs do not characterize contamination in the aquifer if annual withdrawal did not occur.

The EISs have not provided complete and adequate discussion of the nature and extent of the repository's cumulative impact on groundwater in the volcanic-alluvial aquifer. A supplement should include the following additional information:

- A description of the full extent of the volcanic-alluvial aquifer, particularly those parts that could become contaminated, and how water (and potential contaminants) can leave the flow system. For example, the DOE license application describes potential groundwater flow farther to the south of Alkali Flats, into the Southern Death Valley subregion of the regional model domain (DOE, 2008a, General Information, Section 5.2.2.2). This component of the groundwater flow system is not discussed in the EISs.

- An analysis of the cumulative amount of radiological and non-radiological contaminants that can be reasonably expected to enter the aquifer from the repository, and the amount that could reasonably remain over time. In its license application, for example, DOE provides calculated cumulative releases of some radionuclides at different stages within the repository system, as intermediate results in TSPA (e.g., DOE, 2008a, Safety Analysis Report, Section 2.4.2.2.3). This type of information, for radiological and non-radiological contaminants, could be used in the analysis.

- Estimates of contamination in the groundwater, given potential accumulation of radiological and non-radiological contaminants. One way to analyze the overall impacts on groundwater may be a mass-balance approach that accounts for mass released, the part of the groundwater flow system affected by potential releases, and the expected processes that could affect released contaminants. Such an approach would also show the extent of contamination and possible impacts on water quality.

Need for Supplementation 2: Impacts from Surface Discharges of Groundwater

The EISs acknowledge the likelihood of future discharges of contaminated groundwater to the surface. Questions regarding possible locations and impacts of these discharges were raised in comments on the draft Repository Supplemental EIS, both from NRC staff and from the Timbisha Shoshone. DOE's responses restate its conclusion that any potential impacts from surface discharges would be no greater than those represented by doses associated with groundwater withdrawal and use at the ~18-km (11-mi) location (DOE, 2008b, Volume III, response to Comment RRR000524/0030, page CR–497, and Comment RRR000690/0013, page CR–330, respectively).

The discharge of potentially contaminated groundwater to the surface can involve physical conditions that are different from groundwater withdrawal and use in irrigation. These differences may affect how radionuclides can potentially accumulate in near-surface soils. For example, springs in the Yucca Mountain area typically discharge water at low rates. The spring water evaporates quickly and forms mineral deposits at the surface. These mineral deposits can contain potential radionuclide contaminants. In arid lands, evaporation of near-surface groundwater also can lead to precipitation of minerals in soil and shallow sediments, even without spring flow. In contrast, irrigation water penetrates deeper into the soil and can leach minerals from the surface and deposit them in the subsurface. Differences in soil and vegetation also affect how water can move from the surface to the subsurface and form minerals. How much contaminant can accumulate in either a spring deposit or irrigated field depends on how much water is discharged or evaporated at a location, the amount of contamination in the water, and the processes for deposition and removal of minerals and contaminants.

Spring deposits that provide evidence for past discharge of groundwater to the surface are common in the Yucca Mountain region, including fossil deposits that formed during past wetter climates. The paleoclimate record indicates that future wetter periods are reasonably expected for the region (e.g., DOE, 2008a, Safety Analysis Report, Section 2.3.1.2). Future surface discharges during wetter periods may involve different amounts of water and contaminants, and different processes for deposition and removal, compared to present conditions.

The EISs have not provided a complete and adequate discussion of the impacts on soils and surface materials from the processes involved in surface discharges of contaminated groundwater. A supplement should include the following additional information:

- A description of the locations of potential natural discharge of contaminated groundwater for present and expected future wetter periods (for example, as discussed in DOE, 2008a, Safety Analysis Report, Section 2.3.1.2).

- A description of the physical processes at the surface discharge locations that can affect accumulation, concentration, and potential remobilization of groundwater-borne contaminants.

