

Yucca Mountain Site Characterization Project

*REGULATORY COMPLIANCE REVIEW REPORT*

*July 1995*

*U.S. Department of Energy  
Office of Civilian Radioactive Waste Management  
Las Vegas, NV 89109*

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**ENCLOSURE**

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### 3.5.16. 10 CFR 60.2

(10 CFR 60.2 includes the definitions of the terms used in the code of regulations.)

#### Summary

This requirement is the glossary section of 10 CFR Part 60. The definitions apply globally to the project and all ESF designs. No specific design solutions can be tied to this section.

#### **Linings and Ground Support, CI: BABEAB000**

10 CFR 60.2 applies.

#### **Furnishings, CI: BABEAC000**

10 CFR 60.2 applies.

#### **North Ramp Excavation and Layout, CI: BABEAD000**

10 CFR 60.2 applies.

#### **Operations Alcoves Excavation and Layout, CI: BABEAE000**

10 CFR 60.2 applies.

#### **Test Alcoves Excavation and Layout, CI: BABEAF000**

10 CFR 60.2 applies.

#### **Subsurface Lighting, CI: BABFAC000**

10 CFR 60.2 applies.

#### **ESF Subsurface Ventilation, CI: BABFAD000**

10 CFR 60.2 applies.

#### **Subsurface Water CI: BABFAE000**

10 CFR 60.2 applies.

#### **Subsurface Wastewater, CI: BABFAF000**

10 CFR 60.2 applies.

**Subsurface Compressed Air, CI: BABFAG000**

10 CFR 60.2 applies.

**Material and Personnel Handling, CI: BABFCC000**

10 CFR 60.2 applies.

### 3.5.17. 10 CFR 60.15(b)

*Unless the Commission determines with respect to the site described in the application that it is not necessary, site characterization shall include a program of in situ exploration and testing at the depths that wastes would be emplaced.*

#### Summary

Underground openings are developed to meet the needs of in situ site characterization. The ESF is being designed and constructed to provide access to planned waste emplacement depths for testing. The 2C underground openings include the North Ramp, operation support areas, and test support areas.

#### Linings and Ground Support, CI: BABEAB000

The linings and ground support have been designed to maintain the stability of the underground openings to ensure accessibility to test areas.

#### Furnishings, CI: BABEAC000

10 CFR 60.15(b) is not applicable to this configuration item.

#### North Ramp Excavation and Layout, CI: BABEAD000

The North Ramp geology boreholes were drilled along the planned ramp alignment specifically for gathering stratigraphic and engineering information to support the North Ramp engineering design. The North Ramp boreholes were logged by Sandia National Laboratories (Sandia) and the U.S. Geological Survey (USGS).

The ESF excavation layouts are consistent with the enhanced ESF configuration and, therefore, will support the needs of the in situ site characterization and performance confirmation testing.

#### Operations Alcoves Excavation and Layout, CI: BABEAE000

Operations support areas are provided to support underground activities.

#### Test Alcoves Excavation and Layout, CI: BABEAF000

Four test alcoves are planned to be excavated during construction of the North Ramp. The proposed alcove locations include one alcove near the Bow Ridge Fault, at least one alcove near the Drill Hole Wash Fault, one alcove within the Tiva Canyon member (at the TCw-PTn contact), and one alcove just at the bottom of the Pah Canyon member (at the PTn-TSw1

contact). Excavation of alcoves is scheduled to occur after the TBM and its trailing gear have traveled beyond the proposed alcove locations. The TCw-PTn and PTn-TS1A alcoves are designed for radial borehole testing, in which core holes are drilled parallel to the contact (perpendicular to the ramp). The general configuration of the test alcoves (with the exception of the Drill Hole Wash Fault alcove(s), whose dimensions will be determined when the alcove(s) are located) will be approximately 4 to 6 m wide, constructed on a level grade, and a length ranging from 6 to 20 m beyond the ramp wall. The Bow Ridge Fault Test Alcove 2 proposed location is off the north rib prior to the Bow Ridge Fault (at approximately 185 m), and is the location for hydrological testing, hydrochemistry testing, and in-situ seals testing. The location of the TCw-PTn Test Alcove will be field determined off the north rib (approximately the 890 m location), and is the location of radial borehole testing, hydrochemistry testing and in-situ seals testing. The location of the PTn-TSw1 Test Alcove will be field determined off the north rib (approximately the 1060 m location), and is the proposed location of radial borehole testing.

**Subsurface Lighting, CI: BABFAC000**

10 CFR 60.15(b) is not applicable to this configuration item.

**ESF Subsurface Ventilation, CI: BABFAD000**

10 CFR 60.15(b) is not applicable to this configuration item.

**Subsurface Water CI: BABFAE000**

10 CFR 60.15(b) is not applicable to this configuration item.

**Subsurface Wastewater, CI: BABFAF000**

10 CFR 60.15(b) is not applicable to this configuration item.

**Subsurface Compressed Air, CI: BABFAG000**

10 CFR 60.15(b) is not applicable to this configuration item.

**Material and Personnel Handling, CI: BABFCC000**

10 CFR 60.15(b) is not applicable to this configuration item.

3.5.18. 10 CFR 60.15(c)(2)

*The program of site characterization shall be conducted in accordance with the following:*

- (2) *The number of exploratory boreholes and shafts shall be limited to the extent practical consistent with obtaining the information needed for site characterization.*

Summary

This requirement establishes a qualitative limit on the number of boreholes and shafts to be used for site characterization. The application of this requirement to boreholes and shafts has been expanded, however, to include the number of accesses (ramps), consistent with the current ESF layout using ramps. Therefore, it has been applied to the ESF excavation and layout. For ESF package 2C, this includes the North Ramp Excavation and Layout CI.

Linings and Ground Support, CI: BABEAB000

10 CFR 60.15(c)(2) is not applicable to this CI.

Furnishings, CI: BABEAC000

10 CFR 60.15(c)(2) is not applicable to this CI.

North Ramp Excavation and Layout, CI: BABEAD000

As stated in the description of the enhanced ESF configuration in analysis B00000000-01717-0200-00089:

"Consideration 4:

It should be demonstrated that the number of accesses required to construct and operate the repository is minimized (i.e. no more than four).

Response:

The repository concept (enhanced ESF configuration) has been laid out to function with no more than four openings to the surface--the same as in the reference case. Detailed analysis to confirm the adequacy of repository designs limited to no more than four access will be performed during subsequent ACD work."

The ESF design is consistent with the repository concept and with the ESF/GROA interface drawings. Two openings to the surface are provided, consistent with access and safety requirements.

**Operations Alcoves Excavation and Layout, CI: BABEAE000**

10 CFR 60.15(c)(2) is not applicable to this CI.

**Test Alcoves Excavation and Layout, CI: BABEAF000**

10 CFR 60.15(c)(2) is not applicable to this CI.

**Subsurface Lighting, CI: BABFAC000**

10 CFR 60.15(c)(2) is not applicable to this CI.

**ESF Subsurface Ventilation, CI: BABFAD000**

10 CFR 60.15(c)(2) is not applicable to this CI.

**Subsurface Water CI: BABFAE000**

10 CFR 60.15(c)(2) is not applicable to this CI.

**Subsurface Wastewater, CI: BABFAF000**

10 CFR 60.15(c)(2) is not applicable to this CI.

**Subsurface Compressed Air, CI: BABFAG000**

10 CFR 60.15(c)(2) is not applicable to this CI.

**Material and Personnel Handling, CI: BABFCC000**

10 CFR 60.15(c)(2) is not applicable to this CI.

3.5.19. 10 CFR 60.21(c)(1)(ii)(D)

*The effectiveness of engineered and natural barriers, including barriers that may not be themselves a part of the geologic repository operations area, against the release of radioactive material to the environment. The analysis shall also include a comparative evaluation of alternatives to the major design features that are important to waste isolation, with particular attention to the alternatives that would provide longer radionuclide containment and isolation.*

Summary

With respect to the effectiveness of engineered and natural barriers, this requirement has been interpreted to apply to the ESF permanent items (layout and excavation, alcoves, and linings and ground support), with supporting systems installed and operated in accordance with the controls that have been developed in response to 10 CFR 60.15(c)(1). These controls have been developed to limit impacts to the natural barrier.

Layout studies that respond to this requirement for the ESF/GROA were developed. The "Exploratory Studies Facility Alternatives Study" and the "Description and Rationale for Enhancement to the Baseline ESF Configuration Analysis" document the comparative evaluation of alternatives to the major design features that are important to waste isolation. See the discussion in section 3.4 of the initial Regulatory Compliance Review Report, March, 1995.

**Linings and Ground Support, CI: BABEAB000**

The linings and ground support are classified as permanent function items. The linings and ground support are designed and constructed in a manner to limit adverse impacts to the waste isolation capabilities of the site. See the discussion for 10 CFR 60.15(c)(1).

**Furnishings, CI: BABEAC000**

10 CFR 60.21(c)(1)(ii)(D) is not applicable to this CI.

**North Ramp Excavation and Layout, CI: BABEAD000**

The North Ramp excavation layout is consistent with the results of the "Exploratory Studies Facility Alternatives Study" and the "Description and Rationale for Enhancement to the Baseline ESF Configuration Analysis", which are documented in the enhanced ESF configuration layout.

The YMP undertook the Exploratory Studies Facility Alternatives Study (ESFAS) to provide a comprehensive assessment of options for development of an ESF, and how those ESF options would fit into a potential repository. A total of 34 options were developed and evaluated. Repository concepts were developed for each option to ensure that the requirements of 10 CFR 60.21(c)(1)(ii)(D) were adequately addressed."

The current GROA layout is depicted in six ESF/Repository Interface Drawings. These drawings are numbered BC0000000-01717-2100-89100 through 89105, Rev 0. The GROA concept is also described in the document, "Initial Summary Report for Repository/Waste Package Advanced Conceptual Design" B00000000-01717-5705-00015 Rev. 0. The report noted above containing Advanced Conceptual Design (ACD) information is an interim document detailing results of work performed through mid-FY 1994. The repository ACD effort is ongoing, and a final ACD report is planned for issue in mid-FY 1997. The GROA layout shown in the ACD report shows subtle differences from the 6 baseline ESF/GROA interface drawings because the GROA design is evolving. The baseline ESF/GROA drawings are planned to be updated during FY 1996 to reflect the most current GROA concept.

The interface drawings noted above are referenced in Appendix A.2 of the Exploratory Studies Facility Design Requirements (ESFDR) document.

#### **Operations Alcoves Excavation and Layout, CI: BABEAE000**

Alcoves are considered in the excavation layout analyses and design as an interface to the North Ramp. Ground support for the North Ramp is integrated with that of the alcoves. Permanent function ground support in the excavations off the North Ramp which are in the transition zone between the tunnel and excavations include ground support components which are added to supplement ground support systems.

#### **Test Alcoves Excavation and Layout, CI: BABEAF000**

Alcoves are considered in the excavation layout analyses and design as an interface to the North Ramp. Ground support for the North Ramp is integrated with that of the alcoves. Permanent function ground support in the excavations off the North Ramp which are in the transition zone between the tunnel and excavations include ground support components which are added to supplement ground support systems.

#### **Subsurface Lighting, CI: BABFAC000**

10 CFR 60.21(c)(1)(ii)(D) is not applicable to this CI.

#### **ESF Subsurface Ventilation, CI: BABFAD000**

10 CFR 60.21(c)(1)(ii)(D) is not applicable to this CI.

**Subsurface Water CI: BABFAE000**

10 CFR 60.21(c)(1)(ii)(D) is not applicable to this CI.

**Subsurface Wastewater, CI: BABFAF000**

10 CFR 60.21(c)(1)(ii)(D) is not applicable to this CI.

**Subsurface Compressed Air, CI: BABFAG000**

10 CFR 60.21(c)(1)(ii)(D) is not applicable to this CI.

**Material and Personnel Handling, CI: BABFCC000**

10 CFR 60.21(c)(1)(ii)(D) is not applicable to this CI.

### 3.5.20. 10 CFR 60.21(c)(1)(ii)(E)

*An analysis of the performance of the major design structures, systems, and components, both surface and subsurface, to identify those that are important to safety. For the purposes of this analysis, it shall be assumed that operations at the geologic repository operations area will be carried out at the maximum capacity and rate of receipt of radioactive waste stated in the application.*

#### Summary

Items are evaluated to identify those that are important to safety. A classification analysis is performed during the DIE process.

#### Linings and Ground Support, CI: BABEAB000

The linings and ground support are classified as permanent function items. The linings and ground support are designed and constructed in a manner to limit adverse impacts to the waste isolation capabilities of the site. See the discussion for 10 CFR 60.15(c)(1).

As documented in analysis BAB000000-01717-2200-00005, the North Ramp construction is considered "important to safety" and is "determined to be important to radiological safety (IRS) (QA-1) and important to potential interaction, QA-5." "In addition, training, testing, maintenance, periodic inspection, and monitoring records associated with the ground support system must be retained as QA records." "The TS North Ramp has been classified as QA-2, important to waste isolation (by direct inclusion)."

#### Furnishings, CI: BABEAC000

10 CFR 60.21(c)(1)(ii)(E) is not applicable to this CI.

#### North Ramp Excavation and Layout, CI: BABEAD000

Since the TS North Ramp is assumed to be incorporated into a permanent repository, it is assumed that it will eventually provide a path for ventilation and/or instrumentation and control systems required to mitigate radiological consequences of emplacement accidents. It is also assumed that the TS North Ramp (i.e., the excavated opening) will provide a path for transporting waste (during emplacement). The TS North Ramp is therefore conservatively determined to be QA-1, IRS. Although no specific criteria are associated with establishment of a repository roadbed, the QA-1 classification is conservatively extended to the full excavated opening.

**Operations Alcoves Excavation and Layout, CI: BABEAE000**

The alcoves and the associated ground support system are considered to be permanent items. The controls associated with 10 CFR 60.15(c)(1) apply to the design and construction of the operations alcoves. See the discussion for 10 CFR 60.15(c)(1).

**Test Alcoves Excavation and Layout, CI: BABEAF000**

The alcoves and the associated ground support system are considered to be permanent items. The controls associated with 10 CFR 60.15(c)(1) apply to the design and construction of the test alcoves. See the discussion for 10 CFR 60.15(c)(1).

**Subsurface Lighting, CI: BABFAC000**

10 CFR 60.21(c)(1)(ii)(E) is not applicable to this CI.

**ESF Subsurface Ventilation, CI: BABFAD000**

10 CFR 60.21(c)(1)(ii)(E) is not applicable to this CI.

**Subsurface Water CI: BABFAE000**

10 CFR 60.21(c)(1)(ii)(E) is not applicable to this CI.

**Subsurface Wastewater, CI: BABFAF000**

10 CFR 60.21(c)(1)(ii)(E) is not applicable to this CI.

**Subsurface Compressed Air, CI: BABFAG000**

10 CFR 60.21(c)(1)(ii)(E) is not applicable to this CI.

**Material and Personnel Handling, CI: BABFCC000**

10 CFR 60.21(c)(1)(ii)(E) is not applicable to this CI.

3.5.21. 10 CFR 60.72

*(a) DOE shall maintain records of construction of the geologic repository operations area in a manner that ensures their useability for future generations in accordance with § 60.51(a)(2).*

*(b) The records required under paragraph (a) shall include at least the following:*

*(1) Surveys of the underground facility excavations, shafts, and boreholes referenced to readily identifiable surface features or monuments;*

*(2) A description of the materials encountered;*

*(3) Geologic maps and geologic cross sections;*

*(4) Locations and amount of seepage;*

*(5) Details of equipment, methods, progress, and sequence of work;*

*(6) Construction problems;*

*(7) Anomalous conditions encountered;*

*(8) Instrument locations, readings, and analysis;*

*(9) Location and description of structural support systems;*

*(10) Location and description of dewatering systems; and*

*(11) Details, methods of emplacement, and location of seals used.*

### Summary

The intent of this Part 60 requirement is to document and retain all information with respect to the underground construction. The retention of records, especially those of ESF construction, that address this information will facilitate and support the various analyses and studies associated with repository performance.

