# Phased Licensing Approach in NRC Regulations for Yucca Mountain

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**Abstract -** *The societal decision to pursue geological disposal in the United States has involved a long, deliberative, and public process. As part of this public process, the U.S. Nuclear Regulatory Commission published regulations for the disposal of high-level radioactive waste in a proposed repository at Yucca Mountain, Nevada. The regulations provide the licensing requirements to ensure protection of the public and the environment, and the safety of workers, near a potential repository at Yucca Mountain. In particular, the regulations provide for licensing decisions at three phases of development of a high-level waste repository (i.e., construction, operation, and permanent closure). The "phased" or step-wise approach recognizes that significant time (i.e., decades) will be needed to construct and emplace waste in the repository, therefore, it is beneficial to consider safety decisions at logical points in the development of the repository and consider the current understanding of the site as well as improvements in science and engineering. At each phase that decisions are made, the Department of Energy must provide sufficient information to enable the NRC to determine whether to grant a license, grant a license with conditions, or deny a license. NRC's "phased" approach in the regulations for high-level radioactive waste disposal at Yucca Mountain provide for continued development of confidence in licensing decisions. If confidence in repository safety is lost, waste can be retrieved, if necessary, to protect public health and safety. The public and stakeholders will have access to information throughout the process.*

## I. INTRODUCTION

The U.S. Nuclear Regulatory Commission (NRC) published regulations for the disposal of high-level radioactive waste in a proposed repository at Yucca Mountain, Nevada on November 2, 2001[1]. The U.S. societal decision to pursue geologic disposal of high-level waste has involved a long, deliberative, and public process. Initial statutory direction was enacted by the Nuclear Waste Policy Act (NWPA) in1982. In particular, this legislation directed the NRC to set technical requirements and criteria applicable to licensing decisions for three phases of development of a high-level waste repository (i.e., construction, operation, and permanent closure). The "phased" or step-wise approach recognizes that significant time (i.e., decades) will be needed to construct and emplace waste in the repository, therefore, it is beneficial to consider safety decisions at logical points in the development of the repository and consider the current understanding of the site as well as improvements in science and engineering. An important aspect of the "phased" approach is retaining an option to remove (or retrieve) the waste from the repository. The preservation of the ability to retrieve the waste throughout all phases of the licensing process provides flexibility to the decisions makers to reverse the disposal decision if the need arises. NRC's regulations implement a "phased" approach that is aimed at building confidence in regulatory decisions by providing: (1) stable regulatory structure; (2) well-defined decision points and thorough safety reviews; (3) flexibility to take advantage of evolution of technology; (4) opportunities for public involvement; and (5) preservation of a retrieval option.

## II. STABLE REGULATORY STRUCTURE

NRC regulations include technical requirements and criteria, consistent with final environmental standards for Yucca Mountain issued by the U.S. Environmental Protection Agency (EPA) [2] as well as other technical criteria mandated by the NWPA (i.e., the repository system be comprised of multiple barriers). The regulations also include criteria that define the licensing process and the collection of new information such as: licensing criteria; participation in license reviews by the State of Nevada, affected units of local government, and

Indian Tribes; records and reporting; monitoring and testing programs; and performance confirmation. Information is collected throughout the development of the repository (i.e., during site characterization, construction, and operation) and is evaluated at well-defined decision points. The NRC's regulatory structure provides for stability in licensing decisions by specifying the information required to make the licensing decisions at specific decision points and how evolving information is to be incorporated in the licensing process.

## III. WELL-DEFINED DECISION POINTS AND THOROUGH SAFETY REVIEWS

The objective of a step-wise or "phased" approach is to build confidence in the regulatory decisions through well-defined decision points that have logical links to the evolution of the safety case over the period of repository development. The NRC's regulations identify three decision points or phases (i.e., construction authorization, license to receive and possess radioactive waste, and license amendment for permanent closure) and provide specific requirements that are to be considered for each decision. The time required to complete this phased process will allow for generation of additional information. Clearly, the information available at the time of the initial decision (i.e., construction authorization) will be less than that at subsequent phases. However, at each phase, the Department of Energy (DOE) must provide sufficient information to support that phase. Information is required for NRC to review operational safety (e.g., radiation protection for workers, emergency planning) and postclosure safety (e.g., demonstration of compliance with dose limits, description of engineered and geologic barriers of the repository, and performance confirmation program).