- Estimates of the amount of contaminants that could be deposited at or near the surface. This involves estimates of the amount of groundwater involved in discharge or near-surface evaporation, the amounts of radiological and non-radiological contaminants in that water, contaminant concentrations in the resulting deposits, and potential environmental impacts (e.g., effects on biota).

3.2.1.4.2.3 Conclusions

The NRC staff concludes that the EISs do not adequately characterize the potential impact of the proposed action on groundwater and from surface discharge. Staff concludes that the criterion of 10 CFR § 51.109(c)(2), for "significant and substantial new information or new considerations [that would] render such environmental impact statement inadequate," is met for the portion of the EISs that consider impacts to groundwater and from surface discharge over the long term. Supplementation is needed to ensure the EISs are adequate.

If DOE develops the supplement, it would follow its own requirements and procedures.

Any supplement prepared by the NRC staff would be developed in accordance with NRC regulations in Part 51 and with NUREG-1748. If NRC staff prepares the supplement, the staff would publish a notice of intent in the *Federal Register* pursuant to 10 CFR § 51.27 and § 51.116. Given the description in this report of the needed supplementation, and pursuant to 10 CFR § 51.26(d), the staff would not conduct scoping for the supplement. When a draft supplement is published for public comment, the staff would publish in the *Federal Register* a notice of availability. Following a public comment period, the staff would publish a final supplement. The staff anticipates that it could publish the final supplement within approximately six months of the date of the *Federal Register* notice of intent.

3.2.1.4.3 Impacts on Native Americans

Throughout the EISs, DOE discusses separately the spiritual and philosophical aspects of Native American cultural values and the tangible impacts on associated cultural sites and resources (e.g., impacts on artifacts or access restrictions). The EISs describe generally DOE's efforts to assess effects on specific cultural and historic resources. Using the NRC policy statement on Environmental Justice (NRC, 2004), DOE also concludes that there would be no disproportionately high and adverse health impacts to minority and low-income populations within an 84-km (52-mi) radius of Yucca Mountain. DOE indicates that it would further characterize and mitigate such effects in compliance with the National Historic Preservation Act (NHPA) and other applicable laws. The EISs (DOE, 2008b, c; 2002) also contain discussions of American Indian viewpoints. DOE acknowledges that Native American tribes consider

repository development to adversely affect elements of their cultural values and lifeways (DOE, 2002, "Summary," Section S.5.1.6). DOE characterizes the American Indian views as an "opposing American Indian viewpoint" (DOE, 2008b, Tables 2-2 and 2-6). DOE indicates its intent to continue discussions with Native Americans through the Native American Interaction Program to determine best management practices and mitigation measures to address tribal perspectives (for example, DOE, 2008d, Rail Alignment EIS, Section 7.1.2). Separately, DOE also commits to compliance with the various laws that may affect Native American cultural practices, including the American Indian Religious Freedom Act of 1978 and the Native American Graves Protection and Repatriation Act of 1990 (DOE, 2008b, Section 11.2.6). DOE notes that, because consultations and investigations are still ongoing, information is not yet available concerning specific impacts and specific mitigation measures that DOE would implement. DOE has also proposed establishing one or more mitigation advisory boards with governmental entities to identify concerns pertaining to mitigation of adverse impacts (DOE, 2008b, Chapter 9). The staff concludes that the EISs' consideration of Native American concerns and the impacts assessed on cultural resources are adequate under NEPA.

3.2.1.4.4 Accidents

DOE provides an analysis of the frequency and consequences of an aircraft crash on surface facilities as one of its accident scenarios (see DOE, 2008b, Section E.2.1.2.1). DOE evaluated the crash frequency to be 5.9×10^{-7} per year, which is greater than the frequency threshold for evaluating potential impacts provided in DOE's NEPA-implementing guidance (1×10^{-7} per year). DOE then provides a summary of the assumptions used in this frequency assessment. For its review under NRC's NEPA requirements, the NRC staff concludes that DOE's frequency analysis in the Repository Supplemental EIS is not necessary, because the EIS has addressed the consequences of this scenario. To account for consequences, DOE states that it analyzed a scenario in which a jet aircraft strikes and penetrates a Canister Receipt and Closure Facility, and that Section E.7 discusses this scenario as a potential sabotage event. The staff concludes that this analysis is adequate for a consideration of impacts associated with an accidental aircraft crash.

