

STRATEGIC BASIS FOR LICENSE APPLICATION PLANNING FOR A POTENTIAL YUCCA MOUNTAIN REPOSITORY

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ABSTRACT

If Yucca Mountain, Nevada is designated as the site for development of a geologic repository for disposal of spent nuclear fuel and high-level radioactive waste, the Department of Energy (DOE) must obtain Nuclear Regulatory Commission (NRC) approval first for repository construction, then for an operating license, and, eventually, for repository closure and decommissioning. The licensing criteria defined in Code of Federal Regulations, Title 10, Part 63 (10 CFR Part 63) establish the basis for these NRC decisions. Submittal of a license application (LA) to the NRC for authorization to construct a repository at the Yucca Mountain site is, at this point, only a potential future action by the DOE. The policy process defined in the Nuclear Waste Policy Act (NWPA), as amended, for recommendation and designation of Yucca Mountain as a repository site makes it difficult to predict whether or when the site might be designated. The DOE may only submit a LA to the NRC if the site designation takes effect. In spite of this uncertainty, the DOE must take prudent and appropriate action now, and over the next several years, to prepare for development and timely submittal of a LA. This is particularly true given the need for the DOE to develop, load, and certify the operation of its electronic information system to provide access to its relevant records as part of the licensing support network (LSN) in compliance with NRC requirements six months prior to LA submittal. The DOE must also develop a LA, which is a substantially different document from those developed to support a Site Recommendation (SR) decision. The LA must satisfy NRC licensing criteria and content requirements, and address the acceptance criteria defined by the NRC in its forthcoming *Yucca Mountain Review Plan* (YMRP). The content of the LA must be adequate to facilitate NRC acceptance and docketing for review, and the LA and its supporting documents must provide the documented basis for the NRC findings required for a construction authorization. The LA must also support a licensing proceeding before an Atomic Safety and Licensing Board panel prior to NRC action on any decision to authorize construction. The DOE has established a strategic basis for planning that is intended to provide the framework for development of an integrated plan for activities leading to preparation and submittal of a LA.

INTRODUCTION

The DOE's overall objective is to ensure safe disposal of spent nuclear fuel and high-level radioactive waste consistent with applicable laws and safety standards. The primary and more

immediate objective is submittal of a complete and defensible LA to the NRC as soon as possible following the potential designation of the Yucca Mountain site for development as a repository. This position paper defines the general path forward to achieve that objective, including a strategic planning basis and identification of selected decisions or actions that may be needed. Lower-level strategies and cost-effective implementation plans based on the strategic planning basis established here must be prepared to support the DOE's multi-year planning process.

GENERAL STRATEGIC BASIS FOR PLANNING

The LA submitted to the NRC must present sufficient information to demonstrate compliance with the requirements in the NRC's rule establishing the criteria for disposal of high-level radioactive wastes in a potential geological repository at Yucca Mountain, Nevada - 10 CFR Part 63 (1). The LA must be:

- Complete – Provide the information necessary to satisfy NRC content requirements in 10 CFR Part 63 and address the guidance in the forthcoming YMRP to facilitate docketing;
- Transparent and traceable – Provide sufficiently detailed information as to purpose, method, assumptions, inputs, conclusions, and references, so that an independent NRC reviewer technically qualified in the subject area can generally understand the essential information relied upon as the technical basis for the DOE licensing/compliance case without having to consult the supporting documents or the originator of the documents. It should be possible to assess the adequacy of the licensing/compliance case based on full traceability to the supporting documents and other information to permit further, more detailed examination of the technical basis relied upon for the licensing case at reviewer discretion;
- Defensible – The technical case presented for compliance with NRC requirements and performance objectives must be supported by the technical basis documents and the available information.

Preparation and review of the LA are not quality affecting activities and are not subject to the requirements of the DOE *Quality Assurance Requirements and Description* (QARD) (2). The Final Environmental Impact Statement (FEIS) will accompany any LA submitted to the NRC by the DOE. There is no current basis to conclude that a supplement to the FEIS will be needed at LA submittal. The design-basis eventually developed for licensing will be evaluated to ensure that appropriate documentation is prepared, consistent with the requirements of the National Environmental Policy Act, to support NRC adoption of the DOE's FEIS.