Construction records are required to be maintained and submitted by the constructor. The requirement(s) to maintain records are levied on the constructor through several construction specifications. See specifications BAB000000-01717-6300-01400 and 01501. For example, portions of the Part 60 requirement are directly addressed in BAB000000-01717-6300-01400, Constructor Quality Control/Quality Assurance. Secondly, specification

BAB000000-01717-6300-01501 contains requirements for the submission of training records for TBM operators. The rock bolt, steel set, shotcrete, and drill and blast specifications also contain records requirements.

The ESF package 2C DIE analysis (BAB000000-01717-2200-00005) requires records that are in conformance with 10 CFR 60.72 (see DIE requirements 5, 7, and 8).

Final configurations of underground openings and associated systems will be documented on Title III "as-built" drawings.

#### **Linings and Ground Support, CI: BABEAB000**

This requirement has not been specifically allocated to this CI. However, the construction of the linings and ground support is governed by A/E specifications that include requirements for records maintenance and submission. See specification BAB000000-01717-6300-01501, for example.

Also, several records management requirements are mandated through the DIE process. These requirements address ground support records. See DIE requirements 7 and 8 in analysis BAB000000-01717-2200-00005.

#### **Furnishings, CI: BABEAC000**

This requirement has not been specifically allocated to this CI. However, the construction of furnishings is governed by A/E specifications that include requirements for records maintenance and submission. See specification BAB000000-01717-6300-01501, for example.

#### **North Ramp Excavation and Layout, CI: BABEAD000**

The construction of the North Ramp is governed by A/E specifications that include requirements for records maintenance and submission. See specifications BAB000000-01717-6300-01501 and BAB000000-01717-6300-01400, for example.

Also, several records management requirements are mandated through the DIE process. These requirements address TBM operations records and excavation records. See DIE requirements 2 and 7 in analysis BAB000000-01717-2200-00005.

#### **Operations Alcoves Excavation and Layout, CI: BABEAE000**

The construction of the operations alcoves is governed by A/E specifications that include requirements for records maintenance and submission. See specifications BAB000000-01717-6300-01501 and BAB000000-01717-6300-01400, for example.

Also, several records management requirements are mandated through the DIE process. These requirements address drill and blast excavation records, ground support installation records, and ground support maintenance records. See DIE requirements 5, 7 and 8 in analysis BAB000000-01717-2200-00005.

#### **Test Alcoves Excavation and Layout, CI: BABEAF000**

The construction of the test alcoves is governed by A/E specifications that include requirements for records maintenance and submission. See specifications BAB000000-01717-6300-01501 and BAB000000-01717-6300-01400, for example.

Also, several records management requirements are mandated through the DIE process. These requirements address drill and blast excavation records, ground support installation records, and ground support maintenance records. See DIE requirements 5, 7 and 8 in analysis BAB000000-01717-2200-00005.

#### **Subsurface Lighting, CI: BABFAC000**

This requirement has not been specifically allocated to this CI. However, the construction of the subsurface lighting is governed by A/E specifications that include requirements for records maintenance and submission. See specification BAB000000-01717-6300-01501, for example.

#### **ESF Subsurface Ventilation, CI: BABFAD000**

This requirement has not been specifically allocated to this CI. However, the construction of the subsurface ventilation is governed by A/E specifications that include requirements for records maintenance and submission. See specification BAB000000-01717-6300-01501, for example.

#### **Subsurface Water CI: BABFAE000**

This requirement has not been specifically allocated to this CI. However, the construction of the subsurface water system is governed by A/E specifications that include requirements for records maintenance and submission. See specification BAB000000-01717-6300-01501, for example.

#### **Subsurface Wastewater, CI: BABFAF000**

The construction of the subsurface wastewater system is governed by A/E specifications that include requirements for records maintenance and submission. See specification BAB000000-01717-6300-01501, for example.

The ESFDR mandates that the subsurface wastewater CI drainage and pumping systems provide for the measurement of water. A flow meter will be provided at the North Portal for this system, which will assist in the preparation of water usage data and records.

**Subsurface Compressed Air, CI: BABFAG000**

This requirement has not been specifically allocated to this CI. However, the construction of the subsurface compressed air system is governed by A/E specifications that include requirements for records maintenance and submission. See specification BAB000000-01717-6300-01501, for example.

**Material and Personnel Handling, CI: BABFCC000**

This requirement has not been specifically allocated to this CI. However, the construction of the Material and Personnel Handling system is governed by A/E specifications that include requirements for records maintenance and submission. See specification BAB000000-01717-6300-01501, for example.

### 3.5.22. 10 CFR 60.111(a)

*Protection against radiation exposures and releases of radioactive material. The geologic repository operations area shall be designed so that until permanent closure has been completed, radiation exposures and radiation levels, and releases of radioactive materials to unrestricted areas, will at all times be maintained within the limits specified in Part 20 of this chapter and such generally applicable environmental standards for radioactivity as may have been established by the Environmental Protection Agency.*

#### Summary

This requirement represents performance criteria for the repository. The ESF facility is being designed in a manner to not preclude the satisfaction of the objectives of this requirement. In order to not preclude the potential repository from meeting performance objectives, the permanent items of the ESF are designed and constructed in compliance with the controls established in response to 10 CFR 60.15(c)(1).

The above description represents the initial interpretation and allocation of the requirement to ESF Package 2C design from a long-term repository performance perspective. Since package 2C design, the requirement has been re-interpreted to apply to pre-closure operations and the prevention of radioactive releases. The requirement applies to the repository operations time period and not the ESF site characterization time period.

#### Linings and Ground Support, CI: BABEAB000

The linings and ground support are designed and constructed in a manner to limit adverse impacts to the waste isolation capabilities of the site. Construction of linings and ground support is governed by the QA controls imposed by the DIE analysis.

All general construction requirements apply to this CI. Examples of the specific application of general requirements include prohibition of the use of organic grout for rockbolts (DIE Requirement 12), and A/E review of constructor submittals for maintenance of rockbolt drills (DIE Requirement 19).

In addition, DIE Requirements 9, 16, and 20, which control grouting for rockbolts, shotcrete, and chemical grout injection, apply explicitly to this CI. See the discussion for 10 CFR 60.15(c)(1).

#### **Furnishings, CI: BABEAC000**

10 CFR 60.111(a) is not applicable to this CI. However, the general construction requirements apply to this CI. See the discussion for 10 CFR 60.15(c)(1) in the initial Regulatory Compliance Review Report, March, 1995.

#### **North Ramp Excavation and Layout, CI: BABEAD000**

The general construction requirements apply to this CI. Examples of the specific application of general requirements include linear limits on the use of water, based on excavation progress (DIE Requirement 11); testing requirements on diesel equipment used during excavation (DIE Requirement 13); and notification of the Test Coordination Office (TCO) in the event of indication of perched water, as indicated in terms of flowing water (DIE Requirement 17).

In addition, other DIE requirements are explicitly applicable to this CI and activities associated with it: Requirements 1, 2, and 3, concerning controls on the use of the Tunnel Boring Machine (TBM); 4 and 5, controlling drill-and-blast excavation; and 21 and 22, concerning holds applicable to excavation progress. Further, excavation of ESF main accesses by TBM is the best available current technology for excavation of the ESF ramps and main drift while limiting geomechanical damage to the host rock.

#### **Operations Alcoves Excavation and Layout, CI: BABEAE000**

The alcoves and the associated ground support system are considered to be permanent items. The controls associated with 10 CFR 60.15(c)(1) apply to the design and construction of the operations alcoves. See the discussion for 10 CFR 60.15(c)(1) in the initial Regulatory Compliance Review Report, March, 1995.

#### **Test Alcoves Excavation and Layout, CI: BABEAF000**

The alcoves and the associated ground support system are considered to be permanent items. The controls associated with 10 CFR 60.15(c)(1) apply to the design and construction of the test alcoves. See the discussion for 10 CFR 60.15(c)(1) in the initial Regulatory Compliance Review Report, March, 1995.

#### **Subsurface Lighting, CI: BABFAC000**

10 CFR 60.111(a) is not applicable to this CI. However, the general construction requirements do apply to this CI. See the discussion for 10 CFR 60.15(c)(1) in the initial Regulatory Compliance Review Report, March, 1995.

**ESF Subsurface Ventilation, CI: BABFAD000**

10 CFR 60.111(a) is not applicable to this CI. However, the general construction requirements do apply to this CI. See the discussion for 10 CFR 60.15(c)(1) in the initial Regulatory Compliance Review Report, March, 1995.

**Subsurface Water CI: BABFAE000**

10 CFR 60.111(a) is not applicable to this CI. However, the general construction requirements do apply to this CI.

**Subsurface Wastewater, CI: BABFAF000**

10 CFR 60.111(a) is not applicable to this CI. However, the general construction requirements do apply to this CI. See the discussion for 10 CFR 60.15(c)(1) in the initial Regulatory Compliance Review Report, March, 1995.

**Subsurface Compressed Air, CI: BABFAG000**

10 CFR 60.111(a) is not applicable to this temporary CI. However, the general construction requirements do apply to this CI. See the discussion for 10 CFR 60.15(c)(1) in the initial Regulatory Compliance Review Report, March, 1995.

**Material and Personnel Handling, CI: BABFCC000**

10 CFR 60.111(a) is not applicable to this CI. However, the general construction requirements do apply to this CI. See the discussion for 10 CFR 60.15(c)(1) in the initial Regulatory Compliance Review Report, March, 1995.

### 3.5.23. 10 CFR 60.111(b)(1)

*The geologic repository operations area shall be designed to preserve the option of waste retrieval throughout the period during which wastes are being emplaced and, thereafter, until the completion of a performance confirmation program and Commission review of the information obtained from such a program. To satisfy this objective, the geologic repository operations area shall be designed so that any or all of the emplaced waste could be retrieved on a reasonable schedule starting at any time up to 50 years after waste emplacement operations are initiated, unless a different time period is approved or specified by the Commission. This different time period may be established on a case-by-case basis consistent with the emplacement schedule and the planned performance confirmation program.*

#### Summary

This requirement represents performance criteria for the repository. The ESF facility is being designed in a manner to not preclude the satisfaction of the objectives of this requirement. Therefore, this requirement applies to those items that may be incorporated into the potential repository and contribute to the function of that facility - the North Ramp and linings and ground support. In order to not preclude the potential repository from meeting performance objectives, the permanent items of the ESF are designed and constructed in compliance with the controls established in response to 10 CFR 60.15(c)(1).

In order to preserve the option of waste retrieval, this requirement has been interpreted to apply only to the permanent linings and ground support and ramp of the ESF. The stability of the excavated opening is dependent upon the design function of the linings and ground support CI.

#### Linings and Ground Support, CI: BABEAB000

As noted in analysis BAB000000-01717-2200-00005, it is expected that the TS North Ramp will become part of the permanent repository if the site is found suitable. As integral parts of the permanent repository tunnel, the tunnel floor (exclusive of concrete invert segments) and ground support system (including rockbolts and linings) are also considered permanent (the design life of ground support system and floor components is such that they will require periodic inspection and repair if deterioration occurs; nevertheless, the function is permanent (except as noted in 10.6 of BAB000000-01717-2200-00005) and will be maintained during the pre-closure phase of repository operation).

North Ramp support components are considered permanent to allow for "Waste Retrieval on a Reasonable Schedule." These components are found in section 10.4 of BAB000000-01717-2200-00005, Permanence of Items.

Permanent items evaluated include: the TS North Ramp excavation (entire tunnel opening, including roof and floor); ground support systems (i.e., rockbolts, grout, channel units, welded wire fabric, steel sets, steel lagging, mesh, shotcrete, and concrete); and associated excavations constructed along the TS North Ramp, including their ground support systems and floors. It is expected that the TS North Ramp will become part of the permanent repository if the site is found suitable. As integral parts of the permanent repository tunnel, the tunnel floor (exclusive of concrete invert segments) and ground support system (including rockbolts and linings) are also considered permanent [the design life of ground support system and floor components is such that they will require periodic inspection and repair if deterioration occurs; nevertheless, the function is permanent (except as noted in 10.6 of BAB000000-01717-2200-00005) and will be maintained during the pre-closure phase of repository operation].

The test and equipment alcoves, refuge chambers, and sump excavations (and their ground support systems) are assumed to be permanent as part of "underground excavations." The inspection and maintenance practices prescribed for the permanent ground support systems are developed based on the current function of the TS North Ramp as part of the ESF test facility. Additional tests are planned during site characterization that will investigate various ground support systems and monitoring techniques. At the end of site characterization, the combination of the QA records obtained during maintenance and inspection of the ESF ground support system, coupled with results from ground support monitoring tests, will be used to evaluate the adequacy of existing ground support systems and inspection and maintenance controls for the functions to be performed as part of the potential repository. Therefore, prior to incorporation in the potential repository, an assessment will need to be made of the adequacy of the ESF designed ground support, inspection and maintenance practices, and more rigorous repository ground support systems and/or monitoring techniques will be developed and implemented, if necessary, at that time.

**Furnishings, CI: BABEAC000**

10 CFR 60.111(b)(1) is not applicable to this CI.

**North Ramp Excavation and Layout, CI: BABEAD000**

As noted in analysis BAB000000-01717-2200-00005, it is expected that the TS North Ramp will become part of the permanent repository if the site is found suitable. The required functions of the GROA have been considered in the design and construction of the ESF. Ramp grade and size are consistent and viewed as adequate for waste emplacement and retrieval. The North Ramp design is in accordance with the ESF/GROA interface drawings.

**Operations Alcoves Excavation and Layout, CI: BABEAE000**

10 CFR 60.111(b)(1) is not applicable to this CI.

**Test Alcoves Excavation and Layout, CI: BABEAF000**

10 CFR 60.111(b)(1) is not applicable to this CI.

**Subsurface Lighting, CI: BABFAC000**

10 CFR 60.111(b)(1) is not applicable to this CI.

**ESF Subsurface Ventilation, CI: BABFAD000**

10 CFR 60.111(b)(1) is not applicable to this CI.

**Subsurface Water CI: BABFAE000**

10 CFR 60.111(b)(1) is not applicable to this CI.

**Subsurface Wastewater, CI: BABFAF000**

10 CFR 60.111(b)(1) is not applicable to this CI.

**Subsurface Compressed Air, CI: BABFAG000**

10 CFR 60.111(b)(1) is not applicable to this CI.

**Material and Personnel Handling, CI: BABFCC000**

10 CFR 60.111(b)(1) is not applicable to this CI.

### 3.5.24. 10 CFR 60.112

*The geologic setting shall be selected and the engineered barrier system and the shafts, boreholes and their seals shall be designed to assure that releases of radioactive materials to the accessible environment following permanent closure conform to such generally applicable environmental standards for radioactivity as may have been established by the Environmental Protection Agency with respect to both anticipated processes and events and unanticipated processes and events.*

#### Summary

With respect to ESF design, this requirement has been interpreted to be closely related to 10 CFR 60.15(c)(1) and the associated controls on ESF design, construction, and operations. The ESF does not select the geologic setting nor designs the engineered barrier system or seals. However, the ESF must limit adverse impacts to the waste isolation capabilities of the site.