3.2.1.4.5 Transportation Analysis

The transportation impact calculations included in the Repository Supplemental EIS focus on the transportation activities included in the proposed action (i.e., the mostly rail preferred alternative). These transportation impact calculations are based on updated information, such as year 2000 census data, new canister design, updated inventories, and updated shipment estimates. DOE did not update the analyses of alternative transportation scenarios analyzed in the 2002 EIS that are no longer included in the proposed action (e.g., truck-only transportation and intermodal transfer from rail to truck in Nevada). The NRC staff concludes that these prior analyses do not need to be updated since they are not part of the proposed action or alternatives evaluated. Accordingly, the staff has determined that DOE has considered the transportation impacts of the proposed action in its EISs in a manner that is consistent with NRC guidance and applicable regulations.

3.2.1.4.6 Cost-Benefit Analysis

NRC guidance (NRC, 2003a, Section 5.7) identifies, as a matter of NRC practice, that a cost-benefit analysis should be provided as a separate section in an EIS to describe the major costs and benefits for each alternative under consideration. NRC regulations in 10 CFR § 51.71(d) state that the benefits and costs of the proposed action and alternatives should be discussed,

but the regulations do not explicitly require that a separate cost-benefit analysis be developed. The regulations state that "…the draft environmental impact statement will include a preliminary analysis that considers and weighs the environmental effects of the proposed action; the environmental impacts of alternatives to the proposed action; and alternatives available for reducing or avoiding adverse environmental effects and consideration of the economic, technical, and other benefits and costs of the proposed action and alternatives…." Although not summarized in a separate section, DOE does consider environmental costs and benefits as part of its analyses of impacts. Also, the 2002 EIS provides quantitative life-cycle cost estimates (DOE, 2002, Sections 2.1.5 and 2.2.3). The Repository Supplemental EIS provides a summary of estimates of costs for cleanup from transportation accidents (DOE, 2008b, Appendix G, Section G9.7), and summarizes the environmental consequences of the proposed action (e.g., DOE, 2008b, Section 2.3). DOE has updated total life-cycle costs for the repository and for the Caliente rail corridor (DOE, 2008e), though these estimates were published after publication of the EISs (DOE, 2008b, c). The NRC staff has determined that DOE has considered the environmental costs and benefits of the proposed action and the alternatives in its EISs in a manner that is consistent with NRC guidance and applicable regulations.

3.2.2 Significant and Substantial New Information or Considerations

Some new information or considerations were identified as a result of the staff's review. The nature and significance of this information are described below. With the exception of the groundwater analysis (discussed in Section 3.2.1.4.2), the staff concludes that the information or considerations described in this section do not result in a potential significant difference in the impacts evaluated in the EISs.

This section also supplements information presented in Section 3.2.1.4, above. Many of these items pertain to ongoing investigations or consultations. If these various activities result in environmental impacts that are significantly different from those currently assessed in the DOE EISs, the NRC staff expects that DOE would develop additional documentation to fulfill its responsibilities under NEPA. Likewise, significant or substantial new information or considerations may arise from the staff's detailed review of DOE's license application that could require additional NEPA documentation.

3.2.2.1 Groundwater Analyses

As discussed in depth in Section 3.2.1.4.2, the NRC staff concludes that both the 2002 EIS (DOE, 2002) and the Repository Supplemental EIS (DOE, 2008b) do not adequately address the impacts on groundwater and surface discharges from the proposed action. Staff concludes that supplementation is needed to ensure the 2002 EIS and the Repository Supplemental EIS are adequate.

