

**COMPLIANCE DETERMINATION STRATEGY
RRT 4.5.1 PROTECTION AGAINST EXPOSURES AND RELEASES OF
RADIOACTIVE MATERIAL TO INDIVIDUAL MEMBERS OF THE PUBLIC**

APPLICABLE REGULATORY REQUIREMENTS:

10 CFR 60.21(c)(1)(ii)(E)
10 CFR 60.21(c)(2)
10 CFR 60.21(c)(3)
10 CFR 60.21(c)(6)
10 CFR 60.21(c)(7)
10 CFR 60.21(c)(14)
10 CFR 60.111(a)

TYPES OF REVIEW:

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

RATIONALE FOR TYPES OF REVIEW:

Acceptance Review (Type 1) Rationale:

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

Safety Review (Type 3) Rationale:

The applicable regulatory requirements for this review plan topic are related to radiological safety in both restricted and unrestricted areas i.e., for both workers and individual members of the public, respectively. However, the radiological safety of workers is addressed in Sections 4.2, 4.3, 4.4, 5.5, 6.2, and 8.4 of the license application and its attendant review plans, and this section (Section 4.5.1) addresses the radiological safety of individual members of the public only. It concerns how DOE's design for the geologic repository operations area (GROA) will provide for the control of radiation exposures and radiation levels, and releases of radioactive material to individual members of the public during the preclosure period and in doing so, comply with NRC's regulations concerning radiological safety. This regulatory requirement topic also addresses radiological safety during any waste retrieval operations that may be necessary. It is a requirement for which compliance is necessary to make a safety determination for construction authorization as defined in 10 CFR 60.31(a) (i.e., regulatory requirements in Subparts E, G, H, and I). Therefore, the staff will conduct a *Safety Review* of the license application to determine compliance with the applicable regulatory requirements.

There appears to be no lack of certitude as to the methodology needed to determine or demonstrate compliance with the GROA preclosure regulatory requirements for the control of radiation exposures and radiation levels, and releases of radioactive material to individual members of the public during the

preclosure period. The factor considered in making this determination is the knowledge that technology exists to safely control radiation exposures and radiation levels, and releases of radioactive material to the environment until permanent closure. The technology for limiting doses, based on applicable radiation protection standards, is considered to be available because of the past and current experience in similar nuclear operations. Therefore, the type of review for this topic will be a (Type 3) *Safety Review*.

Radiation protection does not appear to pose a risk of noncompliance with the applicable performance objectives based on current knowledge and as a result, has no Key Technical Uncertainties. However, if Key Technical Uncertainties applicable to this regulatory requirement topic are identified in the future, the strategy for compliance determination will be revised.

REVIEW STRATEGY:

Acceptance Review:

In conducting the Acceptance Review of the U.S. Department of Energy's (DOE's) geologic repository operations area (GROA) design for the control of radiation exposures and radiation levels, and releases of radioactive material to individual members of the public, the reviewer should determine if the information present in the license application and its references for demonstrating compliance with the applicable regulatory requirements is complete in technical breadth and depth as identified in regulatory guide "Format and Content of the License Application for the High-Level Waste Repository (FCRG)." The reviewer should determine that all appropriate information for the staff to review the preclosure radiation protection features of DOE's GROA design is presented such that assessments of compliance with the generally applicable standards for radiation protection, described in NRC's regulation¹, can be performed. Those sections of the license application that are related to the review described in this plan are listed in Table 4.5.1-1.

The reviewer should determine that the information in the license application is presented in such a manner that the assumptions, data, and logic leading to a demonstration of compliance with the applicable regulatory requirements are clear and do not require the reviewer to conduct extensive independent analyses or literature searches. The reviewer should also determine that controversial information and appropriate alternative interpretations and models have been acceptably described and considered.

Finally, the reviewer should determine if DOE has either resolved all the NRC staff objections related to the applicable regulatory requirements or provided all the information requested in Section 1.6.2 of the FCRG, for unresolved objections. The reviewer should evaluate the effects of any unresolved objections, both individually and in combinations with others, on: (1) the reviewer's ability to conduct a meaningful and timely review; and (2) the Commission's ability to make a decision regarding construction authorization within the statutory three-year period.

¹ Section 60.111(a) is to be modified to conform to the U.S. Environmental Protection Agency's pre-closure radiation protection standard (see Subpart A of 40 CFR Part 191 (*Code of Federal Regulations*, "Protection of the Environment")).

Safety Review:

In conducting the Safety Review, the reviewer should determine if the information presented in the license application and its references is an acceptable demonstration of compliance with the applicable regulatory requirements. At a minimum, the reviewer should assess the adequacy of the data and the analyses presented in the license application to support DOE's demonstration of compliance with the applicable regulatory requirements. In general, the reviewer should assess the adequacy of the DOE's GROA design for the control of radiation exposures and radiation levels, and releases of radioactive material to individual members of the public. The reviewer will determine if reasonable effort has been made to maintain radiation exposures, and the releases of radioactive material in effluent "as low as is reasonably achievable" (ALARA), as required by 10 CFR Part 20.