#### Linings and Ground Support, CI: BABEAB000

Neither seal, lining, nor roadway repository design criteria have been established. No evaluation of the likelihood of disturbing a potential seal mount, lining surface, or roadway can be made at this time. It is determined, however, that commercial-grade equipment and standard design and construction practices, including the controlled use of the TBM for excavation (DIE Requirements 1,2,3), and QA control requirements on installation of ESF-function linings (DIE Requirement 6), provide sufficient assurance against such an event (i.e., significant disturbance), and that future design criteria will need to consider as-found conditions. The use of commercial-grade ground support for stabilization, as controlled by considerations needed to limit potential impacts to radiological safety, is determined to be sufficient to limit impacts to the potential repository to the extent practical. See DIE analysis BAB000000-01717-2200-00005, Requirement 6.

#### Furnishings, CI: BABEAC000

10 CFR 60.112 has not been applied to this CI. However, the DIE controls in response to 10 CFR 60.15(c)(1) do apply.

#### North Ramp Excavation and Layout, CI: BABEAD000

As noted in analysis BAB000000-01717-2200-00005, Design Input 5.4 indicates that "when a sealing plan is formulated for the North Ramp further evaluation of potential impacts should be performed that incorporate site data on the thermal/mechanical properties of the disturbed zone."

**Operations Alcoves Excavation and Layout, CI: BABEAE000**

10 CFR 60.112 has not been applied to this CI. However, the DIE controls in response to 10 CFR 60.15(c)(1) do apply.

**Test Alcoves Excavation and Layout, CI: BABEAF000**

10 CFR 60.112 has not been applied to this CI. However, the DIE controls in response to 10 CFR 60.15(c)(1) do apply.

**Subsurface Lighting, CI: BABFAC000**

10 CFR 60.112 has not been applied to this CI. However, the DIE controls in response to 10 CFR 60.15(c)(1) do apply.

**ESF Subsurface Ventilation, CI: BABFAD000**

10 CFR 60.112 has not been applied to this CI. However, the DIE controls in response to 10 CFR 60.15(c)(1) do apply.

**Subsurface Water CI: BABFAE000**

10 CFR 60.112 has been inappropriately applied to this CI. However, the DIE controls in response to 10 CFR 60.15(c)(1) do apply.

**Subsurface Wastewater, CI: BABFAF000**

10 CFR 60.112 has been inappropriately applied to this CI. However, the DIE controls in response to 10 CFR 60.15(c)(1) do apply.

**Subsurface Compressed Air, CI: BABFAG000**

10 CFR 60.112 has not been applied to this CI. However, the DIE controls in response to 10 CFR 60.15(c)(1) do apply.

**Material and Personnel Handling, CI: BABFCC000**

10 CFR 60.112 has been inappropriately applied to this CI. However, the DIE controls in response to 10 CFR 60.15(c)(1) do apply.

3.5.25. 10 CFR 60.113(a)(1)(i)

*The engineered barrier system shall be designed so that assuming anticipated processes and events:*

- (A) Containment of HLW will be substantially complete during the period when radiation and thermal conditions in the engineered barrier system are dominated by fission product decay; and*
- (B) any release of radionuclides from the engineered barrier system shall be a gradual process which results in small fractional releases to the geologic setting over long times. For disposal in the saturated zone, both the partial and complete filling with groundwater of available void spaces in the underground facility shall be appropriately considered and analyzed among the anticipated processes and events in designing the engineered barrier system.*

Summary

ESF Package 2C does not include any design for the engineered barrier. However, the ESF permanent items are designed and constructed in a manner that will not inhibit the effectiveness of the engineered barrier. Controls that have been established in response to 10 CFR 60.15(c)(1) are in place to ensure that ESF design, construction and operations are performed in a manner that limit adverse impacts to the site. See the discussion for 10 CFR 60.15(c)(1) for the DIE controls that are imposed on each CI.

Linings and Ground Support, CI: BABEAB000

10 CFR 60.113(a)(1)(i) does not directly apply to this CI.

As noted in analysis BAB000000-01717-2200-00005, Design Input 5.4 indicates that "when a sealing plan is formulated for the North Ramp further evaluation of potential impacts should be performed that incorporate site data on the thermal/mechanical properties of the disturbed zone."

The DIE controls applicable to this CI are performed in a manner that limit adverse impacts to the site. See the discussion for 10 CFR 60.15(c)(1) for the DIE controls that are imposed on each CI.

Furnishings, CI: BABEAC000

10 CFR 60.113(a)(1)(i) does not directly apply to this CI.

The DIE controls applicable to this CI are performed in a manner that limit adverse impacts to the site. See the discussion for 10 CFR 60.15(c)(1) for the DIE controls that are imposed on each CI.

**North Ramp Excavation and Layout, CI: BABEAD000**

10 CFR 60.113(a)(1)(i) does not directly apply to this CI.

The DIE controls applicable to this CI are performed in a manner that limit adverse impacts to the site. See the discussion for 10 CFR 60.15(c)(1) for the DIE controls that are imposed on each CI.

Neither seal, lining, nor roadway repository design criteria have been established. No evaluation of the likelihood of disturbing a potential seal mount, lining surface, or roadway can be made at this time. It is determined, however, that commercial-grade equipment and standard design and construction practices, including the controlled use of the TBM for excavation (DIE Requirements 1,2,3), and QA control requirements on installation of ESF-function linings (DIE Requirement 6), provide sufficient assurance against such an event (i.e., significant disturbance), and that future design criteria will need to consider as-found conditions. The use of commercial-grade ground support for stabilization, as controlled by considerations needed to limit potential impacts to radiological safety, is sufficient to limit impacts to the potential repository to the extent practical.

**Operations Alcoves Excavation and Layout, CI: BABEAE000**

10 CFR 60.113(a)(1)(i) does not directly apply to this CI.

The DIE controls applicable to this CI are performed in a manner that limit adverse impacts to the site. See the discussion for 10 CFR 60.15(c)(1) for the DIE controls that are imposed on each CI.

Neither seal, lining, nor roadway repository design criteria have been established. No evaluation of the likelihood of disturbing a potential seal mount, lining surface, or roadway can be made at this time. It is determined, however, that commercial-grade equipment and standard design and construction practices, including the controlled use of the TBM for excavation (DIE Requirements 1,2,3), and QA control requirements on installation of ESF-function linings (DIE Requirement 6), provide sufficient assurance against such an event (i.e., significant disturbance), and that future design criteria will need to consider as-found conditions. The use of commercial-grade ground support for stabilization, as controlled by considerations needed to limit potential impacts to radiological safety, is determined sufficient to limit impacts to the potential repository to the extent practical.

**Test Alcoves Excavation and Layout, CI: BABEAF000**

10 CFR 60.113(a)(1)(i) does not directly apply to this CI.

The DIE controls applicable to this CI are performed in a manner that limit adverse impacts to the site. See the discussion for 10 CFR 60.15(c)(1) for the DIE controls that are imposed on each CI.

Neither seal, lining, nor roadway repository design criteria have been established. No evaluation of the likelihood of disturbing a potential seal mount, lining surface, or roadway can be made at this time. It is determined, however, that commercial-grade equipment and standard design and construction practices, including the controlled use of the TBM for excavation (DIE Requirements 1,2,3), and QA control requirements on installation of ESF-function linings (DIE Requirement 6), provide sufficient assurance against such an event (i.e., significant disturbance), and that future design criteria will need to consider as-found conditions. The use of commercial-grade ground support for stabilization, as controlled by considerations needed to limit potential impacts to radiological safety, is sufficient to limit impacts to the potential repository to the extent practical.

**Subsurface Lighting, CI: BABFAC000**

10 CFR 60.113(a)(1)(i) does not directly apply to this CI.

The DIE controls applicable to this CI are performed in a manner that limit adverse impacts to the site. See the discussion for 10 CFR 60.15(c)(1) for the DIE controls that are imposed on each CI.

**ESF Subsurface Ventilation, CI: BABFAD000**

10 CFR 60.113(a)(1)(i) does not directly apply to this CI.

The DIE controls applicable to this CI are performed in a manner that limit adverse impacts to the site. See the discussion for 10 CFR 60.15(c)(1) for the DIE controls that are imposed on each CI.

**Subsurface Water CI: BABFAE000**

10 CFR 60.113(a)(1)(i) does not directly apply to this CI.

The DIE controls applicable to this CI are performed in a manner that limit adverse impacts to the site. See the discussion for 10 CFR 60.15(c)(1) for the DIE controls that are imposed on each CI.

**Subsurface Wastewater, CI: BABFAF000**

10 CFR 60.113(a)(1)(i) does not directly apply to this CI.

The DIE controls applicable to this CI are performed in a manner that limit adverse impacts to the site. See the discussion for 10 CFR 60.15(c)(1) for the DIE controls that are imposed on each CI.

**Subsurface Compressed Air, CI: BABFAG000**

10 CFR 60.113(a)(1)(i) does not directly apply to this CI.

The DIE controls applicable to this CI are performed in a manner that limit adverse impacts to the site. See the discussion for 10 CFR 60.15(c)(1) for the DIE controls that are imposed on each CI.

**Material and Personnel Handling, CI: BABFCC000**

10 CFR 60.113(a)(1)(i) does not directly apply to this CI.

The DIE controls applicable to this CI are performed in a manner that limit adverse impacts to the site. See the discussion for 10 CFR 60.15(c)(1) for the DIE controls that are imposed on each CI.

3.5.26. 10 CFR 60.113(a)(1)(ii)

*In satisfying the preceding requirement, the engineered barrier system shall be designed, assuming anticipated processes and events, so that:*

- (A) Containment of HLW within the waste packages will be substantially complete for a period to be determined by the Commission taking into account the factors specified in § 60.113(b) provided, that such period shall be not less than 300 years nor more than 1,000 years after permanent closure of the geologic repository; and*
- (B) The release rate of any radionuclide from the engineered barrier system following the containment period shall not exceed one part in 100,000 per year of the inventory of that radionuclide calculated to be present at 1,000 years following permanent closure, or such other fraction of the inventory as may be approved or specified by the Commission; provided, that this requirement does not apply to any radionuclide which is released at a rate less than 0.1% of the calculated total release rate limit. The calculated total release rate limit shall be taken to be one part in 100,000 per year of the inventory of radioactive waste, originally emplaced in the underground facility, that remains after 1,000 years of radioactive decay.*

Summary

ESF Package 2C does not include any design for the engineered barrier. However, the ESF permanent items are designed and constructed in a manner that will not inhibit the effectiveness of the engineered barrier. Controls that have been established in response to 10 CFR 60.15(c)(1) are in place to ensure that ESF design, construction and operations are performed in a manner that limit adverse impacts to the site. See the discussion for 10 CFR 60.15(c)(1).

Linings and Ground Support, CI: BABEAB000

10 CFR 60.113(a)(1)(ii) does not directly apply to this CI.

As noted in analysis BAB000000-01717-2200-00005, Design Input 5.4 indicates that "when a sealing plan is formulated for the North Ramp further evaluation of potential impacts should be performed that incorporate site data on the thermal/mechanical properties of the disturbed zone."

See the discussion under 10 CFR 60.15(c)(1) for the DIE controls that are imposed on this CI.

**Furnishings, CI: BABEAC000**

10 CFR 60.113(a)(1)(ii) does not directly apply to this CI.  
See the discussion under 10 CFR 60.15(c)(1) for the DIE controls that are imposed on this CI.

**North Ramp Excavation and Layout, CI: BABEAD000**

10 CFR 60.113(a)(1)(ii) does not directly apply to this CI.  
See the discussion under 10 CFR 60.15(c)(1) for the DIE controls that are imposed on this CI.

Neither seal, lining, nor roadway repository design criteria have been established. No evaluation of the likelihood of disturbing a potential seal mount, lining surface, or roadway can be made at this time. It is determined, however, that commercial-grade equipment and standard design and construction practices, including the controlled use of the TBM for excavation (Requirements 1,2,3), and QA control requirements on installation of ESF-function linings (Requirement 6), provide sufficient assurance against such an event (i.e., significant disturbance), and that future design criteria will need to consider as-found conditions. The use of commercial-grade ground support for stabilization, as controlled by considerations needed to limit potential impacts to radiological safety, is determined sufficient to limit impacts to the potential repository to the extent practical.

Design Input 5.4 of analysis BAB000000-01717-2200-00005 indicates that "when a sealing plan is formulated for the North Ramp, further evaluation of potential impacts should be performed that incorporate site data on the thermal/mechanical properties of the disturbed zone." It is determined that reporting requirements of 10 CFR 60.72 and the licensing requirements of 10 CFR 60.135 are adequate to provide this function.

**Operations Alcoves Excavation and Layout, CI: BABEAE000**

10 CFR 60.113(a)(1)(ii) does not directly apply to this CI.  
See the discussion under 10 CFR 60.15(c)(1) for the DIE controls that are imposed on this CI.

Neither seal, lining, nor roadway repository design criteria have been established. No evaluation of the likelihood of disturbing a potential seal mount, lining surface, or roadway can be made at this time. It is determined, however, that commercial-grade equipment and standard design and construction practices, including the controlled use of the TBM for excavation (Requirements 1,2,3), and QA control requirements on installation of ESF-function linings (Requirement 6), provide sufficient assurance against such an event (i.e., significant disturbance), and that future design criteria will need to consider as-found conditions. The use of commercial-grade ground support for stabilization, as controlled by considerations needed to limit potential impacts to radiological safety, is determined sufficient to limit impacts to the potential repository to the extent practical.

Design Input 5.4 of analysis BAB000000-01717-2200-00005 indicates that "when a sealing plan is formulated for the North Ramp, further evaluation of potential impacts should be performed that incorporate site data on the thermal/mechanical properties of the disturbed zone." It is determined that reporting requirements of 10 CFR 60.72 and the licensing requirements of 10 CFR 60.135 are adequate to provide this function.

**Test Alcoves Excavation and Layout, CI: BABEAF000**

10 CFR 60.113(a)(1)(ii) does not directly apply to this CI.  
See the discussion under 10 CFR 60.15(c)(1) for the DIE controls that are imposed on this CI.

Neither seal, lining, nor roadway repository design criteria have been established. No evaluation of the likelihood of disturbing a potential seal mount, lining surface, or roadway can be made at this time. It is determined, however, that commercial-grade equipment and standard design and construction practices, including the controlled use of the TBM for excavation (Requirements 1,2,3), and QA control requirements on installation of ESF-function linings (Requirement 6), provide sufficient assurance against such an event (i.e., significant disturbance), and that future design criteria will need to consider as-found conditions. The use of commercial-grade ground support for stabilization, as controlled by considerations needed to limit potential impacts to radiological safety, is determined sufficient to limit impacts to the potential repository to the extent practical.

Design Input 5.4 of analysis BAB000000-01717-2200-00005 indicates that "when a sealing plan is formulated for the North Ramp, further evaluation of potential impacts should be performed that incorporate site data on the thermal/mechanical properties of the disturbed zone." It is determined that reporting requirements of 10 CFR 60.72 and the licensing requirements of 10 CFR 60.135 are adequate to provide this function.

**Subsurface Lighting, CI: BABFAC000**

10 CFR 60.113(a)(1)(ii) does not directly apply to this CI.  
See the discussion under 10 CFR 60.15(c)(1) for the DIE controls that are imposed on this CI.

**ESF Subsurface Ventilation, CI: BABFAD000**

10 CFR 60.113(a)(1)(ii) does not directly apply to this CI.  
See the discussion under 10 CFR 60.15(c)(1) for the DIE controls that are imposed on this CI.