The technical basis for the LA must build on the final technical basis for a possible SR decision for several reasons:

- Site characterization must be complete prior to a decision by the Secretary of Energy to recommend the site; the expectation is that only a limited amount of confirmatory or design-specific testing will be needed after that decision to verify or otherwise enhance confidence in the technical basis for the LA;
- The technical basis for a SR decision must provide adequate confidence for that decision and, therefore, must be the foundation for development and refinement of the technical basis for the LA;

- The technical basis for the LA, which will support LA preparation and any eventual NRC review, must be essentially complete at the time of initial certification of the LSN, six months prior to LA submittal as required by 10 CFR Part 2, Subpart J (3).
- Use of the existing technical basis, including the SR design basis, as a starting point should provide both schedule and cost benefits for completion of the LA and its supporting technical basis; it should also facilitate NRC review of the LA and its supporting documents since the NRC reviewed the preliminary technical documents for a possible SR decision as one basis for developing its sufficiency comments.

Preparation and review of the technical basis for the LA are classified as quality-affecting activities and are subject to the requirements of the QARD and applicable procedural controls. Existing quality issues and any new or recurring issues must be resolved expeditiously and appropriate measures taken to prevent recurrence. If significant changes to the technical basis existing at the time of a SR decision are needed, they must be justified in terms of their relevance to meeting the primary objective for submittal of a complete and defensible LA and any potential cost impacts.

Development of the technical documents that provide information needed to prepare the LA will take place in parallel only when that approach will not affect the quality of downstream products (e.g., development of Process Model Reports [PMRs] in parallel with the Total System Performance Assessment [TSPA], assuming that the TSPA is based on the Analysis and Model Reports [AMRs] that are summarized and integrated in the PMRs). Adequate review time must be provided to ensure that the information incorporated in downstream products, including draft LA chapters, is consistent with the final source material. Version control of all documents must be maintained and a structured process adhered to for document development and review.

The technical work conducted following SR and prior to completion of the technical basis for the LA must clearly focus on:

- Providing additional design-specific information needed as part of the technical basis for the LA that was not needed for a SR decision;
- Improving confidence in or refining models and other elements of the existing technical basis to enhance the compliance case presented in the LA for NRC review.

Adequate justification must be provided if the results from such work are to be relied upon in developing the technical basis for the LA. A clear distinction must be made between information that will be used to develop the LA technical basis and information that will only be used to verify the essential assumptions, data, and analyses that support the design, preclosure safety analysis, and postclosure performance assessment that will be the basis for NRC findings for construction authorization. Verification may include performance confirmation, research and development work, or other information gathering activities not critical to LA preparation. Work that directly supports the technical basis for the LA takes precedence over work intended only to verify the existing technical basis, unless the work is underway and stopping it would result in irretrievable loss of data.

Further definition and implementation of the strategy must be consistent with DOE budget guidance for development of the annual updates to the Yucca Mountain Project (YMP) multi-year plan for the fiscal years through submittal of the LA. Work must focus on achieving the primary objective for submittal of a complete and defensible LA, but must also adequately support a prioritized and phased infrastructure investment plan that anticipates infrastructure needs at the time of a possible construction authorization.

The final NRC licensing criteria (10 CFR Part 63) were issued on November 2, 2001 (1). The YMRP should be released shortly. Adjustments, if any, to the approach for work in fiscal year 2002 (FY02) and the basis for defining work to complete the LA and its supporting technical basis must satisfy the NRC licensing requirements and adequately address NRC guidance. Evaluation of the NRC requirements and guidance should be complete and appropriate changes made to the YMP baseline and to the LA Guidance and Products Database as soon as possible after the YMRP is issued. These changes must be documented early in the process to facilitate completion of the LA technical basis and the LA.

Non-NRC requirements that govern YMP activities must be adequately addressed, including those imposed by DOE directives, external regulation and oversight (e.g., permit terms and conditions), and other Federal and State agencies.

The strategic approach and plans to address the NRC's Key Technical Issues (KTIs) and preclosure topics, and the related agreement items, are major elements in defining the path forward to submittal of a LA that the NRC will docket for review in an expeditious manner. All KTIs and agreement items must be adequately considered and addressed by the time the LA is submitted to provide support for NRC docketing. Wherever possible, agreement items should be closed prior to LA submittal based on available information or information from ongoing activities, and updates of technical documents to reflect this information or provide clarification. Additional work, including new testing and analyses, will undertaken in cases where it was clearly specified, or where it is not specified but essential to satisfy an agreement. Some information documented in the agreement items may be confirmatory.