DOE's demonstration of compliance with the applicable regulatory requirements is expected to consist of the following: (1) identification of the repository conditions and events associated with normal operations and those events that can be reasonably expected to occur prior to permanent closure (such as those events referred to in American Nuclear Society Standard, ANSI/ANS-57.9-1984 (ANS, 1984), as Design Events "I," "II," and "III"), that could lead to radiation exposures and radiation levels, and releases of radioactive material to individual members of the public; (2) estimation of the probabilities (numerical or qualitative) that these repository conditions and events may occur, and determination of the regulatory limits for impacts of those probabilities; (3) estimation of the source terms (quantities, concentrations, and specifications of potential levels of radiation exposures and radiation levels, and releases of radioactive material) that are expected to occur for applicable conditions and events; (4) identification and analyses of receptors (locations and lifestyles of people potentially exposed) for potential radiation exposures and radiation levels, and releases of radioactive material; and (5) use of models to determine potential radiological impacts within the exposed population.

The NRC staff's evaluation of compliance will also consist of five steps, paralleling the steps in DOE's demonstration of compliance. The specific aspects of the license application on which a reviewer will focus are discussed below, and the *Acceptance Criteria* are identified in Section 3.0 of this Review Plan. The scope of this review plan includes:

- (1) Identification of the repository conditions and events, associated with normal operations and those conditions and events that can be reasonably expected to occur prior to permanent closure, that could lead to radiation exposures and radiation levels, and releases of radioactive material to individual members of the public. DOE is expected to use event trees, fault trees, and similar methods to identify repository conditions potentially leading to radiological impacts on individual members of the public. The NRC staff will review DOE's submittal, but will not independently develop its own identification of repository conditions.
- (2) Estimation of the probabilities (numerical or qualitative) that these repository conditions and events may occur, and determination of the regulatory limits for impacts of those probabilities. The NRC staff will review DOE's submittal, but will not independently develop its own probability estimates. The NRC staff will independently confirm that the proper regulatory limits have been applied to the potential radiological impacts of the applicable repository conditions and events.
- (3) Analyses of the source terms (quantities, concentrations, and specifications of potential releases and direct radiation exposure levels) that are expected to occur for applicable conditions

and events. DOE's analyses of the source terms are expected to include the quantities and rates of discharges of radioactive materials to, and radiation exposures and radiation levels, and releases of radioactive material found in, the general environment as a result of those conditions and events that can be reasonably expected to occur prior to permanent closure. Analyses of the source terms are also expected to include any items intended to control or monitor radiological exposure as a result of those conditions and events that can be reasonably expected to occur prior to permanent closure that affect the concentration and exposure limits specified in 10 CFR Part 20 and such generally applicable environmental standards for radioactivity as may be established by NRC². The NRC staff expects DOE's source term analyses to include estimates of the quantities of radionuclides discharged per unit time in each effluent stream. The NRC staff will review DOE's analyses of source terms, but will not independently develop its own estimates.

(4) Identification and analyses of receptors (locations and lifestyles of people potentially exposed) for potential radiation exposures and radiation levels, and releases of radioactive material. DOE's identification and analyses of receptors is expected to be based on projections of current demographic and lifestyle conditions near the repository and on DOE's plans for reducing potential exposures to any potential releases resulting from the conditions and events that can be reasonably expected to occur prior to permanent closure. Thus, different receptor analyses may be developed for various conditions and events that can be reasonably expected to occur at the repository. The NRC staff will review DOE's identification and analyses of receptors, but will not independently develop its own analyses.

(5) Use of models to determine potential radiological impacts within the exposed population. The NRC staff expects DOE's estimates of impacts to include: (a) anticipated concentrations of each significant radionuclide, in effluent, at the boundary of the restricted areas and the contribution of each significant radionuclide to the radiation dose, to individual members of the public; (b) calculations and explanations of the measures used to support the biological and transport models used to determine dose, with emphasis on critical pathways to humans; (c) annual whole body individual and collective doses determined to be attributed to releases of radioactive materials and direct radiation; and (d) details specified in Sections 4.5.1.1 through 4.5.1.4 of the FCRG, especially the requirements specified in 10 CFR 60.111(a)³ and the information request made in Section 4.5.1.3 of the FCRG. The NRC staff will review DOE's use of models to determine potential radiological impacts, but will not independently develop its own determinations.

The *Safety Review* for those design basis events which are beyond those events that can be reasonably expected to occur prior to permanent closure will be addressed separately in Section 3.2.6 ("Assessment of Design Criteria for the Controlled-Use Area") of the license application and its attendant review plan.