**Subsurface Water CI: BABFAE000**

10 CFR 60.113(a)(1)(ii) does not directly apply to this CI.  
See the discussion under 10 CFR 60.15(c)(1) for the DIE controls that are imposed on this CI.

**Subsurface Wastewater, CI: BABFAF000**

10 CFR 60.113(a)(1)(ii) does not directly apply to this CI.  
See the discussion under 10 CFR 60.15(c)(1) for the DIE controls that are imposed on this CI.

**Subsurface Compressed Air, CI: BABFAG000**

10 CFR 60.113(a)(1)(ii) does not directly apply to this CI.  
See the discussion under 10 CFR 60.15(c)(1) for the DIE controls that are imposed on this CI.

**Material and Personnel Handling, CI: BABFCC000**

10 CFR 60.113(a)(1)(ii) does not directly apply to this CI.  
See the discussion under 10 CFR 60.15(c)(1) for the DIE controls that are imposed on this CI.

### 3.5.27. 10 CFR 60.131(b)(2)

*Protection against dynamic effects of equipment failure and similar events. The structures, systems, and components important to safety shall be designed to withstand dynamic effects such as missile impacts, that could result from equipment failure, and similar events and conditions that could lead to loss of their safety functions.*

#### Summary

This 10 CFR Part 60 requirement has been conservatively tied to ESFDR requirements that address natural hazards, as well as hazards resulting from equipment failure. For ESF Package 2C, the items important to safety include the permanent items of the ESF, which are the excavated openings and linings and ground support.

The impact of natural hazards, such as earthquakes, floods, and wind, on structures, systems and components (SSC) important to safety (ITS) is limited, but is considered in the design of the systems that interface with SSC ITS. Fluid distribution systems, such as fire protection, water, and wastewater, will be designed to 0.3 g acceleration and will use mechanical couplings that allow some degree of angular and lateral movement. Wind forces present no problem to underground structures. Floods caused by natural causes are highly unlikely because of the limited precipitation and because the portal is located above the probable maximum flood level. In addition, the tunnel's excavated grade is designed to prohibit surface waters from entering the tunnel.

#### Linings and Ground Support, CI: BABEAB000

Wind forces do not present hazards to the linings and ground support. The materials used in the construction of the linings and ground support are inherently non-combustible.

#### Furnishings, CI: BABEAC000

10 CFR 60.131(b)(2) is not applicable to this CI. It is not an SSC ITS.

#### North Ramp Excavation and Layout, CI: BABEAD000

Floods caused by natural causes are highly unlikely because of the limited precipitation and because the portal is located above the probable maximum flood level. In addition, the tunnel's excavated grade is designed to prohibit surface waters from entering the tunnel.

#### Operations Alcoves Excavation and Layout, CI: BABEAE000

10 CFR 60.131(b)(2) is not directly applicable to this CI.

**Test Alcoves Excavation and Layout, CI: BABEAF000**

10 CFR 60.131(b)(2) is not directly applicable to this CI.

**Subsurface Lighting, CI: BABFAC000**

10 CFR 60.131(b)(2) is not applicable to this CI.

**ESF Subsurface Ventilation, CI: BABFAD000**

10 CFR 60.131(b)(2) is not applicable to this CI.

**Subsurface Water CI: BABFAE000**

10 CFR 60.131(b)(2) is not applicable to this CI.

**Subsurface Wastewater, CI: BABFAF000**

10 CFR 60.131(b)(2) is not applicable to this CI.

**Subsurface Compressed Air, CI: BABFAG000**

10 CFR 60.131(b)(2) is not applicable to this CI.

**Material and Personnel Handling, CI: BABFCC000**

10 CFR 60.131(b)(2) is not applicable to this CI.

3.5.28. 10 CFR 60.131(b)(3)

*Protection against fires and explosions.*

- (i) The structures, systems, and components important to safety shall be designed to perform their safety functions during and after credible fires or explosions in the geologic repository operations area.*
- (ii) To the extent practicable, the geologic repository operations area shall be designed to incorporate the use of noncombustible and heat resistant materials.*
- (iii) The geologic repository operations area shall be designed to include explosion and fire detection alarm systems and appropriate suppression systems with sufficient capacity and capability to reduce the adverse effects of fires and explosions on structures, systems, and components important to safety.*
- (iv) The geologic repository operations area shall be designed to include means to protect systems, structures, and components important to safety against the adverse effects of either the operation or failure of the fire suppression systems.*

Summary

For ESF Package 2C, the items important to safety include the permanent items of the ESF, which are the excavated openings and linings and ground support. This 10 CFR Part 60 requirement does not impose any specific design requirements on these items, but the protection of such has been delegated to the design of the various fire suppression systems for the underground.

SSCs that are ITS will continue to perform effectively under credible fire and explosion conditions, as indicated in the analysis BABFAH000-01717-0200-00121, Sections 10.2, 10.12, 10.15, 10.16, and 11.1.

The ESF will consist of a series of underground openings containing a main drift that connects to the lower ends of the North and South Ramps at the TS level. The majority of the construction materials, including ground support, will be non-combustible.

There are three exceptions:

During the installation of steel sets small quantities of timber blocking and wedges may be used; however, this material must be removed prior to acceptance of the steel set installation by the Architect/Engineer.

Timber will be used for temporary rail supports at the TBM launch area for approximately 30 m (100 ft). The temporary supports will remain in place until the TBM is at least 150 m (500 ft) into the tunnel.

Certain materials, such as the muck conveyor belt and wire insulation, are limited-combustible materials.

The potential for a toxic, biological, and/or radiation incident due to a fire is not considered to be a major threat.

The possibility of a fire igniting in the ESF due to exposure from an ongoing fire outside the portal entrance is highly improbable. Surface facilities are of noncombustible construction and are physically removed from the tunnel entrance. MSHA regulations [30 CFR 57.4431] also prohibit the storage of flammable and combustible materials close to the portal to reduce the possibility of a fire. A surface fire, involving the muck conveyor, could cause a burning return belt to transport the fire into the tunnel. This scenario is unlikely and would occur only if the belt safeguards, speed switches etc., fail. Fire protection systems, at the drive, would also have to fail for this to occur.

The ESF subsurface facilities present some special challenges to fire protection design.

The "structure" itself is noncombustible.

The primary means of extinguishing fires during construction will be a dry chemical fire protection system. Organics retained in the TS North Ramp and associated alcoves and refuge chambers must be limited to prevent effects on a potential repository. It is determined however that chemical releases as a result of fires, or extinguishing thereof, are insignificant relative to this limit (and therefore do not impact waste isolation) since dry chemical residue will be removed following discharge. Dry chemical and water shall not be combined for fire protection (because of the assumption that dry chemical releases can be cleaned up). Although its use cannot be precluded for personnel safety, a system using water hose stations will be installed as a supplemental system. It is determined that the backup use of water in the amount required to extinguish a fire is not likely to impact waste isolation, and that any impact as a result of this event can be adequately evaluated after the fact when specific details of the event are available. Any actuation of dry chemical fire protection or the backup use of water will be evaluated after the fact and following removal of the powder and/or water to the extent practical. The requirements associated with mitigation and reporting of spills are adequate to control this activity.

Inadvertent explosions could occur in the TS North Ramp or associated alcoves and refuge chambers during construction and during transport of explosives for excavation further underground in the ESF. The explosives box is a properly constructed explosive transportation container for subsurface use. It will be properly grounded and labeled, lined with non-sparking material, and covered. The box will have two separated compartments,

one for explosives and one for detonators. The car transporting the explosives is to be posted with proper warning signs during transportation, and appropriate multipurpose (ABC) fire extinguisher(s) will be mounted on the car. The potential for accidental detonation is considered remote enough not to warrant the need for QA controls since the utmost care will be exercised during the course of ensuring personnel safety. In the event that a significant uncontrolled explosion does occur, an evaluation of potential impacts to the surrounding rock mass will have to be made at that time based on as-found conditions.

The primary fire protection system to be installed in the TS North Ramp will consist of a multipurpose dry chemical system capable of both manual and automatic activation. Fire suppression systems will be installed at the head, tail, drive, and take-up pulleys of the conveyor; on the TBM (at the hydraulic storage tank and the lubricating oil tank); on the maintenance rail car; on mobile, diesel-driven equipment; on diesel-driven locomotives; on the diesel-driven crane locomotive; and on electric locomotives. Portable fire extinguishers are to be installed at the head, tail, drive, and take-up pulleys of the conveyor; at locations along the tunnel; on the TBM; on the maintenance and explosives rail cars; on diesel and electric locomotives; on diesel-driven mobile equipment; at all electrical equipment alcoves/niches; at all water pumping stations; at all testing enclosures; and at all refuge chambers. Smoke/heat detectors will be installed in the electrical equipment alcoves, providing alarm so that fire fighting response can be performed with portable extinguishers. Heat detectors, some of which initiate alarmed, dry chemical systems, will be installed at the conveyor head, tail, and take-up pulleys, as well as on the TBM, diesel and electric locomotives, maintenance car, and diesel-driven mobile equipment.

**Linings and Ground Support, CI: BABEAB000**

10 CFR 60.131(b)(3) is not directly applicable to this CI.

**Furnishings, CI: BABEAC000**

10 CFR 60.131(b)(3) is not applicable to this CI. It is not an SSC ITS.

**North Ramp Excavation and Layout, CI: BABEAD000**

10 CFR 60.131(b)(3) is not directly applicable to this CI.

**Operations Alcoves Excavation and Layout, CI: BABEAE000**

10 CFR 60.131(b)(3) is not directly applicable to this CI.

**Test Alcoves Excavation and Layout, CI: BABEAF000**

10 CFR 60.131(b)(3) is not directly applicable to this CI.

**Subsurface Lighting, CI: BABFAC000**

10 CFR 60.131(b)(3) is not applicable to this CI. It is not an SSC ITS.

**ESF Subsurface Ventilation, CI: BABFAD000**

10 CFR 60.131(b)(3) is not applicable to this CI. It is not an SSC ITS.

**Subsurface Water CI: BABFAE000**

10 CFR 60.131(b)(3) is not applicable to this CI. It is not an SSC ITS.

**Subsurface Wastewater, CI: BABFAF000**

10 CFR 60.131(b)(3) is not applicable to this CI. It is not an SSC ITS.

**Subsurface Compressed Air, CI: BABFAG000**

10 CFR 60.131(b)(3) is not applicable to this CI. It is not an SSC ITS.

**Material and Personnel Handling, CI: BABFCC000**

10 CFR 60.131(b)(3) is not applicable to this CI. It is not an SSC ITS.

3.5.29. 10 CFR 60.131(b)(4)(i)

*Emergency capability.*

*The structures, systems, and components important to safety shall be designed to maintain control of radioactive waste and radioactive effluents, and permit prompt termination of operations and evacuation of personnel during an emergency.*

Summary

This requirement applies only to the permanent ESF items that are identified as items important to safety. These items include the tunnel and the permanent ground support. These items are controlled with the criteria established in the ESF design package 2C DIE analysis. See the discussion for 10 CFR 60.15(c)(1).

Linings and Ground Support, CI: BABEAB000

All general construction requirements apply to this CI. Examples of the specific application of general requirements include prohibition of the use of organic grout for rockbolts (Requirement 12), and A/E review of constructor submittals for maintenance of rockbolt drills (Requirement 19). In addition, Requirements 9, 16, and 20, which control grouting for rockbolts, shotcrete, and chemical grout injection, apply explicitly to this CI.

See also the following DIE controls:

Requirement 6: The standard mining practices ( i.e., conventional industry techniques and commercial grade materials conforming to requirements of A/E drawings and specifications) employed for emplacement of permanent function ground support systems (i.e., rock bolts, steel sets, concrete, and shotcrete) associated with the TS North Ramp and associated excavations (alcoves, refuge chambers, etc.) are controlled by applying the following minimum QA requirements:

- a. receipt inspection and verification of representative materials per A/E specifications;
- b. 100% verification of placement;
- c. selected installation testing;
- d. and A/E approval of changes.

**Requirement 7:** Ground support work performed in the TS North Ramp and associated excavations (alcoves, etc.) shall be documented in accordance with ground support specifications. These records shall document work processes in conformance with 10 CFR 60.72. Receipt verification and procedural documentation, including changes to bolt patterns, shall also be treated as QA records.

**Requirement 8:** Procedures shall provide for routine inspection, maintenance, monitoring and repair (as required) of components of the ground support system in both the TS North Ramp and in associated alcoves and refuge chambers. The in-place testing and surveillance frequencies and repair criteria for these procedures should be based on review and evaluation of manufacturers' recommendations and standard mining practices. Maintenance or the addition of appurtenances shall not compromise the critical characteristics of the permanent function ground support in the TS North Ramp or associated excavations. Post-installation welding on ground support components must consider the applicable sections of QARD Section 9.0. The inspection, maintenance, and repair procedures shall document work processes in conformance with 10 CFR 60.72 and shall be maintained as QA records.

**Furnishings, CI: BABEAC000**

10 CFR 60.131(b)(4)(i) is not applicable to this CI.

**North Ramp Excavation and Layout, CI: BABEAD000**

The general construction requirements apply to this CI. Examples of the specific application of general requirements include linear limits on the use of water, based on excavation progress (Requirement 11); testing requirements on diesel equipment used during excavation (Requirement 13); and notification of the Test Coordination Office (TCO) in the event of indication of perched water, as indicated in terms of flowing water (Requirement 17).

In addition, other requirements are explicitly applicable to this CI and activities associated with it: Requirements 1, 2, and 3, concerning controls on the use of the Tunnel Boring Machine (TBM); 4 and 5, controlling drill-and-blast excavation; and 21 and 22, concerning holds applicable to excavation progress. Further, excavation of ESF main accesses by TBM is the best available current technology for excavation of the ESF ramps and main drift while limiting geomechanical damage to the host rock.

**Operations Alcoves Excavation and Layout, CI: BABEAE000**

The general construction requirements apply to this CI. As above, one specific application of general requirements includes linear limits on the use of water, but based on alcove width relative to main access width (Requirement 11).

In addition, Requirements 4, 5, 21, and 22 apply explicitly to this CI, as with main access excavation.

**Test Alcoves Excavation and Layout, CI: BABEAF000**

The requirements applicable to this CI are essentially the same as those applied above for Operations Alcoves.

Requirement 22 also applies to test alcoves; exact locations of test alcoves are dependent on the locations of geologic features (faults and stratigraphic contacts).

**Subsurface Lighting, CI: BABFAC000**

10 CFR 60.131(b)(4)(i) is not applicable to this CI.

**ESF Subsurface Ventilation, CI: BABFAD000**

10 CFR 60.131(b)(4)(i) is not applicable to this CI.

**Subsurface Water CI: BABFAE000**

10 CFR 60.131(b)(4)(i) is not applicable to this CI.

**Subsurface Wastewater, CI: BABFAF000**

10 CFR 60.131(b)(4)(i) is not applicable to this CI.

**Subsurface Compressed Air, CI: BABFAG000**

10 CFR 60.131(b)(4)(i) is not applicable to this CI.

**Material and Personnel Handling, CI: BABFCC000**

10 CFR 60.131(b)(4)(i) is not applicable to this CI.

### 3.5.30. 10 CFR 60.131(b)(9)

*Compliance with mining regulations. To the extent that DOE is not subject to the Federal Mine Safety and Health Act of 1977, as to the construction and operation of the geologic repository operations area, the design of the geologic repository operations area shall nevertheless include such provisions for worker protection as may be necessary to provide reasonable assurance that all structures, systems, and components important to safety can perform their intended functions. Any deviation from relevant design requirements in 30 CFR, Chapter I, Subchapters D, E, and N will give rise to a rebuttable presumption that this requirement has not been met.*

#### Summary

This 10 CFR Part 60 requirement ties the requirements of 30 CFR 57 to the design of SSC ITS. This 10 CFR Part 60 requirement is specifically implemented by ESFDR requirement 3.2.1.H.2.e, which is allocated to all ESF permanent items (linings, ground support, underground excavations). Applicable requirements from 30 CFR Part 57 have been mandated to relevant subsurface design, construction, and operations by the ESFDR. Reference to 30 CFR 57, when used, is included in the appropriate design analyses.