PLANNING BASIS FOR SPECIFIC TECHNICAL AND SUPPORT AREAS

Design

The primary focus must be on development of the appropriate level of design documentation and analysis needed for the LA submittal (e.g., System Description Documents (SDDs), design analyses, materials lists and specifications, general arrangement drawings, process and flow diagrams). Justification for the design products list must be provided and must be consistent with the "*Level of Design Detail Necessary for the License Application for Construction Authorization*" (4). The NRC has indicated its general agreement with the DOE approach as documented in the "Summary Highlights of NRC/DOE technical Exchange and Management Meeting on Pre-Closure Safety, July 24-26, 2001" (5).

The flexibility to operate the design to achieve a range of temperatures following repository closure must be preserved. Documentation to supplement the existing qualified documentation

for the upper end of the thermal range must be available to support LA development if the lower end of the thermal range is considered in the basis for licensing.

There will be no provision for new boreholes to characterize expansion areas to accommodate a possible lower-temperature operating mode for input to the LA for construction authorization. Available information on subsurface conditions in potential expansion areas from surface mapping, geophysical surveys, and extrapolation of data from existing boreholes should provide an adequate basis for a preliminary design for the LA. There will be adequate time following LA submittal to obtain any additional subsurface information needed for final design and construction since potential expansion areas will not be developed until well after a license is received.

The design and concept of operations will support modular construction of surface and subsurface facilities (e.g., incremental, step-wise construction of surface waste packaging facilities and subsurface emplacement drifts), and time phasing of both construction and operations, consistent with the approach described in the *Yucca Mountain Science and Engineering Report* (YMS&ER) (6). Such an approach will allow sequential decisions to be made incorporating lessons learned and permit the leveling of annual construction costs. Changes to the design and requirements baseline should be the minimum necessary to address these construction and operational concepts, and any associated safety issues (e.g., parallel construction and operation of surface and subsurface facilities). Given the previously stated strategic approach to definition of the level of design detail for the LA for construction authorization, there should be limited need for prototype work prior to LA submittal. Any prototype work conducted must be justified in terms its significance to the NRC findings required for construction authorization. Prototype work that has the potential to present significant resource conflicts or that could substantially delay LA submittal will not be funded, absent a demonstration of a critical link to the defensibility of the licensing case.

The LA requirement to provide the proposed schedules for construction, receipt and emplacement should be based on the modular and phased development of surface and subsurface facilities. The schedules should clearly indicate the extent of construction that will constitute "substantially complete construction" for the finding that NRC must eventually make as one basis for issuance of a license to receive and possess waste (e.g., similar to the Phase I development plan in the YMS&ER). The proposed schedule must also reflect the expected waste stream, and decisions made with respect to initial receipt and emplacement rates, and planned changes in both receipt and emplacement rates over time.

The preclosure safety analysis (PSA) required by 10 CFR Part 63 and the documentation that supports the PSA must build on the preliminary preclosure safety assessment developed as part of the technical basis for a SR decision. Consistent with the preliminary assessment for SR, the PSA developed and documented as part of the technical basis for the LA will be based on a 100-year operating period, although the design will not preclude extended operations and monitoring for up to 300 years.

Achievement of the primary objective for submittal of the LA takes precedence over considerations such as long-lead construction-design and procurement to the extent that such

considerations would delay LA submittal. The long-range strategic planning basis following LA submittal must include consideration of long-lead items, but there is no provision for early construction that would require an exemption from the NRC licensing requirements in 10 CFR Part 63.

Science and Analysis

The NRC (1) describes a performance assessment (i.e., TSPA) as a systematic analysis that identifies the features, events, and processes (FEPs) that might affect the performance of a Yucca Mountain repository system and their probabilities of occurrence, and examines the effects those FEPs on that performance. The TSPA is used to estimate radiological exposures and releases to the accessible environment to demonstrate compliance with the postclosure standards in 10 CFR Part 63, Subpart L, for individual protection, human intrusion, and ground-water protection.

There will be a single TSPA developed and documented in accordance with applicable QA requirements and procedures, as part of the technical basis for the LA. This will avoid potential problems associated with bringing two different analyses, based on different sets of modeling assumptions (e.g., bounding versus realistic), into the licensing review process. The TSPA that supports the LA will be developed from the TSPA supplemental model described in volume 2 of the *FY01 Supplemental Science and Performance Analyses* (SSPA) (7), consistent with the general strategic approach for development of the technical basis for the LA based on that for the SR decision. Revisions to model components, process models, and model abstractions, if needed to support a TSPA more representative of expected repository performance, will be developed and discussed with the NRC, and documented in updated AMRs. PMRs will summarize and integrate the information from the AMRs for each process model to provide a source for development of related portions of the LA. The PMRs may also provide a more integrated reference than the AMRs for certain information needed to support the TSPA model and to justify the bases for the analyses performed. The analyses performed must be consistent with the NRC postclosure performance objectives and requirements in 10 CFR Part 63. The documentation of the technical basis for the TSPA must address the acceptance criteria in the YMRP.