At the construction authorization stage, the NRC will determine whether DOE's demonstration of safety is complete and defensible (i.e., whether protection of workers and public health and safety and the environment is maintained during operations; and public health and safety and the environment is protected over the 10,000 year postclosure compliance period after the repository is permanently closed). For example, DOE will need to provide information that shows it has (1) identified and evaluated accident sequences related to the design and operation of the waste handling and emplacement activities of the repository; (2) considered relevant features, events, and processes that could affect the timing and magnitude of the dose estimates over the postclosure compliance period; and (3)designed the repository consistent with the objectives of the material control and accounting program and the retrieval option. Additionally, the DOE will need to describe its performance confirmation program (i.e., program to continue to conduct site and engineering investigations to confirm the understanding of repository system). The performance confirmation program continues until permanent closure with the single objective to test and confirm the technical basis for the safety decisions. Contested issues raised by parties in the high-level waste proceeding will be critically reviewed through the NRC's hearing process. The NRC staff will conduct an independent and thorough review and Commission review of issues contested in the proceeding and uncontested issues is required before issuance of a construction authorization.

Once DOE has completed construction sufficient for initial operations, a decision is made at this second phase as to whether to grant, grant with conditions, or deny a license for the U.S. Department of Energy DOE to receive and possess high-level waste. At this time, the NRC will review DOE's "updated" license application. From an operational perspective, the license application will be updated in the sense that the repository operations area is ready for initial operations (e.g., waste handling facilities and initial repository drifts are complete). Prior to determining whether to issue a license, the Commission can make findings based in part, on inspection of above ground facilities and repository drifts rather than the review of plans that were submitted at the construction authorization phase. Inspection of geologic repository operations area would need to confirm that DOE built the repository as described in its licence application and repository operations can be conducted consistent with the regulations (e.g., radiation protection for workers, and adequate protective measures can and will be taken in the event of a radiological emergency). From a postclosure perspective, the license would be updated in the sense that information obtained during construction and the performance confirmation program is evaluated in the context of the prior safety decisions (i.e., assumptions, data, and analyses that led to the findings that permitted the construction). NRC's decision on the license to receive and possess high-level waste is also subject to NRC's hearing process.

A final phase (permanent closure) occurs when DOE seeks a license amendment to permanently close the repository. At this time, emplacement of waste will have ceased and the performance confirmation program has been completed. NRC must determine whether DOE has satisfied with the post closure requirements and whether new data (i.e., information collected under the

performance confirmation program) continue to support the bases for prior decisions.

## IV. FLEXIBILITY TO TAKE ADVANTAGE OF TECHNOLOGY

It is recognized that the development of a repository (i.e., construction of repository drifts, emplacement of waste, and closure of the repository openings) will occur over a number of decades. Over this time period, it can be expected that knowledge in science and engineering will continue to grow that will aid understanding of the overall behavior and safety of the repository. Additionally, the regulations specify that the DOE is to conduct a "performance confirmation" program that is aimed at confirming the assumptions, data, and analyses that supported the construction of the repository and subsequent emplacement of the wastes. The performance confirmation program is focused on the assumed subsurface conditions and assumed functionality of the geologic and engineered systems and components important to the postclosure performance of the repository and the related performance assessment (i.e., quantitative analyses used to estimate future behavior or performance of the repository). It is expected that new information, both from the performance confirmation program and the evolution of technology over the extensive time (i.e., decades) planned for repository development, may require re-evaluation and potential design changes. The design changes and re-evaluations will not necessarily occur at times amenable for consideration at the key decision points (e.g., license to receive and possess high-level waste). The NRC process provides flexibility for DOE to propose and NRC to review and approve design changes for the enhancement of safety or cost benefit changes consistent with safety. Further, NRC's regulations require DOE to provide timely notification and evaluation of any information with significant safety implications. This information and DOE's evaluation is subject to NRC review. All information, changes, and supporting evaluations are made available for public review consistent with protection of sensitive security data.