Although 10 CFR 60.131(b)(9) ties the requirements of 30 CFR 57 to SSC ITS, some of the requirements of 30 CFR 57 apply to design of underground temporary systems not important to safety, and these requirements have been considered in the design. For example, 30 CFR 57 requirements have been considered in the design of the ventilation system.

#### Linings and Ground Support, CI: BABEAB000

Requirements to provide safe means of access to all underground working places (30 CFR 57.11001) have been considered in the design and construction of the North Ramp access. See analysis BABE00000-01717-0200-00003. The proper design, selection and installation of linings and ground support inherently implement this requirement by contributing to the stability of the underground opening(s).

#### Furnishings, CI: BABEAC000

10 CFR 60.131(b)(9) is not applicable to this CI.

#### North Ramp Excavation and Layout, CI: BABEAD000

The design of the North Ramp is consistent with the requirements of 30 CFR Part 57.

**Operations Alcoves Excavation and Layout, CI: BABEAE000**

30 CFR Part 57 requirements have been considered in the design of the Operations Alcoves Excavation and Layout, as documented in the TS North Ramp Alcove and Stubout Location Analysis BABE00000-01717-0200-00003. Shelter holes, safe access, escapeways, refuge areas, and refuge chamber communications are design features that contribute to worker safety and will be permanent features of the ESF and later in the potential repository.

**Test Alcoves Excavation and Layout, CI: BABEAF000**

30 CFR Part 57 requirements have been considered in the design of the Test Alcoves Excavation and Layout, as documented in the TS North Ramp Alcove and Stubout Location Analysis BABE00000-01717-0200-00003. 30 CFR 57 requirements for safe access have been considered, as well as requirements for ground support and ventilation..

**Subsurface Lighting, CI: BABFAC000**

10 CFR 60.131(b)(9) is not applicable to this CI.

**ESF Subsurface Ventilation, CI: BABFAD000**

10 CFR 60.131(b)(9) is not applicable to this CI.

**Subsurface Water CI: BABFAE000**

10 CFR 60.131(b)(9) is not applicable to this CI.

**Subsurface Wastewater, CI: BABFAF000**

10 CFR 60.131(b)(9) is not applicable to this CI.

**Subsurface Compressed Air, CI: BABFAG000**

10 CFR 60.131(b)(9) is not applicable to this CI.

**Material and Personnel Handling, CI: BABFCC000**

10 CFR 60.131(b)(9) is not applicable to this CI.

### 3.5.31. 10 CFR 60.133(b)

*Flexibility of design. The underground facility shall be designed with sufficient flexibility to allow adjustments where necessary to accommodate specific site conditions identified through in situ monitoring, testing, or excavation.*

#### Summary

Flexibility in the design of the underground excavations is implemented through a ground support system that can accommodate varying ground conditions. Underground utilities can be added, subtracted, and moved, as necessary, to accommodate ongoing construction, monitoring, and testing. The ESF excavation layouts are consistent with the enhanced ESF layout arrangement, which promotes flexibility with respect to alternative layouts.

#### Linings and Ground Support, CI: BABEAB000

Varying ground conditions will require flexibility in support. The DIE states:

##### TS North Ramp Ground Support

North Ramp ground support configurations are dependent on the type of ground encountered. Different types of ground support will be used based on the conditions encountered during North Ramp excavation. Ground support will include mechanical, groutable rockbolts; Super Swellex rockbolts; split sets; welded wire fabric (mesh); shotcrete; concrete; steel sets; channel units; and steel lagging.

In the case of the Williams-type rockbolts, bolts are pre-tensioned upon installation but the strain produced by the pre-tensioning process is not the critical characteristic; rather, the bonding of the rockbolt, after grouting, to the surrounding rock is critical.

Pre-tensioning of the Williams-type rockbolts is performed only for immediate effects, including personnel safety, minimization of the potential for dilation or deleterious rock movement, and seismic criteria. The long-term functions of the rockbolts are met by the grout. No credit is taken for tension once the rockbolt is grouted. With the grout, the rockbolt becomes a passive anchor.

In the event that ground conditions are encountered during excavation that are determined to be incapable of supporting TBM operation (such as may be the case in the area of the Bow Ridge Fault), the option of chemical grouting to stabilize the ground is being considered as a contingency. This may involve drilling holes from the surface, or from within the tunnel, and injecting grout materials (involving such mixtures as sodium silicate and sodium aluminate, or cement grout with sodium silicate or aluminum silicate as a set control agent) into a zone in front of the TBM. Less extensive chemical grouting procedures include void filling, using

cementitious grout to fill voids created by caving and/or running ground in the crown and walls of the tunnel; and tunnel grouting with packers to stabilize fractured and weak rock, and to control water inflows if perched water is encountered.

#### **Furnishings, CI: BABEAC000**

Furnishings can be added, subtracted, and moved, as necessary, to accommodate ongoing construction, monitoring, and testing.

#### **North Ramp Excavation and Layout, CI: BABEAD000**

The ESF excavation layouts are consistent with the enhanced ESF layout arrangement, which "allows the repository designers increased flexibility with respect to alternative layouts, especially those layouts that allow flat (or nearly flat) slopes in the emplacement drifts and accesses, and those that avoid having emplacement drifts cross the fault."

"The controls established in the interest of preserving tunnel integrity, including the mapping and reporting of as-found geologic conditions, are determined adequate to limit potential adverse impacts or the likelihood of ESF construction and operation precluding the establishment of repository criteria."

The exact location of major faults in the ESF cannot be determined without additional information; therefore, design and construction flexibility are required to allow final location and configuration of alcoves to be based upon geologic data obtained during ramp construction. Additional major faults requiring testing may be encountered during ramp excavation. Determination of major faults, actual alcove locations, final depth, orientation, and configuration will be determined in the field based on geologic information and written criteria provided by the USGS prior to alcove construction. The tentative locations of the alcoves are shown on the design drawings.

In the event that adverse ground conditions prevent TBM advance, the Constructor and A/E will develop a plan for continuing TBM advance. The plan shall address, as appropriate, the proposed method for TBM and/or trailing gear retrieval, alternative excavation technologies, special equipment needed, details of materials such as grouts to be used, as appropriate, and the intended method for ground support. The plan for continuing TBM advance will be documented by the A/E and treated as QA Records. Documentation shall include impacts to Specification Sections under QA control.

#### **Operations Alcoves Excavation and Layout, CI: BABEAE000**

As stated in the Los Alamos National Laboratory letter LA-EES-13-LV-03-94-026, "The exact location of major faults and contacts in the ESF North Ramp cannot be determined at this time; therefore, design and construction flexibility is required to allow final location of

alcoves based on geohydrologic data obtained during ramp construction. The final alcove location will be based on written criteria provided by the USGS prior to alcove construction." The design drawings show the tentative locations for the alcoves.

"Locations should have flexibility to be located within 30 m of the desired location to accommodate ground conditions." The desired locations are shown on the design drawings. "The controls established in the interest of preserving tunnel integrity, including the mapping and reporting of as-found geologic conditions, are determined adequate to limit potential adverse impacts or the likelihood of ESF construction and operations precluding the establishment of repository criteria."

The ESF excavation layouts are consistent with the enhanced ESF layout arrangement. "Flexibility is enhanced because cross drifting within the TSw2 is performed at the ends of the block--not through the center--where they could interfere with the future arrangement and orientation of potential repository main and emplacement drifts. This preserves the option for the repository designers to develop a wide range of concepts unhindered by the ESF drifts."

As stated in the Los Alamos National Laboratory letter LA-EES-13-LV-03-94-026, "Design and construction flexibility is required to allow final location of alcoves based on geohydrologic data obtained during ramp construction." Changes in the lithophysal content of the tuff and in local joint patterns will initially be identified during implementation of the Underground Geologic Mapping test. The tentative locations of the alcoves are shown on the design drawings.

The exact location of major faults in the ESF cannot be determined without additional information; therefore, design and construction flexibility are required to allow final location and configuration of alcoves to be based upon geologic data obtained during ramp construction. Additional major faults requiring testing may be encountered during ramp excavation. Determination of major faults, actual alcove locations, final depth, orientation, and configuration will be determined in the field based on geologic information and written criteria provided by the USGS prior to alcove construction. The tentative locations of the alcoves are shown on the design drawings.

#### **Test Alcoves Excavation and Layout, CI: BABEAF000**

The exact location of major faults in the ESF cannot be determined without additional information; therefore, design and construction flexibility are required to allow final location and configuration of alcoves to be based upon geologic data obtained during ramp construction. Additional major faults requiring testing may be encountered during ramp excavation. Determination of major faults, actual alcove locations, final depth, orientation, and configuration will be determined in the field based on geologic information and written criteria provided by the USGS prior to alcove construction. Changes in the lithophysal

content of the tuff and in local joint patterns will initially be identified during implementation of the Underground Geologic Mapping test. The tentative locations of the alcoves are shown on the design drawings.

As stated in the Los Alamos National Laboratory letter LA-EES-13-LV-03-94-026, "The exact location of major faults and contacts in the ESF North Ramp cannot be determined at this time; therefore, design and construction flexibility is required to allow final location of alcoves based on geohydrologic data obtained during ramp construction. The final alcove location will be based on written criteria provided by the USGS prior to alcove construction."

"Locations should have flexibility to be located within 30 m of the desired location to accommodate ground conditions."

"The controls established in the interest of preserving tunnel integrity, including the mapping and reporting of as-found geologic conditions, are determined adequate to limit potential adverse impacts or the likelihood of ESF construction and operations precluding the establishment of repository criteria."

The ESF excavation layouts are consistent with the enhanced ESF layout arrangement. "Flexibility is enhanced because cross drifting within the TSw2 is performed at the ends of the block--not through the center--where they could interfere with the future arrangement and orientation of potential repository main and emplacement drifts. This preserves the option for the repository designers to develop a wide range of concepts unhindered by the ESF drifts."

#### Subsurface Lighting, CI: BABFAC000

Utilities are considered temporary, and as such, can be added, subtracted, and moved, as necessary, to accommodate ongoing construction, monitoring, and testing.

#### ESF Subsurface Ventilation, CI: BABFAD000

The underground utilities shall provide the flexibility needed to accommodate the uncertainty in the design of the ESF. The underground utilities for the ESF shall not preclude monitoring and investigation of in situ conditions, and shall accommodate site-specific conditions, construction, and operation of the ESF. The ventilation systems contains such features as reversible flow, capacity that can be doubled for different flows and maximum of four TBM scenario, and the system will be a flowthrough system after North and South Ramps are complete. The ventilation system serves all testing areas.

#### Subsurface Water CI: BABFAE000

The underground utilities shall provide the flexibility needed to accommodate the uncertainty in the design of the ESF.

Water supply to all areas, water monitoring, and removal from all areas.

The underground utilities for the ESF shall not preclude monitoring and investigation of in situ conditions, and shall accommodate site-specific conditions, construction, and operation of the ESF. Utilities are considered temporary, and as such, can be added, subtracted, and moved, as necessary, to accommodate ongoing construction, monitoring, and testing.

#### **Subsurface Wastewater, CI: BABFAF000**

Wastewater may be comprised of drilling water, rock cleaning water for mapping, fire protection water, main supply water, dust control water, and groundwater. This recovery system is to be used for the control, handling, treatment, and transfer of wastewater and ground water to the Surface Wastewater Handling System. Fluids recovered during construction operations are to be disposed of in such a way as to avoid the potential for performance impacts in accordance with 10 CFR 60.15(c)(1). The wastewater removal system will provide for measurement as required.

Wastewater may be comprised of drilling water, rock cleaning water for mapping, fire protection water, main supply water, dust control water, and groundwater. This recovery system is to be used for the control, handling, treatment, and transfer of wastewater and ground water to the Surface Wastewater Handling System. Fluids recovered during construction operations are to be disposed of in such a way as to avoid the potential for performance impacts in accordance with 10 CFR 60.15(c)(1). The wastewater removal system will provide for measurement as required.

#### **Subsurface Compressed Air, CI: BABFAG000**

Utilities are considered temporary, and as such, can be added, subtracted, and moved, as necessary, to accommodate ongoing construction, monitoring, and testing.

#### **Material and Personnel Handling, CI: BABFCC000**

Flexibility of design [10 CFR 60.133(b)] is reflected in the drawings and specifications. See specification 02452, Section 1.06.D.

Utilities are considered temporary, and as such, can be added, subtracted, and moved, as necessary, to accommodate ongoing construction, monitoring, and testing.

All designs shall meet the following requirements:

- . The track system shall allow for operation on a three-shift-per-day, seven-day-per-week schedule throughout both the ESF construction and operation phases.
- . The track system shall be designed to provide an inherent availability of 98 percent, with maintenance per the Supplier's recommendation.
- . The track system shall be designed and constructed so that it can be easily and economically maintained.
- . The track system shall be designed to allow ease of replacement of installed equipment.
- . The track system design and construction shall provide access to all points, items, units, and components that require testing, servicing, adjusting, removal, replacement, or repair.

### 3.5.32. 10 CFR 60.133(c)

*Retrieval of waste. The underground facility shall be designed to permit retrieval of waste in accordance with the performance objectives of § 60.111.*

#### Summary

In order to preserve the option of waste retrieval, this requirement has been interpreted to primarily apply to the permanent linings and ground support item of the ESF. The stability of the excavated opening is dependent upon the design function of the linings and ground support CI. Retrievability is also supported by the implementation of the repository enhanced layout in ESF design and construction.

#### Linings and Ground Support, CI: BABEAB000

North Ramp support components are considered permanent to allow for "Waste Retrieval on a Reasonable Schedule." These components are found in 10.4, Permanence of Items.

Permanent items evaluated include: the TS North Ramp excavation (entire tunnel opening, including roof and floor); ground support systems (i.e., rockbolts, grout, channel units, welded wire fabric, steel sets, steel lagging, mesh, shotcrete, and concrete); and associated excavations constructed along the TS North Ramp, including their ground support systems and floors.

It is expected that the TS North Ramp will become part of the permanent repository if the site is found suitable. As integral parts of the permanent repository tunnel, the tunnel floor (exclusive of concrete invert segments) and ground support system (including rockbolts and linings) are also considered permanent [the design life of ground support system and floor components is such that they will require periodic inspection and repair if deterioration occurs; nevertheless, the function is permanent (except as noted in 10.6) and will be maintained during the pre-closure phase of repository operation].

The test and equipment alcoves, refuge chambers, and sump excavations (and their ground support systems) are assumed to be permanent as part of "underground excavations." The inspection and maintenance practices prescribed for the permanent ground support systems are developed based on the current function of the TS North Ramp as part of the ESF test facility. Additional tests are planned during site characterization that will investigate various ground support systems and monitoring techniques. At the end of site characterization, the combination of the QA records obtained during maintenance and inspection of the ESF ground support system, coupled with results from ground support monitoring tests, will be used to evaluate the adequacy of existing ground support systems and inspection and maintenance controls for the functions to be performed as part of the potential repository. Therefore, prior to incorporation in the potential repository, an assessment will need to be made of the adequacy of the ESF designed ground support,

inspection and maintenance practices, and more rigorous repository ground support systems and/or monitoring techniques will be developed and implemented, if necessary, at that time.