Models used for the TSPA to evaluate compliance with regulatory requirements for repository system performance after closure should utilize the available scientific and design information to make credible and defensible projections that represent expected long-term repository performance wherever possible, including the uncertainty associated with modeling such behavior. Such a representation is preferred over one that is inappropriately conservative or bounding and that would tend to underestimate or mask repository performance, limit the ability to understand and demonstrate the relative contributions of the various repository barriers important to waste isolation, and reduce flexibility in making necessary design decisions and constructing compliance arguments. The data and software used in support of model development and TSPA analyses must be fully qualified, and all models must be validated (i.e., information presented to provide confidence that the models are valid for their intended use).

The design basis for the TSPA completed for the LA will be consistent with the LA design basis that evolves from that described in the YMS&ER (see discussion under Design above), including

operating conditions that affect the postclosure environment, emplacement area, and rate and duration of ventilation. Performance analyses and documentation for the lower end of the thermal range to supplement the existing qualified performance analyses for the upper end of the thermal range must be available to support LA development if the lower end of the thermal range is considered in the basis for licensing.

Only new work that is directly related to meeting the requirements of 10 CFR Part 63, addressing criteria in the YMRP, or satisfying KTI agreements, will be considered. It is expected that most of the work needed to establish the technical basis for the LA will involve additional analyses and updates of documentation to clarify or enhance the basis for the assessment of compliance with the NRC's postclosure performance objectives. The *Yucca Mountain Site Description* must be updated to document the current understanding of site conditions, including that resulting from new work relevant to licensing, as the basis for information presented in the LA and its supporting documents. The *Yucca Mountain Site Characterization Project Site Atlas* must also be updated to document the locations and areas of study for the investigations conducted at the Yucca Mountain site to support development of a description of work conducted to characterize the site for input to the LA.

The QARD Supplement III requirement (2) that data relied upon "to address safety or waste isolation issues" shall be identified in a manner that facilitates traceability to associated documentation and to its qualification status must be met. The documentation and the data reduction processes used must be described in enough detail to allow independent qualified individuals to either "retrace the investigations and confirm the results, or...repeat the investigation and achieve comparable results, without recourse to the original investigator." This requirement relates to both parameter values, and their supporting data; and models and their supporting technical and theoretical basis. There must be agreement among investigators and modelers on the aspects of parameter development; a formal process for development and tracking of parameter values through any intermediate modeling steps to the ultimate intended use in TSPA; consistent use of parameter distributions; a formal process to document and control parameter values for specific code runs so that the output can be duplicated; and configuration control of models and software.

Requirements for technical data management must be met to ensure that the data that are relevant to licensing are accessible and traceable. The Technical Data Management System (TDMS) must be updated, maintained, and made available to the NRC to support closure of KTI agreement items prior to LA submittal and to facilitate NRC review of the LA, if one is submitted.

License Application/Licensing

The LA must be sufficiently comprehensive and transparent to support independent reviews by NRC staff and others. Reviewers should be able to develop an understanding of the essential data, interpretations, models, designs and design bases, and performance and design analyses, that are relied upon as the technical basis for the DOE's licensing case without need to refer to the supporting documents for the licensing case. The LA must be sufficiently traceable so reviewers can easily go to more detailed information relevant to the licensing case in the

supporting technical documents (or to cross-referenced material within the LA) should they choose to conduct a more detailed review. This approach is intended to facilitate NRC review and completion of the staff Safety Evaluation Report (SER) within the 18-month period defined in the schedule for the licensing proceeding in Appendix D of 10 CFR Part 2 (3). Consistent with this approach, there should be no specification of page counts for LA chapters.

Pre-licensing interactions with the NRC must be clearly linked to the completion of documentation to address the KTI agreement items. Additional meetings will be considered, as appropriate, to reach early agreement with the NRC on the LA format and content, resolution of preclosure safety and design-detail issues, and selected approaches and methodologies critical to the licensing case. Interactions will continue on the topical reports currently under NRC review or for which DOE has committed to provide additional information (e.g., reports covering methods for assessment of the seismic design basis and criticality).

Commitments and comments from the NRC and all other external parties will be managed using an appropriate database management system, with incremental modifications as necessary to improve its function. This system will also be used to manage and document decisions.

