

**DIVISION OF HIGH-LEVEL WASTE REPOSITORY SAFETY
DIRECTOR'S POLICY AND PROCEDURE LETTER 14**

**APPLICATION OF YMRP FOR
REVIEW UNDER REVISED PART 63 (PUBLISHED ON MARCH 13, 2009)**

1. POLICY

The U.S. Department of Energy (DOE) license application (LA) is being reviewed in a manner that is consistent with 10 CFR Part 63, which has been revised to incorporate those newly revised portions of the U.S. Environmental Protection Agency (EPA) standards (EPA, 2008) that specify environmental requirements for the period beyond 10,000 years after closure. The revisions to Part 63 specify quantitative limits for the potential exposures after 10,000 years, including requirements applicable to the performance assessment used to estimate the potential exposures. Additionally, the revised regulations prescribe the use of newer dosimetry for estimating doses for the pre-closure and post-closure period. Consistent with the requirements of Part 63, the U.S. Nuclear Regulatory Commission (NRC) staff and management are committed to using the Yucca Mountain Review Plan (YMRP) in an efficient and effective manner to assist with this review.

2. OBJECTIVES

The objectives of this Policy and Procedure Letter (PPL) are to clarify how the YMRP (NRC, 2003) is to be used to support review of the DOE license application in specific areas associated with the recent revisions made to Part 63 and to identify specific regulatory citations to be used in evaluation findings for those chapters in which the recent revisions affected the rule designations [e.g., 10 CFR § 63.114(a)].

Specific technical areas of the review affected by the recent revisions are:

- A) compliance with the individual protection standard for the period after 10,000 years;
- B) review of performance assessment for the period after 10,000 years; and
- C) use of newer dosimetry.

3. BACKGROUND

The YMRP is sufficiently detailed and the regulations for the period of time after 10,000 years are sufficiently prescriptive that the YMRP can be used, without revision, to assist the review of the DOE license application, subject to the following considerations.

The staff also needs to be made aware of changes to the regulations that affect the referencing to 10 CFR §§ 63.114, 63.311, 63.321 and 63.342 used in evaluation findings of certain chapters of the Safety Evaluation Report (SER).

See the Federal Register for further details on the revisions to Part 63 (NRC, 2009).

4. BASIC REQUIREMENTS

A) Compliance with Individual Protection

There are three overall acceptance criteria for evaluating DOE compliance with the individual protection standard: (1) the performance assessment must include appropriate scenarios, (2) peak dose cannot exceed the exposure standard, and (3) performance assessment must demonstrate a credible representation of repository performance. These acceptance criteria remain unchanged and are to be used in the review of the performance assessment for the period after 10,000 years subject to the specific constraints specified in Part 63. In particular, the following represent additional considerations beyond and in addition to those specified in the YMRP:

- 1) Scenarios used in the calculation of the annual dose as a function of time are adequate.
[Acceptance Criterion 1; page 2.2-133, YMRP]

Scenarios for the post-10,000 year period are considered adequate if they include the scenarios used in the performance assessment for the initial 10,000 years (e.g., the processes, their mathematical abstractions, and attendant parameters may remain the same as used in the 10,000 year assessment). However:

- The seismic analysis may be limited to the effects caused by damage to the drifts in the repository, failure of the waste packages, and long-term changes in the water table elevation under Yucca Mountain (i.e., the magnitude of water table rise under Yucca Mountain).
 - The igneous activity analysis may be limited to the effects of a volcanic event directly intersecting the repository. The igneous event may be limited to that causing damage to the waste packages directly, resulting in releases of radionuclides to the biosphere, atmosphere, or groundwater.
 - The climate change analysis may be limited to the effects of increased water flow through the repository as a result of climate change, and the resulting transport and release of radionuclides to the accessible environment.
 - The effects of general corrosion on engineered barriers must be assessed. A constant representative corrosion rate throughout the assessment period up to one-million years or a distribution of corrosion rates correlated to other repository parameters may be used.
- 2) An adequate demonstration must be provided to show that the annual dose does not exceed the exposure standard.
[Acceptance Criterion 2; page 2.2-134, YMRP]

The approach to evaluating the performance assessment provided in the YMRP for evaluating statistical stability of the average dose curve for the initial 10,000 years is to be applied to the average dose curve for period after 10,000 years.

- 3) The total system performance assessment code provides a credible representation of repository performance.
[Acceptance Criterion 3; page 2.2-134, YMRP]

The approach to evaluating the performance assessment provided in the YMRP for evaluating the credibility of the average dose curve for the initial 10,000 years is to be applied to the average dose curve for period after 10,000 years.

B) Review of Performance Assessment for the Period after 10,000 Years

Beyond what is performed under "Compliance with Individual Protection" (item A above), the review of the performance assessment for the period after 10,000 years is limited to the deep percolation rate and water table rise.

- 1) Deep Percolation Rate (Climate Change)

The nature and degree of climate change may be represented in the performance assessment by stochastically sampling constant-in-time climate conditions that commence 10,000 years after disposal and extend through the period of geologic stability (i.e., 1 million years). The constant-in-time values are the spatial average of the deep percolation rate within the area bounded by the repository footprint. The constant-in-time deep percolation rates used to represent climate change are based on a lognormal distribution with an arithmetic mean of 41 mm/year (1.6 inches/year) and a standard deviation of 33 mm/year (1.3 inches/year). The lognormal distribution is truncated so that the deep percolation rates vary between 10 and 100 mm/year (0.39 and 3.9 inches/year). Consistency of the deep percolation rates with the abstractions for flow paths in the unsaturated zone and saturated zones is considered in the YMRP as part of model integration (page 2.2-60 Acceptance Criterion 1 number 3) and is also appropriate to assist the review.