**Furnishings, CI: BABEAC000**

10 CFR 60.133(c) is not applicable to this CI.

**North Ramp Excavation and Layout, CI: BABEAD000**

As noted in analysis BAB000000-01717-2200-00005, it is expected that the TS North Ramp will become part of the permanent repository if the site is found suitable. The required functions of the GROA have been considered in the design and construction of the ESF. Ramp grade and size are consistent and viewed as adequate for waste emplacement and retrieval. The ESF excavation layouts are consistent with the enhanced ESF layout arrangement. As shown on the design drawings, nothing in the design precludes the retrieval of waste from the potential repository.

**Operations Alcoves Excavation and Layout, CI: BABEAE000**

10 CFR 60.133(c) is not applicable to this CI.

**Test Alcoves Excavation and Layout, CI: BABEAF000**

10 CFR 60.133(c) is not applicable to this CI.

**Subsurface Lighting, CI: BABFAC000**

10 CFR 60.133(c) is not applicable to this CI.

**ESF Subsurface Ventilation, CI: BABFAD000**

10 CFR 60.133(c) is not applicable to this CI.

**Subsurface Water CI: BABFAE000**

10 CFR 60.133(c) is not applicable to this CI.

**Subsurface Wastewater, CI: BABFAF000**

10 CFR 60.133(c) is not applicable to this CI.

**Subsurface Compressed Air, CI: BABFAG000**

10 CFR 60.133(c) is not applicable to this CI.

**Material and Personnel Handling, CI: BABFCC000**

10 CFR 60.133(c) is not applicable to this CI.

### 3.5.33. 10 CFR 60.133(d)

*Control of water and gas. The design of the underground facility shall provide for control of water or gas intrusion.*

#### Summary

This requirement has been interpreted to address naturally occurring pockets of water and gas that may be encountered during underground excavation.

#### Linings and Ground Support, CI: BABEAB000

10 CFR 60.133(d) is not applicable to this configuration item.

#### Furnishings, CI: BABEAC000

10 CFR 60.133(d) is not applicable to this configuration item.

#### North Ramp Excavation and Layout, CI: BABEAD000

The TS North Ramp is entirely within the unsaturated zone above the water table. In the NRG drilling, no water was identified at the location of the North Ramp excavation. In NRG-7/7A, a small amount of water was encountered at the TSw3 vitrophyre layer, which is about 240 m below the North Ramp excavation. This occurrence of water is presently being investigated.

During the ESF construction phase, the negative ramp slope will cause water entering the tunnel to flow to the excavation face, until the TBM reaches the lowest point of the tunnel, at 2800 m. During this phase, an electric motor driven submersible pump will be used to pump water from the face into a portable sump. Two pumps will be available for redundancy. A portable, skid mounted sump will be located on one of the rolling stock platform cars, with a capacity of approximately 4 m<sup>3</sup>.

The ESF has been classified as non-gassy. If, during site characterization, the potential for gas intrusion is found to exist, ESF design and construction will incorporate measures for the mitigation of the gas intrusion. These measures may include drilling or probing in advance of tunneling or the use of tomography in the attempt to locate voids.

#### Operations Alcoves Excavation and Layout, CI: BABEAE000

10 CFR 60.133(d) is not applicable to this configuration item.

**Test Alcoves Excavation and Layout, CI: BABEAF000**

10 CFR 60.133(d) is not applicable to this configuration item.

**Subsurface Lighting, CI: BABFAC000**

10 CFR 60.133(d) is not applicable to this configuration item.

**ESF Subsurface Ventilation, CI: BABFAD000**

10 CFR 60.133(d) is not applicable to this configuration item.

**Subsurface Water CI: BABFAE000**

10 CFR 60.133(d) is not applicable to this configuration item.

**Subsurface Wastewater, CI: BABFAF000**

10 CFR 60.133(d) is not applicable to this configuration item.

**Subsurface Compressed Air, CI: BABFAG000**

10 CFR 60.133(d) is not applicable to this configuration item.

**Material and Personnel Handling, CI: BABFCC000**

10 CFR 60.133(d) is not applicable to this configuration item.

### 3.5.34. 10 CFR 60.133(e)(1)

#### *Underground openings.*

*Openings in the underground facility shall be designed so that operations can be carried out safely and the retrievability option maintained.*

#### Summary

This requirement applies to the permanent items of the ESF, which are the excavated openings and the linings and ground support.

The Geomechanics classification and the NGI system are empirical methods for the selection of modern tunnel reinforcement measure such as rock bolts, wire mesh, and shotcrete. These two classification systems are used to classify the rock mass along TS North Ramp. These two systems are chosen because both are based on numerous case histories, both can easily be used to define rock mass quantities applicable to excavation stability, and both are directed toward the present conventional support techniques of rock bolts, mesh, and shotcrete. Langkopf and Gnirk (1986) also recommend the use of both Geomechanics and NGI rock mass classification systems of the design of the support systems for underground openings in tuff. The Geomechanics and NGI classification systems "are of special interest because they include sufficient information to provide a realistic assessment of the factors which influence the stability of an underground excavation" (Hoek and Brown, 1980).

Each excavation(s) is considered on a case-by-case basis. Nothing in the ESF excavation/ground support design precludes repository development.

Commercial grade mining materials and conventional mining industry practices are determined to be acceptable for maintaining the integrity of the opening and reducing the likelihood of a rockfall, due to the integral conservatisms involved. Standard practices are those mining practices conforming with appropriate A/E drawings and specification sections. These practices include conservatisms for assuring personnel safety; conservative application of subsurface seismic design criteria; finite difference analytical techniques; continuing observations of rock quality (and inputs of these observations into the design process); and the timely application of ground support as a result of personnel safety concerns and normal TBM operation. The acceptability of these conventional techniques is assured by the application of certain nominal QA controls.

#### Linings and Ground Support, CI: BABEAB000

The inspection and maintenance practices prescribed for the permanent ground support systems are developed based on the current function of the TS North Ramp as part of the ESF test facility. Additional tests are planned during site characterization which will

investigate various ground support systems and monitoring techniques. At the end of site characterization, the combination of the QA records obtained during maintenance and inspection of the ESF ground support system, coupled with results from ground support monitoring tests, will be used to evaluate the adequacy of existing ground support systems and inspection and maintenance controls for the functions to be performed as part of the potential repository. Therefore, prior to incorporation in the potential repository, an assessment will need to be made of the adequacy of the ESF designed ground support, inspection and maintenance practices, and more rigorous repository ground support systems and/or monitoring techniques will be developed and implemented, if necessary, at that time.

**Furnishings, CI: BABEAC000**

10 CFR 60.133(e)(1) does not apply to this configuration item.

**North Ramp Excavation and Layout, CI: BABEAD000**

It is expected that the TS North Ramp will become part of the permanent repository if the site is found suitable. As integral parts of the permanent repository tunnel, the tunnel floor (exclusive of concrete invert segments) and ground support system (including rockbolts and linings) are also considered permanent (the design life of ground support system and floor components is such that they will require periodic inspection and repair if deterioration occurs; nevertheless, the function is permanent (except as noted in 10.6) and will be maintained during the pre-closure phase of repository operation).

The minimum TS opening size required to satisfy all criteria, constraints, and assumptions used in the analysis is a nominal 25-ft diameter tunnel. The analysis is primarily based on consideration of ESF requirements related to ventilation and equipment/utility envelopes. Factors directly or indirectly considered include: ventilation quantity requirements, air velocity constraints, traffic patterns, equipment clearances, conveyor/utility locations, safety/stability considerations, cost/schedule considerations, and testing considerations.

The ESF layouts are consistent with the enhanced ESF layout arrangement. As shown on the design drawings, nothing in the design precludes the retrieval of waste from the potential repository.

**Operations Alcoves Excavation and Layout, CI: BABEAE000**

See the summary discussion for this requirement.

**Test Alcoves Excavation and Layout, CI: BABEAF000**

See the summary discussion for this requirement.

**Subsurface Lighting, CI: BABFAC000**

10 CFR 60.133(e)(1) does not apply to this configuration item.

**ESF Subsurface Ventilation, CI: BABFAD000**

10 CFR 60.133(e)(1) does not apply to this configuration item.

**Subsurface Water CI: BABFAE000**

10 CFR 60.133(e)(1) does not apply to this configuration item.

**Subsurface Wastewater, CI: BABFAF000**

10 CFR 60.133(e)(1) does not apply to this configuration item.

**Subsurface Compressed Air, CI: BABFAG000**

10 CFR 60.133(e)(1) does not apply to this configuration item.

**Material and Personnel Handling, CI: BABFCC000**

10 CFR 60.133(e)(1) does not apply to this configuration item.

3.5.35. 10 CFR 60.133(g)

*Underground facility ventilation. The ventilation system shall be designed to:*

- (1) Control the transport of radioactive particulates and gases within and releases from the underground facility in accordance with the performance objectives of § 60.111(a).*
- (2) Assure continued function during normal operations and under accident conditions; and*
- (3) Separate the ventilation of excavation and waste emplacement areas.*

Summary

This requirement has been interpreted to be applicable only to repository ventilation. However, several design features of the ESF will not preclude the performance objectives of the repository ventilation system. ESF temporary systems are removable, and, therefore, will not obstruct repository ventilation flow. The ESF excavation and layout is consistent with the ESF/GROA interface drawings. The layout of the ESF, which consists of a loop of two access ramps and a main drift, supports the preliminary concept for repository ventilation.

**Linings and Ground Support, CI: BABEAB000**

10 CFR 60.133(g) is not applicable to this CI.

**Furnishings, CI: BABEAC000**

The ventilation design will consider the resistance of ramp appurtenances, including furnishings.

**North Ramp Excavation and Layout, CI: BABEAD000**

The ESF excavation and layout is consistent with the ESF/GROA interface drawings. The layout of the ESF, which consists of a loop of two access ramps and a main drift, supports the preliminary concept for repository ventilation.

**Operations Alcoves Excavation and Layout, CI: BABEAE000**

10 CFR 60.133(g) is not applicable to this CI.

**Test Alcoves Excavation and Layout, CI: BABEAF000**

10 CFR 60.133(g) is not applicable to this CI.

**Subsurface Lighting, CI: BABFAC000**

10 CFR 60.133(g) is not applicable to this CI; subsurface lighting is removable and will not obstruct repository ventilation flow.

**ESF Subsurface Ventilation, CI: BABFAD000**

10 CFR 60.133(g) is not applicable to this CI; subsurface ventilation is removable and will not obstruct repository ventilation flow.

**Subsurface Water CI: BABFAE000**

10 CFR 60.133(g) is not applicable to this CI; subsurface water is removable and will not obstruct repository ventilation flow.

**Subsurface Wastewater, CI: BABFAF000**

10 CFR 60.133(g) is not applicable to this CI; subsurface wastewater is removable and will not obstruct repository ventilation flow.

**Subsurface Compressed Air, CI: BABFAG000**

10 CFR 60.133(g) is not applicable to this CI; subsurface compressed air is removable and will not obstruct repository ventilation flow.

**Material and Personnel Handling, CI: BABFCC000**

10 CFR 60.133(g) is not applicable to this CI; material and personal handling is removable and will not obstruct repository ventilation flow.

### 3.5.36. 10 CFR 60.133(h)

*Engineered barriers. Engineered barriers shall be designed to assist the geologic setting in meeting the performance objectives for the period following permanent closure.*

#### Summary

ESF Package 2C does not include any design for the engineered barrier. However, the ESF permanent items are designed and constructed in a manner that will not inhibit the effectiveness of the engineered barrier. Controls that have been established in response to 10 CFR 60.15(c)(1) are in place to ensure that ESF design, construction and operations are performed in a manner that limit adverse impacts to the site. See the discussion for 10 CFR 60.15(c)(1).

#### Linings and Ground Support, CI: BABEAB000

10 CFR 60.133(h) does not directly apply to this CI.

Neither seal, lining, nor roadway repository design criteria have been established. No evaluation of the likelihood of disturbing a potential seal mount, lining surface, or roadway can be made at this time. It is determined, however, that commercial-grade equipment and standard design and construction practices, including the controlled use of the TBM for excavation (Requirements 1,2,3), and QA control requirements on installation of ESF-function linings (Requirement 6), provide sufficient assurance against such an event (i.e., significant disturbance), and that future design criteria will need to consider as-found conditions. The use of commercial-grade ground support for stabilization, as controlled by considerations needed to limit potential impacts to radiological safety, is determined sufficient to limit impacts to the potential repository to the extent practical.

See the discussion under 10 CFR 60.15(c)(1) for the DIE controls that are imposed on this CI.

#### Furnishings, CI: BABEAC000

10 CFR 60.133(h) does not directly apply to this CI.

See the discussion under 10 CFR 60.15(c)(1) for the DIE controls that are imposed on this CI.

#### North Ramp Excavation and Layout, CI: BABEAD000

10 CFR 60.133(h) does not directly apply to this CI.

See the discussion under 10 CFR 60.15(c)(1) for the DIE controls that are imposed on this CI.

Neither seal, lining, nor roadway repository design criteria have been established. No evaluation of the likelihood of disturbing a potential seal mount, lining surface, or roadway can be made at this time. It is determined, however, that commercial-grade equipment and standard design and construction practices, including the controlled use of the TBM for excavation (Requirements 1,2,3), and QA control requirements on installation of ESF-function linings (Requirement 6), provide sufficient assurance against such an event (i.e., significant disturbance), and that future design criteria will need to consider as-found conditions. The use of commercial-grade ground support for stabilization, as controlled by considerations needed to limit potential impacts to radiological safety, is determined sufficient to limit impacts to the potential repository to the extent practical.

Design Input 5.4 of analysis BAB000000-01717-2200-00005 indicates that "when a sealing plan is formulated for the North Ramp, further evaluation of potential impacts should be performed that incorporate site data on the thermal/mechanical properties of the disturbed zone." It is determined that reporting requirements of 10 CFR 60.72 and the licensing requirements of 10 CFR 60.135 are adequate to provide this function.

**Operations Alcoves Excavation and Layout, CI: BABEAE000**

10 CFR 60.133(h) does not directly apply to this CI.  
See the discussion under 10 CFR 60.15(c)(1) for the DIE controls that are imposed on this CI.

Neither seal, lining, nor roadway repository design criteria have been established. No evaluation of the likelihood of disturbing a potential seal mount, lining surface, or roadway can be made at this time. It is determined, however, that commercial-grade equipment and standard design and construction practices, including the controlled use of the TBM for excavation (Requirements 1,2,3), and QA control requirements on installation of ESF-function linings (Requirement 6), provide sufficient assurance against such an event (i.e., significant disturbance), and that future design criteria will need to consider as-found conditions. The use of commercial-grade ground support for stabilization, as controlled by considerations needed to limit potential impacts to radiological safety, is determined sufficient to limit impacts to the potential repository to the extent practical.

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**Test Alcoves Excavation and Layout, CI: BABEAF000**

10 CFR 60.133(h) does not directly apply to this CI.  
See the discussion under 10 CFR 60.15(c)(1) for the DIE controls that are imposed on this CI.