In addition to determining potential radiological impacts, discussed above, DOE will need to evaluate the cost-effectiveness of reductions of those impacts. In order to demonstrate that projected radiological impacts are ALARA, DOE is expected to determine both individual and collective radiological impacts,

² Section 60.111(a) is to be modified to conform to the U.S. Environmental Protection Agency's pre-closure radiation protection standard (see Subpart A of 40 CFR Part 191 (*Code of Federal Regulations*, "Protection of the Environment")).

³ Section 60.111(a) is to be modified to conform to the U.S. Environmental Protection Agency's pre-closure radiation protection standard (see Subpart A of 40 CFR Part 191 (*Code of Federal Regulations*, "Protection of the Environment")).

as well as economic costs, for reasonably available alternatives to the major structures, systems, and components of the repository. Of primary interest is the performance of the following systems and/or subsystems:

- (1) hot cells;
- (2) radioactive waste management systems;
- (3) fire and explosion protection systems;
- (4) monitoring systems;
- (5) communication systems;
- (6) instrumentation and control systems;
- (7) on-site transportation systems;
- (8) ventilation systems;
- (9) operation support systems;
- (10) decontamination or dismantlement systems;
- (11) waste emplacement systems;
- (12) waste retrieval systems; and
- (13) other radiological safety related facilities.

The adequacy of DOE's evaluations of these structures, systems, and components including any possible interrelationship among such items, both individually or in combination with others, which would impact radiation protection and the cost-effectiveness of reductions in determined impacts should also be assessed by the reviewer.

In order to conduct an effective review, the reviewer will rely on staff expertise and independently acquired knowledge, information, and data, in addition to that provided by the DOE in its license application. The reviewer should be able to identify those variables that may significantly influence the final radiation protection system, and identify the anticipated average radiation exposures and radiation levels, and releases of radioactive material. It is incumbent upon the reviewer to have acquired a body of knowledge regarding these and other critical considerations in anticipation of conducting the review to assure that the DOE's GROA design for the control of radiation exposures and radiation levels, and releases of radioactive material to individual members of the public is sufficient in scope and depth to provide the information to resolve the concerns.

It should be noted that the information contained in Section 4.5.1 of the license application will be reviewed in parallel with the *Safety Reviews* of the information described in Table 4.5.1-1. If it is determined that the conclusions reached by the *Safety Reviews* described in Table 4.5.1-1 are inadequate to support the *Safety Reviews* called for in this section of the license application, then additional information will be requested from DOE before the *Safety Review* of this section can continue.

Contributing Analysts:

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APPLICABLE REGULATORY REQUIREMENTS FOR EACH REVIEW TYPE:

Type 1:

10 CFR 60.21(c)(1)(ii)(E)
10 CFR 60.21(c)(2)
10 CFR 60.21(c)(3)
10 CFR 60.21(c)(6)
10 CFR 60.21(c)(7)
10 CFR 60.21(c)(14)
10 CFR 60.111(a)

Type 3:

10 CFR 60.21(c)(1)(ii)(E)
10 CFR 60.21(c)(2)
10 CFR 60.21(c)(3)
10 CFR 60.21(c)(6)
10 CFR 60.21(c)(7)
10 CFR 60.21(c)(14)
10 CFR 60.111(a)

REFERENCES:

American Nuclear Society, "Design Criteria for an Independent Spent Fuel Storage Installation (Dry Storage Type)," American National Standards Institute, La Grange Park, Illinois, ANSI/ANS-57.9-1984, 1984.

Code of Federal Regulations, "Environmental Standards for the Management and Disposal of Spent Nuclear Fuel, High-Level, and Transuranic Radioactive Wastes," Part 191, Chapter I, Title 40. "Protection of the Environment."

U.S. Nuclear Regulatory Commission, "Format and Content For the License Application for the High-Level Waste Repository," Office of Nuclear Regulatory Research. [Refer to the "Products List" for the Division of High-Level Waste Management to identify the most current edition in effect.]

TABLE 4.5.1-1: Sections of the License Application That Are Related to the *Safety Review* of the "Protection Against Radiation Exposures and Releases of Radioactive Material to Individual Members of the Public" Section of the License Application.

<i>License Application Section</i>	<i>Section Title</i>
2.5	Radioactive Material
3.2.6	Assessment of Criteria for the Controlled-use Area
4.1	Description of the GROA Structures, Systems, and Components:
	4.1.1 Surface Facilities
	4.1.2 Shafts and Ramps
	4.1.3 Underground Facilities
	4.1.4 Radiation Protection Systems
4.2	Assessment of Compliance with Design Criteria For Surface Facilities
4.3	Assessment of Compliance with Design Criteria For Shafts and Ramps
4.4	Assessment of Compliance with Design Criteria For Underground Facility
5.5	Radiation Protection for Engineered Barrier Systems
7.2	Description of the Radiation Protection Program
8.4	Radiation Protection During Performance Confirmation
11.0	Emergency Planning