3.2.2.2 Postclosure Criticality

DOE has conducted extensive analyses of postclosure criticality since the 2002 EIS, with reports dating from as recently as 2008. These analyses are identified and discussed in Section 2.2.1.4.1 of the Safety Analysis Report (DOE, 2008a). However, as the staff noted in comment RRR000524/0009 on the draft Repository Supplemental EIS, the EIS does not reference these analyses. None of the analyses appears to be discussed in Chapter 5 of the final Repository Supplemental EIS. DOE concludes in the Repository Supplemental EIS (DOE, 2008b, Section 5.9) that updated design information and studies would not significantly change the environmental impacts of postclosure criticality that are assessed in the 2002 EIS. Based

on its knowledge of this issue and based on its review of the information provided in the 2002 EIS, the NRC staff concludes that the 2002 EIS's general conclusion about postclosure criticality impacts would not significantly change.

3.2.2.3 Hydrothermal Upwelling

The Repository Supplemental EIS (DOE, 2008b) discusses opposing views on the interpretation of the presence of carbonate-opal veinlets at Yucca Mountain that could indicate warm upwelling of water rather than water infiltrating from the surface. However, the discussion in the Repository Supplemental EIS (DOE, 2008b, Section 3.1.4.2.2) does not reference information dated after 2004. More recent information on these studies is available. For example, recent studies presenting opposing reviews include Gray, et al. (2005); Dublyansky and Polyansky (2007); and Whelan, et al. (2008). Based on its review of these and other reports, the NRC staff concludes that this more recent information would not significantly alter the discussion presented in the Repository Supplemental EIS (DOE, 2008b).

3.2.2.4 Volcanic Hazards Information

The Repository Supplemental EIS (DOE, 2008b) and the DOE license application (DOE, 2008a) use information derived from a 1996 expert elicitation for the analysis of potential volcanism at the Yucca Mountain site (CRWMS M&O, 1996). Subsequent aeromagnetic and ground magnetic data indicate the possible existence of buried basaltic volcanic centers in Crater Flat and northern Amargosa Valley that are not included in the 1996 probabilistic volcanic hazard analysis (DOE, 2008b, Section 3.1.3.1.3). These new data could result in changes to the mean annual frequency of intersection of a basaltic dike with the repository footprint. DOE states in the Repository Supplemental EIS (DOE, 2008b, Section 3.1.3.1.3) that it is updating the 1996 analysis to "…review and interpret the new information." Based on its knowledge of this issue and based on its review of the information provided in the Repository Supplemental EIS (DOE, 2008b), the NRC staff concludes that the EIS's general conclusion about the impacts associated with volcanic activity would not significantly change.

3.3 Conclusions

The NRC staff concludes that the 2002 EIS, the Repository Supplemental EIS, and the Rail Corridor SEIS meet NRC completeness and adequacy requirements in 10 CFR § 51.91 and in 10 CFR Part 51, Subpart A, Appendix A, and that the EISs are generally consistent with NRC's NEPA guidance in NUREG–1748 (NRC, 2003a). The NRC staff has determined that significant and substantial new considerations related to groundwater analyses in the 2002 EIS (DOE, 2002) and in the Repository Supplemental EIS (DOE, 2008b) render those analyses of the EISs inadequate without further supplementation. These considerations are addressed in depth in Section 3.2.1.4.2 of this report. The staff has not identified other significant or substantial new information or considerations that would render the EISs (DOE, 2008b, c; 2002) inadequate.

4 NRC CONSULTATIONS

4.1 Consultation under Section 106 of the National Historic Preservation Act

Section 106 of the NHPA requires consultation for any Federal action that may affect historic or cultural resources. As a Federal agency, NRC has the responsibility to comply with these requirements. NRC guidance for conducting Section 106 consultation is described in NUREG–1748 (NRC, 2003a, Appendix D).