Neither seal, lining, nor roadway repository design criteria have been established. No evaluation of the likelihood of disturbing a potential seal mount, lining surface, or roadway can be made at this time. It is determined, however, that commercial-grade equipment and standard design and construction practices, including the controlled use of the TBM for excavation (Requirements 1,2,3), and QA control requirements on installation of ESF-function linings (Requirement 6), provide sufficient assurance against such an event (i.e., significant disturbance), and that future design criteria will need to consider as-found conditions. The use of commercial-grade ground support for stabilization, as controlled by considerations needed to limit potential impacts to radiological safety, is determined sufficient to limit impacts to the potential repository to the extent practical.

Design Input 5.4 of analysis BAB000000-01717-2200-00005 indicates that "when a sealing plan is formulated for the North Ramp, further evaluation of potential impacts should be performed that incorporate site data on the thermal/mechanical properties of the disturbed zone." It is determined that reporting requirements of 10 CFR 60.72 and the licensing requirements of 10 CFR 60.135 are adequate to provide this function.

**Subsurface Lighting, CI: BABFAC000**

10 CFR 60.133(h) does not directly apply to this CI.  
See the discussion under 10 CFR 60.15(c)(1) for the DIE controls that are imposed on this CI.

**ESF Subsurface Ventilation, CI: BABFAD000**

10 CFR 60.133(h) does not directly apply to this CI.  
See the discussion under 10 CFR 60.15(c)(1) for the DIE controls that are imposed on this CI.

**Subsurface Water CI: BABFAE000**

10 CFR 60.133(h) does not directly apply to this CI.  
See the discussion under 10 CFR 60.15(c)(1) for the DIE controls that are imposed on this CI.

**Subsurface Wastewater, CI: BABFAF000**

10 CFR 60.133(h) does not directly apply to this CI.  
See the discussion under 10 CFR 60.15(c)(1) for the DIE controls that are imposed on this CI.

**Subsurface Compressed Air, CI: BABFAG000**

10 CFR 60.133(h) does not directly apply to this CI.  
See the discussion under 10 CFR 60.15(c)(1) for the DIE controls that are imposed on this CI.

**Material and Personnel Handling, CI: BABFCC000**

10 CFR 60.133(h) does not directly apply to this CI.  
See the discussion under 10 CFR 60.15(c)(1) for the DIE controls that are imposed on this CI.

3.5.37. 10 CFR 60.134(a)

*General design criterion. Seals for shafts and boreholes shall be designed so that following permanent closure they do not become pathways that compromise the geologic repository's ability to meet the performance objectives or the period following permanent closure.*

Summary

ESF Package 2C does not include any design for shaft and borehole seals. However, the ESF permanent items are designed and constructed in a manner that will not inhibit the effectiveness of future seals.

**Linings and Ground Support, CI: BABEAB000**

No pressure grouting shall be performed without prior approval in the following locations:

- (a)  
Immediately below the shaft collar and ramp portal structures in the area where an anchor to bedrock seal is planned to be installed at the time of closure.
- (b)  
At the interface between the nonwelded tuff and the Topopah Spring tuff.
- (c)  
In the extension of the shaft or ramps below the main ESF test level.
- (d)  
Within 15 meters (50 feet) of the boundary of the ESF main test area.
- (e)  
Within fault zones.

**Furnishings, CI: BABEAC000**

10 CFR 60.134(a) is not applicable to this CI.

**North Ramp Excavation and Layout, CI: BABEAD000**

10 CFR 60.134(a) is not directly applicable to this CI.

**Operations Alcoves Excavation and Layout, CI: BABEAE000**

10 CFR 60.134(a) is not directly applicable to this CI.

**Test Alcoves Excavation and Layout, CI: BABEAF000**

10 CFR 60.134(a) is not directly applicable to this CI.

**Subsurface Lighting, CI: BABFAC000**

10 CFR 60.134(a) is not applicable to this CI.

**ESF Subsurface Ventilation, CI: BABFAD000**

10 CFR 60.134(a) is not applicable to this CI.

**Subsurface Water CI: BABFAE000**

10 CFR 60.134(a) is not applicable to this CI.

**Subsurface Wastewater, CI: BABFAF000**

10 CFR 60.134(a) is not applicable to this CI.

**Subsurface Compressed Air, CI: BABFAG000**

10 CFR 60.134(a) is not applicable to this CI.

**Material and Personnel Handling, CI: BABFCC000**

10 CFR 60.134(a) is not applicable to this CI.

3.5.38. 10 CFR 60.134(b)

*Selection of materials and placement methods. Materials and placement methods for seals shall be selected to reduce, to the extent practicable:*

- (1) The potential for creating a preferential pathway for groundwater to contact the waste packages or*
- (2) For radionuclide migration through existing pathways.*

Summary

ESF Package 2C does not include any design for shaft and borehole seals. However, the ESF permanent items are designed and constructed in a manner that will not inhibit the effectiveness of future seals. Controls on grouting that may affect the performance of future seals are in place, and construction material used in the floors of the drifts are designed to be removable.

Linings and Ground Support, CI: BABEAB000

No pressure grouting shall be performed without prior approval in the following locations:

- (a) Immediately below the shaft collar and ramp portal structures in the area where an anchor to bedrock seal is planned to be installed at the time of closure.
- (b) At the interface between the nonwelded tuff and the Topopah Spring tuff.
- (c) In the extension of the shaft or ramps below the main ESF test level.
- (d) Within 15 meters (50 feet) of the boundary of the ESF main test area.
- (e) Within fault zones.

Requirement 20 from the DIE analysis requires the following: Chemical grout injection shall not be used unless no other practical method can be implemented to stabilize weak ground, since the use of organics in the volume needed to control such an injection may impact the waste isolation capability of the site. Therefore, an A/E evaluation of the use of the chemical grout injection (including re-evaluation of potential waste isolation and test interference impact) must be performed prior to its implementation.

Precast, steel-reinforced concrete invert segments are to be lowered into place between the TBM and the first trailing gear car as the TBM advances. Backer rod seals will be installed between the inverts and along the edges of the inverts to inhibit leakage of fluids to the

ground underneath. The invert segments will provide a rail bed and roadway for ESF construction. Rails, inserts, and turnouts for TBM trailing gear and haulage will also be installed. Turnouts will be designed to minimize derailments. The steel rails are to be bolted into embeds within the invert segments. Additional rail components include joint bars, track bolts, and rail bonding. Lifting eyes will be embedded in the inverts to facilitate removal. The invert segments are designed to support steel sets, where needed. The invert segments are designed to be removable.

**Furnishings, CI: BABEAC000**

10 CFR 60.134(b) is not applicable to this CI.

**North Ramp Excavation and Layout, CI: BABEAD000**

10 CFR 60.134(b) is not applicable to this CI.

**Operations Alcoves Excavation and Layout, CI: BABEAE000**

10 CFR 60.134(b) is not directly applicable to this CI.

**Test Alcoves Excavation and Layout, CI: BABEAF000**

10 CFR 60.134(b) is not directly applicable to this CI.

**Subsurface Lighting, CI: BABFAC000**

10 CFR 60.134(b) is not applicable to this CI.

**ESF Subsurface Ventilation, CI: BABFAD000**

10 CFR 60.134(b) is not applicable to this CI.

**Subsurface Water CI: BABFAE000**

10 CFR 60.134(b) is not applicable to this CI.

**Subsurface Wastewater, CI: BABFAF000**

10 CFR 60.134(b) is not applicable to this CI.

**Subsurface Compressed Air, CI: BABFAG000**

10 CFR 60.134(b) is not applicable to this CI.

**Material and Personnel Handling, CI: BABFCC000**

**10 CFR 60.134(b) is not applicable to this CI.**

### 3.5.39. 10 CFR 60.137

*The geologic repository operations area shall be designed so as to permit implementation of a performance confirmation program that meets the requirements of Subpart F of this part.*

#### Summary

This regulatory requirement was written to address the performance confirmation program.

As discussed in SCP 8.3.5.16, the DOE believes that the performance confirmation activities are a subset of the site characterization activities already planned. If site characterization information indicates that additional baseline information is needed, then the baseline phase of the performance confirmation plan will be appropriately modified.

The purpose of the ESF is to provide facilities, underground openings, utilities, and services to support site characterization, including subsurface in-situ testing. The ESF design, construction, operations, and testing will not preclude execution of the performance confirmation plan.

Some or all of these tests may be continued as part of the performance confirmation program if the repository is developed at this site.

In order to not preclude the execution of the performance confirmation plan, it is essential that the integrity of the site be maintained. The ESF has been designed and is being constructed in accordance with 10 CFR 60.15 (c)(1) to limit adverse impacts on the site to the extent practicable, (refer to the response to 10 CFR 60.15 (c)(1)).

#### Linings and Ground Support, CI: BABEAB000

The ESF linings and ground support are designed to maintain access for testing and provide openings that may be used for the potential repository. The linings and ground supports are designed for a 100 year maintainable life. The provision of a 100 year maintainable stable opening allows for in situ monitoring over this period of repository access for the implementation of the performance confirmation program (see the TS North Ramp Ground Support Scoping Analysis BABEAB000-01717-0200-00010).

The A/E has developed ground support design for the TS North Ramp to facilitate site characterization and performance testing without significantly detracting from meeting other repository requirements (TS North Ramp Scoping Analysis, BABEAB000-01717-0200-00010). The site characterization and performance testing involves testing activities include: mapping, instrumentation, deformation monitoring and observations. The ground support

design provides for the evaluation of the continued functioning of the ground support system. Data collected from these activities may support the performance confirmation program.

**Furnishings, CI: BABEAC000**

10 CFR 60.137 is not applicable to this CI.

However, furnishings are designed so as not to preclude the performance confirmation program as follows:

- a) Furnishings are removable to the extent practical to minimize impact on potential repository performance and performance confirmation;
- b) DIE controls require that residual materials, such as grout and bolts, are reported through the TFM Management Plan so they can be evaluated during the performance confirmation program.

**North Ramp Excavation and Layout, CI: BABEAD000**

This CI, as a major component of the ESF, supports the goals and objectives of site characterization by providing access to the potential host medium for in-situ testing.

The Exploratory Studies Facility (ESF) excavation layouts are consistent with the enhanced ESF configuration. As noted on pages 10 and 11 of analysis B00000000-01717-0200-00089, *Description and Rationale for Enhancement to the Baseline ESF Configuration Analysis*:  
The change will...

- . Maintain the full scope of the site suitability and characterization testing provided in Option 30 and provide enhanced characterization opportunities in some areas..

The North Ramp has been designed and is being excavated in accordance with DIE requirements that respond to 10 CFR 60.15 (c)(1).

**Operations Alcoves Excavation and Layout, CI: BABEAE000**

Requirement 10 CFR 60.137 has not been allocated to this CI. However, operations alcoves are provided to support ESF activities, including site characterization testing. Operations alcoves are provided to meet safety requirements for underground personnel and to house the necessary utilities and equipment that support ESF activities. The ESF design layouts in Package 2C for location of operations alcoves are consistent with the conclusions reached in the TS North Ramp Alcove and Stubout Location Analysis for configuration and location of operations alcoves so as not to interfere with in situ site characterization testing.

## Test Alcoves Excavation and Layout, CI: BABEAF000

Test alcoves provide access to underground areas for testing and house test equipment and supporting systems. Design of test alcoves has considered work space and other in situ testing requirements contained in Los Alamos National Laboratory letter LA-EES-13-LV-03-94-026 and construction monitoring and testing requirements contained in Test Planning Package T-93-2.

The Exploratory Studies Facility (ESF) excavation layouts are consistent with the enhanced ESF configuration and therefore will support the performance confirmation program startup by allowing access to areas targeted for study or performance monitoring. As noted on pages 10 and 11 of analysis B00000000-01717-0200-00089, Description and Rationale for Enhancement to the Baseline ESF Configuration Analysis:

.The change will...

- . Maintain the full scope of the site suitability and characterization testing provided in Option 30 and provide enhanced characterization opportunities in some areas..

Design of test alcoves has incorporated work space and other in situ testing requirements contained in Los Alamos National Laboratory letter LA-EES-13-LV-03-94-026, and construction monitoring and testing requirements contained in Test Planning Package T-93-2. Some or all of these tests may be continued as part of the performance confirmation program if the repository is developed at this site.

Section 10.6, Test Alcoves, of analysis BABE00000-01717-0200-00003 indicates:

.The five test alcoves planned to be excavated during construction of the North Ramp are as follows: (1) hydrologic properties of major faults (HPMF) alcove located at the Bow Ridge and Drill Hole Wash faults (three alcoves), and (2) radial borehole test alcoves (two alcoves)..

The test alcove locations as shown on the drawings are approximate. The actual locations will be field determined based on the site-specific conditions encountered. The ESF excavation layouts are consistent with the enhanced ESF configuration and therefore meet the requirements for performing in situ monitoring, laboratory and field testing, and in situ experiments.

The requirement to facilitate performance confirmation testing is a constraint to the design and is implemented through the design drawings.

In accordance with DIE requirements drill and blast excavation methods incorporate controls to minimize rock damage within the test alcove area that could impact confirmation testing. Materials control requirements will provide an inventory of all committed (lost or abandoned) materials during drill and blast excavation of the test alcoves. Permanent records of committed materials will be available to support evaluation of data from the

confirmation testing program. QA controls have been applied to records related to ESF test alcove excavation materials permanently committed (lost or abandoned) in the rock mass surrounding the test alcoves that could impact confirmation testing.

#### **Subsurface Lighting, CI: BABFAC000**

Although 10 CFR 60.137 has not been allocated to this configuration item, there are requirements in the ESFDR for lighting to support testing needs.

Lighting is required for underground activities; therefore, this configuration item represents a utility required for testing in the underground and is provided accordingly.

#### **ESF Subsurface Ventilation, CI: BABFAD000**

Although 10 CFR 60.137 has not been allocated to this configuration item, there are requirements in the ESFDR indicating the need for ventilation to support testing. This set of ESFDR requirements are not associated with 10 CFR 60.137.

See DIE requirements in response to 10 CFR 60.15 (c)(1) for this configuration item.

#### **Subsurface Water CI: BABFAE000**

The underground water distribution system design combines water requirements for fire protection services, construction, testing, and operations for the Exploratory Studies Facility (ESF).

A 6 in. diameter pipe will provide nonpotable water to meet the combined requirements as stated above. See the discussion on 10 CFR 60.15 (c)(1) regarding the tracing of nonpotable water and associated DIE requirements.

#### **Subsurface Wastewater, CI: BABFAF000**

The design includes a wastewater handling system. The ability to collect and transfer wastewater from the underground to the surface assists in the prevention of test interference.

A permanent sump, storage tank, pumping equipment, and piping will be provided at the tunnel low point to collect wastewater, ground water, or spillage or leakage from the water mains for transfer to the surface for final disposal to support the in situ testing program.

Fluids recovered during construction operations are to be disposed of in such a way as to avoid the potential for performance impacts in accordance with 10 CFR 60.15(c)(1). The Wastewater Removal System will provide for measurement of discharge as required.

Wastewater may be comprised of drilling water, rock cleaning water for mapping, fire protection water, main supply water, dust control water, and groundwater. Isolation valves located at intervals along the 15-cm (6-inch) water supply line will limit inflows in the event of a pipe break.

**Subsurface Compressed Air, CI: BABFAG000**

The Compressed Air System located on the surface provides air to the underground via a piping distribution system. Quantities required for testing are considered, reference the analysis in BABFAG000-01717-0200-000161, Table 1, Equipment Air Demand.

See DIE requirements in response to 10 CFR 60.15 (c)(1) for this configuration item.

The compressor facility located on the surface provides air to the underground via a piping distribution system. Quantities of required air were derived. Adequate compressed air is provided for testing purposes.