## V. OPPORTUNITIES FOR PUBLIC INVOLVEMENT

The U.S. societal decision to pursue geologic disposal of high-level waste has involved a long, deliberative, and public process. As part of the process, the U.S. Congress considered and debated technical, political, and social issues in the development of statutory direction of the U.S. high-level waste program – specifically the Nuclear Waste Policy Act was enacted in 1982 that specified objectives for the high-level waste program and defined the roles of the Department of Energy, the Environmental Protection Agency, and the Nuclear Regulatory Commission. This was amended in 1987 to focus on Yucca Mountain. Later, in 1992 Congress passed the Energy Policy Act that directed the EPA to contract with the National Academy of Sciences (NAS) to provide recommendations for health based standards for Yucca Mountain. The NAS held meetings, which were open to the public, to assist its deliberations on the recommendations for Yucca Mountain standards. The NAS published its recommendations for Yucca Mountain standards in 1995. The EPA proposed standards for Yucca Mountain for public comment in 1999 and finalized the standards in 2001. The NRC likewise proposed regulations for Yucca Mountain in 1999 for public comment and finalized the regulations in 2001.

The societal process continued with the President's decision to approve the Department of Energy's site recommendation. Once the Presidential decision was made, the State of Nevada exercised its right to object to the site recommendation. Congress debated the issue and voted to approve the site recommendation. The DOE is preparing a license application tentatively planned for submission to the NRC in late 2004. NRC has 3 years (with a possible 12-month extension) to complete its review and conduct a public hearing. Thus, the NRC licensing process is being initiated after more than 20 years of technical, political, and societal involvement and consideration for geological disposal of high-level waste. The public will continue to have opportunities for involvement during NRC's hearing process. The NRC's hearing process is a formal process conducted under rules that provide a transparent record of regulatory decisions on contested issues.

## VI. PRESERVATION OF RETRIEVAL OPTION

The option for retrieval of emplaced waste is a fundamental aspect of NRC regulations related to the "phased" approach. The "phased" approach allows increased understanding to be developed and considered throughout all phases of the licensing process. Preservation of the ability to retrieve waste throughout all the phases of the licensing process provides flexibility to the decision makers to reverse the disposal decision if confidence in safety is lost. The Commission recognized that the retrieval operation would be an unusual event, and may be an involved and expensive operation [3]. Therefore the repository design and procedures should not make it impossible or impractical to retrieve waste

prior to closing the repository if such retrieval turns out to be necessary to protect public health and safety. As such, DOE can expect that its plans and procedures in this area will receive review by the NRC staff as part of any construction authorization.

## VII. CONCLUSION

NRC's "phased" approach in the regulations for high-level radioactive waste disposal at Yucca Mountain provide for continued development of confidence in licensing decisions consistent with the time required to construct and operate the repository. NRC review and regulatory decisions occur at three logical and well-defined points, namely: construction authorization; license to receive and possess radioactive material; and amendment for permanent closure. At each stage that decisions are made, DOE must provide sufficient information to enable the NRC to determine whether to grant a license, grant a license with conditions, or deny a license. At the initial stage (i.e., construction authorization), the NRC review will primarily involve review of DOE plans and analyses, however, later phases also will involve updated information as facilities and underground openings are completed and performance confirmation tests are conducted. The NRC licensing process requires responsiveness to new information at key decision points and timely consideration of any information with significant safety implications. If confidence in repository safety is lost, waste can be retrieved, if necessary, to protect public health and safety. The public and stakeholders will have access to information throughout the process.

## DISCLAIMER

The NRC staff views expressed herein are preliminary and do not constitute a final judgment or determination of the matters addressed or of the acceptability of a license application for a geologic repository at Yucca Mountain.

## REFERENCES


1 NRC, "10 CFR Parts 19, 20, 21, 30, 40, 51, 60, 61, and 63 - Disposal of High-Level Radioactive Wastes in a Proposed Geologic Repository at Yucca Mountain, Nevada; Final Rule," November 2, 2001 (66 FR 55732).

2 EPA, "Public Health and Environmental Radiation Protection Standards for Yucca Mountain, NV," Final Rule, 40 CFR Part 197 (66 FR 32073; June 13, 2001)

3 NRC, "Staff Analysis of Public Comments on Proposed Rule 10 CFR part 60, `Disposal of High-Level Radioactive Wastes in Geologic Repositories'," Office of Nuclear Regulatory Research, U.S. Nuclear Regulatory Commission, NUREG-0804, December 1983; p. 11