As identified in Section 114(f) of the NWPA, DOE is the lead agency for preparing an EIS for a proposed geologic repository at Yucca Mountain, Nevada. DOE must also conduct consultations to fulfill its responsibilities under the NHPA. Toward this end, DOE entered into a programmatic agreement with the Advisory Council on Historic Preservation and the Nevada State Historic Preservation Office in 1988. Since then, DOE has obtained updated information on cultural and historical resources near Yucca Mountain and is preparing a new programmatic agreement for cultural resource management with respect to the construction, operation, monitoring, and eventual closure of a geologic repository. As noted in Section 3.2.1.4.1 of this report, DOE is still consulting with the Nevada State Historic Preservation Office and the Advisory Council on Historic Preservation to finalize the programmatic agreement. In the Repository Supplemental EIS (DOE, 2008b, Section 4.1.5), DOE stated, "While this agreement is in ongoing negotiation among the parties, DOE is abiding by the process set forth in Section 106 of the National Historic Preservation Act of 1966 (16 U.S.C. 470, et seq.)."

NRC may elect to become a concurring party to this programmatic agreement (if finalized) to fulfill its obligations under the NHPA, if NRC decides to issue DOE a construction authorization for the proposed repository. NRC has sent a letter to DOE requesting an amendment to the draft programmatic agreement. The proposed amendment is a clause stating that NRC may wish to become a concurring party. A copy of this letter is attached in Appendix B.

If the programmatic agreement among DOE, the Advisory Council on Historic Preservation and the Nevada State Historic Preservation Office were not finalized, NRC would conduct its own consultation process to comply with the requirements of Section 106 of NHPA. NRC staff would fulfill its Section 106 consultation requirements by following the guidance in NUREG–1748 (NRC, 2003a, Appendix D), as appropriate.

4.2 Consultation under Section 7 of the Endangered Species Act

Section 7 of the Endangered Species Act requires consultation for any Federal action that may affect endangered or threatened species or critical habitat. As a Federal agency, NRC has the responsibility to comply with these requirements. NRC guidance for conducting Section 7 consultation is described in NUREG–1748 (NRC, 2003a, Appendix D).

In developing its EIS for the proposed repository at Yucca Mountain (DOE, 2008b, c; 2002), DOE must also conduct consultations to fulfill the requirements of the Endangered Species Act. DOE conducted and finalized consultations with the U.S. Fish and Wildlife Service, which issued a biological opinion for the proposed repository (DOE, 2002, Appendix O). DOE has also stated in a letter to the Service that it is the lead agency and has completed formal consultation for construction, operation, monitoring, and closure of the proposed geologic repository (see Appendix B).

In August, 2008, NRC staff spoke with a representative of the Southern Nevada Field Office of the U.S. Fish and Wildlife Service, who confirmed that consultation under Section 7 with DOE is complete and that the Service does not require any NRC action at this time.

5 SUMMARY AND CONCLUSIONS

5.1 Summary

Pursuant to Section 114(f) of the NWPA, DOE has prepared EISs (DOE, 2008b, c; 2002) to evaluate the potential environmental impacts associated with the construction, operation, and permanent closure of a high-level radioactive waste geologic repository at Yucca Mountain, Nevada.

The NRC staff has conducted a review to determine whether it is practicable to adopt the EISs in accordance with criteria in 10 CFR § 51.109(c). The NRC staff also compared the EISs to NRC's NEPA regulations in Part 51, NRC guidance (NRC, 2003a), and, as appropriate, Council on Environmental Quality regulations and guidance to evaluate the adequacy of the DOE analyses with respect to NEPA.

Consistent with the NWPA and with NRC's regulations in 10 CFR § 51.109, the NRC staff's adoption review is neither a duplication of DOE's efforts nor a detailed review of all technical aspects of the analyses contained in these EISs. Further, an NRC staff determination of adoption of these EISs does not necessarily mean that NRC independently would have arrived at the same conclusions as DOE on matters of fact or policy.