- 2) Water Table Rise Due to Seismic Events

The National Research Council (1992) conducted a comprehensive technical evaluation of mechanisms that could raise the water table at Yucca Mountain (National Research Council, *Ground Water at Yucca Mountain: How High Can It Rise?*, National Academy Press, Washington, D.C., 1992). The Council considered both the dynamic response of the water table to propagation of seismic waves, as well as the long-term hydrologic response of the ground water system to permanent changes in rock stress after the seismic waves pass. The Council concluded that transient effects are not relevant to the performance of a repository. Of potential significance, however, are permanent changes to the fluid pore pressure or rock permeability that may bring about long-term changes in the height of the water table. The Council concluded that the "results indicate a probable maximum transient rise on the order of 20 m or less."

NRC staff shall evaluate whether the DOE approach for determining the magnitude of the water table rise from seismic activity considers the information provided by the National Research Council as referenced in the National Academy of Sciences report entitled, "Technical Bases for Yucca Mountain Standards" (1995). Water table rise is considered in the YMRP as part of model integration (page 2.2-69 Acceptance Criterion 1 number 8 and page 2.2-85 Acceptance Criterion 1 number 9) and is also appropriate to assist the review.

3) General Corrosion

General corrosion of the engineered barriers is expected to continue after 10,000 years following the same material science principles that influence general corrosion in the initial 10,000 years (e.g., general corrosion processes, whether at 9,900 or 10,100 years after closure, follow the same principles). Staff shall confirm that the general corrosion rate or distribution of corrosion rates used in the performance assessment for the period after 10,000 years are consistent with experimental data, technical bases and the incorporation of uncertainty used for the general corrosion in the performance assessment for the initial 10,000 years. General corrosion of engineered barriers is considered in the YMRP as part of model integration (page 2.2-22 Acceptance Criterion 1 numbers 2 and 3) and is also appropriate to assist the review.

C) Review of Newer Dosimetry

The use of appropriate tissue or organ weighting factors in biosphere dose conversion factors is considered in the YMRP as part of data uncertainty in the biosphere modeling for the post-closure period (page 2.2-128 Acceptance Criterion 3 number 2) and is also appropriate to assist the review. The use of appropriate tissue or organ weighting factors in dose calculations for the pre-closure period is considered in the YMRP as part of the review of the pre-closure consequence analysis (page 2.1-32 Acceptance Criterion 2 number 1, page 2.1-33 Acceptance Criterion 2 number 6 and page 2.1-33 Acceptance Criterion 3 number 1) and is also appropriate to assist the review.

D) Regulatory Citations for Evaluation Findings

The YMRP contains citations to the regulations that are not consistent with the revised regulations at 63.114, 63.311, 63.321 and 63.342. The following table provides the old citation and the new citation to be used in the SER.

Description	Old Citation	New Citation
63.114 Requirements for performance assessment		
Include data and information	63.114(a)	63.114(a)(1)
Account for uncertainties	63.114(b)	63.114(a)(2)
Alternative conceptual models	63.114(c)	63.114(a)(3)
Events to be considered	63.114(d)	63.114(a)(4)
Inclusion and exclusion of FEPs	63.114(e)	63.114(a)(5)

Degradation of engineered barriers	63.114(f)	63.114(a)(6)
Technical basis for models	63.114(g)	63.114(a)(7)
Period after 10,000 years	NA	63.114(b)
63.311 Individual protection standard after permanent closure		
Limit for initial 10,000 years	63.311	63.311(a)(1)
Limit for period after 10,000 years	NA	63.311(a)(2)
Include all pathways	63.311	63.311(b)
63.321 Individual protection standard for human intrusion		
Timing of human intrusion	63.321(a)	63.321(a)
Limit for initial 10,000 years	63.321(b)(1)	63.321(b)(1)
Limit for period after 10,000 years	NA	63.321(b)(2)
Include all pathways	63.321(b)(1)	63.321(c)
63.342 Limits on performance assessments		
Exclude very unlikely and insignificant FEPs	63.342	63.342(a)
Exclude unlikely FEPs	63.342	63.342(b)
Continue FEPs beyond 10,000 years	NA	63.342(c)
Include seismic and igneous scenarios	NA	63.342(c)(1)
Limits on seismic analysis	NA	63.342(c)(1)(i)
Limits on igneous analysis	NA	63.342(c)(1)(ii)
Climate change	NA	63.342(c)(2)
General corrosion	NA	63.342(c)(3)

5. RESPONSIBILITIES AND AUTHORITIES

All HLWRS staff and managers are to ensure the license application review is performed consistent with the guidance procedures provided in this PPL.

6. References

NRC, 2009, 10 CFR Part 63: Implementation of a Dose Standard After 10,000 Years; Final Rule; 74 FR 10811; March 13, 2009

EPA, 2008, 40 CFR 197: Public Health and Environmental Radiation Protection Standards for Yucca Mountain, Nevada; Final Rule; 73 FR 61256; October 15, 2008

NRC, 2003, Yucca Mountain Review Plan: Final Report, NUREG-1804 Rev. 2