Technical and regulatory reviews of draft LA chapters by all affected offices within the DOE, as well as Naval Reactors, must occur in parallel to make the initial review process as efficient as possible. The review of draft chapters must be complete along with the essential supporting technical basis documents before initial LSN certification, six months prior to LA submittal. DOE management review of and concurrence on the integrated LA, and production of the final document, will take place during the six months following initial LSN certification. Opportunities to accelerate the LA development schedule should be considered, including early preparation and review of programmatic inputs (e.g., general descriptions of the QA program, emergency response plan, records maintenance program) at a level of detail appropriate for the LA for a construction authorization. Development of these inputs could begin following evaluation of NRC requirements in 10 CFR Part 63 and guidance in the YMRP.

TECHNICAL AND BUSINESS SUPPORT, INCLUDING INFRASTRUCTURE INVESTMENT

Support work must focus on achieving the primary objective of earliest possible submittal of a LA following a potential site designation, but must also adequately support a prioritized and phased infrastructure investment plan that anticipates infrastructure needs at the time of a possible construction authorization.

Information management and related administrative services must focus on defining the minimal work and staff requirements that are adequate and necessary to support elements critical to LA docketing and review, including records management activities and LSN development, loading, and monitoring to permit certification. YMP computer hardware and software upgrades should be limited to what is adequate and necessary to support YMP work and allow interoperability among users based on equipment that is supported by current technology. Adequate staff support for maintenance of current and new systems is essential. Specialized hardware and

software needs must be evaluated and any acquisitions justified in terms of their support for work needed for the LA.

Testing support efforts must adequately support ongoing testing and the minimal amount of new testing that is needed to confirm or enhance the LA technical basis. Support for long-term confirmatory testing will be limited and must be justified. Support activities must be integrated with design, science, and analysis activities and needs. Future site construction, operations, and support services must be based on a site development plan. Proposed investments in infrastructure and site improvements must be prioritized and phased to ensure YMP needs are met at the time of a possible construction authorization. Safety will be maintained through risk-informed and cost-effective use of both infrastructure improvements (higher cost) and administrative controls (lower cost). Infrastructure investment decisions must weigh potential benefits against the potential impact on the schedule for LA submittal.

Environmental safety and health must focus on meeting permit terms and conditions for current activities. Permitting for future activities must be considered, with potential risks of delay in the permit approval process weighed against potential significance to and effects on LA submittal. Work in this area must be limited to what is sufficient to meet applicable DOE directives, and satisfy DOE's Integrated Safety Management requirements.

SUMMARY

Submittal of a LA to the NRC for authorization to construct a repository at the Yucca Mountain site is, at this point, only a potential future action by the DOE. The policy process defined in the Nuclear Waste Policy Act (NWPA), as amended (8, 9), for recommendation and designation of Yucca Mountain as a repository site makes it difficult to predict whether or when the site might be designated. The DOE may only submit a LA to the NRC if the site designation takes effect. In spite of this uncertainty, the DOE must take prudent and appropriate action now, and over the next several years, to prepare for development and timely submittal of a LA. This is particularly true given the need for the DOE to develop, load, and certify the operation of its electronic information system to provide access to its relevant records as part of the LSN in compliance with NRC requirements (3) six months prior to LA submittal. The DOE must also develop a LA, which is a substantially different document from those developed to support a SR decision. The LA must satisfy NRC licensing criteria and content requirements (1), and address the acceptance criteria defined by the NRC in its forthcoming YMRP. The content of the LA must be adequate to facilitate NRC acceptance and docketing for review, and the LA and its supporting documents must provide the documented basis for the NRC findings required for a construction authorization. The LA must also support a licensing proceeding before an Atomic Safety and Licensing Board panel prior to NRC action on any decision to authorize construction.

The DOE's overall objective is to ensure safe disposal of spent nuclear fuel and high-level radioactive waste consistent with applicable laws, regulations, and environmental radiation protection standards. The primary and more immediate objective is submittal of a complete and defensible LA to the NRC as soon as possible following the potential designation of the Yucca Mountain site for development as a repository. The DOE has established a strategic basis for planning that defines the general path forward to achieve that objective. It is intended to provide

the framework for development of an integrated plan for activities leading to preparation and submittal of a LA, including identification of selected decisions or actions that may be needed. Lower-level strategies and cost-effective implementation plans based on the strategic planning basis must be prepared to support the DOE's multi-year planning process.

REFERENCES

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