NRC staff will docket the license application and begin its detailed review (NRC, 2003b). The purpose of the detailed review is to determine if the design, performance, and operations proposed by DOE comply with the NRC regulations for the proposed Yucca Mountain repository in Part 63. A staff determination that it is practicable to adopt the EISs does not prejudge the outcome of the review of DOE's license application under Part 63.

5.2 Conclusions

Based on its review and discussion presented in the preceding sections, the NRC staff has concluded the following:

- With regard to the criterion in 10 CFR § 51.109(c)(1), the NRC staff has determined that the proposed action to be taken by the Commission and as described in the EISs (DOE, 2008b, c; 2002) is substantially the same as the proposed action described in the license application.

- With regard to the criterion in 10 CFR § 51.109(c)(2), the EISs (DOE, 2008b, c; 2002) are generally consistent with NRC and Council on Environmental Quality regulations and NRC guidance for completeness and adequacy. The staff has identified significant and substantial considerations that render the groundwater analyses of the 2002 EIS and the Repository Supplemental EIS (DOE, 2008b; 2002) inadequate. The staff has not identified significant and substantial new information or considerations that would render the Rail Corridor SEIS (DOE, 2008c) inadequate.

The NRC staff concludes that it is practicable to adopt the EISs (DOE, 2008b, c; 2002) with supplementation as discussed in Section 3.2.1.4.2.

6 REFERENCES

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APPENDIX A

CONTRIBUTORS TO THE REVIEW

Name	Organization	Education	Years of Experience
Ahn, Tae	U.S. Nuclear Regulatory Commission (NRC)	Dr., Metallurgy, 1978 M.E., Materials Science, 1974 B.S., Metallurgical Engineering, 1970	25
Arlt, Hans	NRC	Dr. rer.nat., Natural Science, 1995 B.S., Geological Sciences, 1981	15
Benke, Roland	Center for Nuclear Waste Regulatory Analyses (CNWRA)	Ph.D., Nuclear Engineering, 2000 M.E., Radiological Health Engineering, 1996 B.S., Nuclear Engineering, 1994	14
Bradbury, John	NRC	Ph.D., Geochemistry/Mineralogy, 1984 M.S., Geology, 1975 B.S., Chemistry, 1970	24
Bryan, C. Hobson	Consultant	Ph.D., Sociology/Psychology, 1968 M.A., Sociology/Psychology, 1966 B.A., Sociology/Psychology/English, 1964	44
Canter, Larry	Consultant	Ph.D., Environmental Health Engineering, 1967	41
Cook, John	NRC	M.S., Environmental and Industrial Health, 1975 B.S., Chemistry, 1972	33
Compton, Keith	NRC	Ph.D., Environmental Engineering and Science, 2001 B.S., Physics, 1986	16
Dancer, David	NRC	M.S., Chemical Engineering, 1969 B.S, Chemical Engineering, 1967	41
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Garcia-Santos, Norma	NRC	M.S., Chemical Engineering, 2001 B.S., Chemical Engineering, 1997	8
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Tillar, William	Consultant	M.S., Air Pollution Meteorology, 1992 B.S., Atmospheric Sciences, 1990	18

Name	Organization	Education	Years of Experience
Turner, David R.	CNWRA	Ph.D., Geology, 1990 M.S., Geology, 1985 B.A., Music/Geology, 1981	27
Vechioli, Lucieann	NRC	B.S., Mechanical Engineering, 2004	3
Werling, Bradley	CNWRA	M.S., Environmental Science, 2000 B.S., Chemistry, 1999 B.A., Engineering Physics, 1985	23
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Witt, Kevin	NRC	M.S., Nuclear Engineering, 2003 B.S., Mechanical Engineering, 2001	7

APPENDIX B

CONSULTATION LETTERS

August 16, 2008

Dr. William J. Boyle, Director
Regulatory Authority Office
Office of Civilian Radioactive Waste Management
U.S. Department of Energy
1551 Hillshire Drive
Las Vegas, NV 89134-6321

SUBJECT: U.S. NUCLEAR REGULATORY COMMISSION REQUEST FOR AMENDMENT TO THE DRAFT PROGRAMMATIC AGREEMENT BETWEEN THE U.S. DEPARTMENT OF ENERGY, NEVADA STATE HISTORIC PRESERVATION OFFICE, AND THE ADVISORY COUNCIL ON HISTORIC PRESERVATION FOR THE PROPOSED GEOLOGIC REPOSITORY AT YUCCA MOUNTAIN, NEVADA

Dear Dr. Boyle,

The U.S. Nuclear Regulatory Commission (NRC) staff understands that the U.S. Department of Energy is preparing a programmatic agreement (PA), titled "Programmatic Agreement for the Development of a Nuclear Waste Repository at Yucca Mountain, Nye County, Nevada," as part of its consultation process under Section 106 of the National Historic Preservation Act (NHPA) for the proposed geologic repository at Yucca Mountain. To help fulfill NRC's obligations under the NHPA, NRC may wish to become a concurring party to this PA, if it is finalized and if NRC grants a construction authorization for the proposed repository.

NRC requests that the following clause be included in the draft PA:

> [Whereas, the U.S. Nuclear Regulatory Commission (NRC) may wish to become a concurring party to this Programmatic Agreement, if NRC grants a construction authorization for the proposed repository.]

On July 29, 2008, NRC staff spoke with Mr. Thomas McCulloch of the Advisory Council on Historic Preservation, who stated he does not object to the inclusion of this clause. A copy of this letter is being provided to the Advisory Council on Historic Preservation and the Nevada State Historic Preservation Office for their information.

Please contact Ms. Christine Pineda or Ms. Carmen Rivera, of my staff, if you have any questions about this matter. Ms. Pineda can be reached at 301-492-3154 or Christine.pineda@nrc.gov. Ms. Rivera can be reached at 301-492-3186 or Carmen.rivera@nrc.gov.

Sincerely,

Jeffrey Clark, Acting Deputy Director **/RA/**
Division of High-Level Waste Repository Safety
Office of Nuclear Material Safety
and Safeguards

cc: See attached list.

Alice Baldrica,
Nevada State Historic Preservation Officer
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QA: N/A

JUL 29 2008

Mr. Robert D. Williams, Field Supervisor
U.S. Department of the Interior
Nevada Fish and Wildlife Office
1340 Financial Boulevard, Suite 234
Reno, NV 89502

Dear Mr. Williams:

In August 2001, the U.S. Department of Energy (DOE) and the U.S. Fish and Wildlife Service completed formal consultation for the construction, operation, monitoring, and closure of a geologic repository at Yucca Mountain, Nevada. As part of its obligation under the Nuclear Waste Policy Act, as amended, the DOE was the lead agency for that consultation, pursuant to 50 C.F.R. 402.07.

The DOE recently submitted a license application to the U.S. Nuclear Regulatory Commission (NRC) seeking authorization to construct a repository for spent nuclear fuel and high-level radioactive waste at Yucca Mountain. That application will now undergo an acceptance review, and if docketed, the NRC will conduct technical reviews and hearings to consider the scientific and design information in the application. If the NRC authorizes DOE to construct the repository, the NRC would be the regulator.

The construction activities that DOE described in the license application are covered in the scope considered during the 2001 formal consultation and during development of the *Final Biological Opinion for the Effects of Construction, Operation and Monitoring, and Closure of a Geologic Repository at Yucca Mountain, Nye County, Nevada (2001)*.

If you have any questions of the DOE or need additional information, please contact Marian J. Crawford of my staff at (702) 794-5585.

Sincerely,

James W. Hollrith, Director
Construction Management and
Site Operations Office

cc:
Cynthia Martinez, U.S. Fish and Wildlife Service,
Southern Nevada Field Office, Las Vegas, NV