**Material and Personnel Handling, CI: BABFCC000**

Material and Personnel Handling is required for underground activities therefore this configuration item represents a utility required for testing in the underground and is provided accordingly.

Although 10 CFR 60.137 has not been allocated to this configuration item, there are requirements in the ESFDR indicating the need for material and personnel handling to support testing. This set of ESFDR requirements are not associated with 10 CFR 60.137.

### 3.5.40. 10 CFR 60.140(b)

*The program shall have been started during site characterization and it will continue until permanent closure.*

#### Summary

This regulatory requirement was written to address the performance confirmation program. It has been interpreted as a programmatic requirement which establishes the time period for the implementation of the performance confirmation program. ESF design does not establish the time period for the performance confirmation program, but inherently supports the establishment of the performance confirmation program by providing the capability to perform site characterization testing.

As discussed in SCP 8.3.5.16, the DOE believes that the performance confirmation activities are a subset of the site characterization activities already planned. If site characterization information indicates that additional baseline information is needed, then the baseline phase of the performance confirmation plan will be appropriately modified.

The purpose of the ESF is to provide facilities, underground openings, utilities, and services to support site characterization, including subsurface in-situ testing. The ESF design, construction, operations, and testing will not preclude execution of the performance confirmation plan.

Some or all of these tests may be continued as part of the performance confirmation program if the repository is developed at this site.

In order to not preclude the execution of the performance confirmation plan, it is essential that the integrity of the site be maintained. The ESF has been designed and is being constructed in accordance with 10 CFR 60.15 (c)(1) to limit adverse impacts on the site to the extent practicable. (refer to the response to 10 CFR 60.15 (c)(1)).

#### Linings and Ground Support, CI: BABEAB000

The ESF linings and ground support are designed to maintain access for testing and provide openings that may be used for the potential repository. The linings and ground supports are designed for a 100 year maintainable life. The provision of a 100 year maintainable stable opening allows for in situ monitoring over this period of repository access for the implementation of the performance confirmation program (see the TS North Ramp Ground Support Scoping Analysis BABEAB000-01717-0200-00010).

The A/E has developed ground support design for the TS North Ramp to facilitate site characterization and performance testing without significantly detracting from meeting other repository requirements (TS North Ramp Scoping Analysis, BABEAB000-01717-0200-00010). The site characterization and performance testing activities include: mapping, instrumentation, deformation monitoring and observations. The ground support design provides for the evaluation of the continued functioning of the ground support system. Data collected from these activities may support the performance confirmation program.

**Furnishings, CI: BABEAC000**

10 CFR 60.140(b) is not applicable to this CI.

However, furnishings are designed so as not to preclude the performance confirmation program as follows:

- a) Furnishings are removable to the extent practical to minimize impact on potential repository performance and performance confirmation;
- b) DIE controls require that residual materials, such as grout and bolts, are reported through the TFM Management Plan so they can be evaluated during the performance confirmation program.

**North Ramp Excavation and Layout, CI: BABEAD000**

This CI, as a major component of the ESF, supports the goals and objectives of site characterization by providing access to the potential host medium for in-situ testing.

The Exploratory Studies Facility (ESF) excavation layouts are consistent with the enhanced ESF configuration. As noted on pages 10 and 11 of analysis B00000000-01717-0200-00089, Description and Rationale for Enhancement to the Baseline ESF Configuration Analysis: The change will...

- . Maintain the full scope of the site suitability and characterization testing provided in Option 30 and provide enhanced characterization opportunities in some areas..

The North Ramp has been designed and is being excavated in accordance with DIE requirements that respond to 10 CFR 60.15 (c)(1).

**Operations Alcoves Excavation and Layout, CI: BABEAE000**

Requirement 10 CFR 60.140(b) has not been allocated to this CI. However, operations alcoves are provided to support ESF activities, including site characterization testing. Operations alcoves are provided to meet safety requirements for underground personnel and to house

the necessary utilities and equipment that support ESF activities. The ESF design layouts in Package 2C for location of operations alcoves are consistent with the conclusions reached in the TS North Ramp Alcove and Stubout Location Analysis for configuration and location of operations alcoves so as not to interfere with in situ site characterization testing.

#### Test Alcoves Excavation and Layout, CI: BABEAF000

Test alcoves provide access to underground areas for testing and house test equipment and supporting systems. Design of test alcoves has considered work space and other in situ testing requirements contained in Los Alamos National Laboratory letter LA-EES-13-LV-03-94-026 and construction monitoring and testing requirements contained in Test Planning Package T-93-2.

The Exploratory Studies Facility (ESF) excavation layouts are consistent with the enhanced ESF configuration and therefore will support the performance confirmation program startup by allowing access to areas targeted for study or performance monitoring. As noted on pages 10 and 11 of analysis B00000000-01717-0200-00089, Description and Rationale for Enhancement to the Baseline ESF Configuration Analysis:

.The change will...

- . Maintain the full scope of the site suitability and characterization testing provided in Option 30 and provide enhanced characterization opportunities in some areas..

Design of test alcoves has incorporated work space and other in situ testing requirements contained in Los Alamos National Laboratory letter LA-EES-13-LV-03-94-026, and construction monitoring and testing requirements contained in Test Planning Package T-93-2. Some or all of these tests may be continued as part of the performance confirmation program if the repository is developed at this site.

Section 10.6, Test Alcoves, of analysis BABE00000-01717-0200-00003 indicates:

.The five test alcoves planned to be excavated during construction of the North Ramp are as follows: (1) hydrologic properties of major faults (HPMF) alcove located at the Bow Ridge and Drill Hole Wash faults (three alcoves), and (2) radial borehole test alcoves (two alcoves)..

The test alcove locations as shown on the drawings are approximate. The actual locations will be field determined based on the site-specific conditions encountered. The ESF excavation layouts are consistent with the enhanced ESF configuration and therefore meet the requirements for performing in situ monitoring, laboratory and field testing, and in situ experiments.

The requirement to facilitate performance confirmation testing is a constraint to the design and is implemented through the design drawings.

In accordance with DIE requirements drill and blast excavation methods incorporate controls to minimize rock damage within the test alcove area that could impact confirmation testing. Materials control requirements will provide an inventory of all committed (lost or abandoned) materials during drill and blast excavation of the test alcoves. Permanent records of committed materials will be available to support evaluation of data from the confirmation testing program. QA controls have been applied to records related to ESF test alcove excavation materials permanently committed (lost or abandoned) in the rock mass surrounding the test alcoves that could impact confirmation testing.

**Subsurface Lighting, CI: BABFAC000**

Although 10 CFR 60.140(b) has not been allocated to this configuration item, there are requirements in the ESFDR for lighting to support testing needs.

Lighting is required for underground activities; therefore, this configuration item represents a utility required for testing in the underground and is provided accordingly.

**ESF Subsurface Ventilation, CI: BABFAD000**

Although 10 CFR 60.140(b) has not been allocated to this configuration item, there are requirements in the ESFDR indicating the need for ventilation to support testing. This set of ESFDR requirements are not associated with 10 CFR 60.140(b).

See DIE requirements in response to 10 CFR 60.15 (c)(1) for this configuration item.

**Subsurface Water CI: BABFAE000**

Although 10 CFR 60.140(b) has not been allocated to this configuration item, there are requirements in the ESFDR indicating the need for water to support testing. The underground water distribution system design combines water requirements for fire protection services, construction, testing, and operations for the Exploratory Studies Facility (ESF).

A 6 in. diameter pipe will provide nonpotable water to meet the combined requirements as stated above. See the discussion on 10 CFR 60.15 (c)(1) regarding the tracing of nonpotable water and associated DIE requirements.

**Subsurface Wastewater, CI: BABFAF000**

Although 10 CFR 60.140(b) has not been allocated to this configuration item, there are requirements in the ESFDR indicating the need for a wastewater system to support testing.

The design includes a wastewater handling system. The ability to collect and transfer wastewater from the underground to the surface assists in the prevention of test interference.

A permanent sump, storage tank, pumping equipment, and piping will be provided at the tunnel low point to collect wastewater, ground water, or spillage or leakage from the water mains for transfer to the surface for final disposal to support the in situ testing program.

Fluids recovered during construction operations are to be disposed of in such a way as to avoid the potential for performance impacts in accordance with 10 CFR 60.15(c)(1). The Wastewater Removal System will provide for measurement of discharge as required.

Wastewater may be comprised of drilling water, rock cleaning water for mapping, fire protection water, main supply water, dust control water, and groundwater. Isolation valves located at intervals along the 15-cm (6-inch) water supply line will limit inflows in the event of a pipe break.

#### **Subsurface Compressed Air, CI: BABFAG000**

Although 10 CFR 60.140(b) has not been allocated to this configuration item, there are requirements in the ESFDR indicating the need for compressed air to support testing. This set of ESFDR requirements are not associated with 10 CFR 60.140(b). The Compressed Air System located on the surface provides air to the underground via a piping distribution system. Quantities required for testing are considered, reference the analysis in BABFAG000-01717-0200-000161, Table 1, Equipment Air Demand.

See DIE requirements in response to 10 CFR 60.15 (c)(1) for this configuration item.

The compressor facility located on the surface provides air to the underground via a piping distribution system. Quantities of required air were derived. Adequate compressed air is provided for testing purposes.

#### **Material and Personnel Handling, CI: BABFCC000**

Although 10 CFR 60.140(b) has not been allocated to this configuration item, there are requirements in the ESFDR indicating the need for material and personnel handling to support testing. This set of ESFDR requirements are not associated with 10 CFR 60.140(b). Material and Personnel Handling is required for underground activities therefore this configuration item represents a utility required for testing in the underground and is provided accordingly.

3.5.41. 10 CFR 60.142(a).

*During the early or developmental stages of construction, a program for in situ testing of such features as borehole and shaft seals, backfill, and the thermal interaction effects of the waste packages, backfill, rock, and groundwater shall be conducted.*

Summary

This regulatory requirement was written to address the performance confirmation program.

As discussed in SCP 8.3.5.16, the DOE believes that the performance confirmation activities are a subset of the site characterization activities already planned. If site characterization information indicates that additional baseline information is needed, then the baseline phase of the performance confirmation plan will be appropriately modified.

The purpose of the ESF is to provide facilities, underground openings, utilities, and services to support site characterization, including subsurface in-situ testing. The ESF design, construction, operations, and testing will not preclude execution of the performance confirmation plan.

Some or all of these tests may be continued as part of the performance confirmation program if the repository is developed at this site.

In order to not preclude the execution of the performance confirmation plan, it is essential that the integrity of the site be maintained. The ESF has been designed and is being constructed in accordance with 10 CFR 60.15 (c)(1) to limit adverse impacts on the site to the extent practicable. (refer to the response to 10 CFR 60.15 (c)(1)).

Linings and Ground Support, CI: BABEAB000

Design Input 5.4 of analysis BAB000000-01717-2200-00005 indicates that "when a sealing plan is formulated for the North Ramp, further evaluation of potential impact should be performed that incorporate site data on the thermal/mechanical properties of the disturbed zone."

A broad range of testing is proposed to accommodate the potential broad range of conditions that may be encountered in the underground workings. The types and numbers of sealing tests are ultimately dependent on the geology, hydrology, and design of the underground facility. The ESF design is flexible enough to perform characterization and seal component in situ testing.

There are requirements in the ESFDR indicating the need for linings and ground support to maintain access for testing. This set of ESFDR requirements are not associated with 10 CFR 60.142(a). The linings and ground supports are designed for a 100 year maintainable life. The provision of a 100 year maintainable stable opening allows for in situ monitoring over this period (see the TS North Ramp Ground Support Scoping Analysis BABEAB000-01717-0200-00010).

**Furnishings, CI: BABEAC000**

10 CFR 60.142(a) is not applicable to this CI.

**North Ramp Excavation and Layout, CI: BABEAD000**

This CI, as a major component of the ESF, supports the goals and objectives of site characterization by providing access to the potential host medium for in-situ testing.

The ESF excavation layout is consistent with the ESF/GROA interface drawings referenced in the ESFDR Appendix A2.

Although 10 CFR 60.142(a) has not been allocated to this configuration item, there are requirements in the ESFDR indicating the need for an access to the *in situ* medium to accomplish testing. This set of ESFDR requirements are not associated with 10 CFR 60.142(a).

**Operations Alcoves Excavation and Layout, CI: BABEAE000**

Operations alcoves are provided to support ESF activities, including site characterization testing. Operations alcoves are provided to meet safety requirements for underground personnel and to house the necessary utilities and equipment that support ESF activities. The ESF design layouts in Package 2C for location of operations alcoves are consistent with the conclusions reached in the TS North Ramp Alcove and Stubout Location Analysis for configuration and location of operations alcoves so as not to interfere with in situ site characterization testing.

Although 10 CFR 60.142(a) has not been allocated to this configuration item, there are requirements in the ESFDR indicating the need for operations support areas. This set of ESFDR requirements are not associated with 10 CFR 60.142(a).

**Test Alcoves Excavation and Layout, CI: BABEAF000**

Design Input 5.4 of analysis BAB000000-01717-2200-00005 indicates that "when a sealing plan is formulated for the North Ramp, further evaluation of potential impact should be performed that incorporate site data on the thermal/mechanical properties of the disturbed zone."

A broad range of testing is proposed to accommodate the potential broad range of conditions that may be encountered in the underground workings. The types and numbers of sealing tests are ultimately dependent on the geology, hydrology, and design of the underground facility. The ESF design is flexible enough to perform characterization and seal component in situ testing.

Test alcoves are provided to allow access to underground areas for testing, house test equipment, and accommodate the utilities required for testing.

Design of test alcoves has considered work space and other in situ testing requirements contained in Los Alamos National Laboratory letter LA-EES-13-LV-03-94-026 and construction monitoring and testing requirements contained in Test Planning Package T-93-2.

#### **Subsurface Lighting, CI: BABFAC000**

Lighting is required for underground activities therefore this configuration item represents a utility required for testing in the underground and is provided accordingly..

Although 10 CFR 60.142(a) has not been allocated to this configuration item, there are requirements in the ESFDR indicating the need for lighting to support testing. This set of ESFDR requirements are not associated with 10 CFR 60.142(a).

#### **ESF Subsurface Ventilation, CI: BABFAD000**

Ventilation is required for underground activities therefore this configuration item represents a utility required for testing in the underground and is provided accordingly..

Although 10 CFR 60.142(a) has not been allocated to this configuration item, there are requirements in the ESFDR indicating the need for ventilation to support testing. This set of ESFDR requirements are not associated with 10 CFR 60.142(a).

#### **Subsurface Water CI: BABFAE000**

A 6 in. diameter piping system is used to provide nonpotable water to meet the combined requirements for construction, testing and fire protection. This includes allowance for support of testing. In addition, see the discussion in the response to 10 CFR 60.15 (c)(1) regarding the tracing of nonpotable water.

Although 10 CFR 60.142(a) has not been allocated to this configuration item, there are requirements in the ESFDR indicating the need for water to support testing. This set of ESFDR requirements are not associated with 10 CFR 60.142(a).

### **Subsurface Wastewater, CI: BABFAF000**

The ability to collect and transfer wastewater assists in the prevention of test interference. A permanent sump, storage tank, pumping equipment, and piping will be provided at the tunnel low point to collect any wastewater or ground water encountered due to either natural or accidental events for transfer to the surface for final disposal to support the in situ testing program.

Although 10 CFR 60.142(a) has not been allocated to this configuration item, there are requirements in the ESFDR indicating the need for a wastewater system to support testing. This set of ESFDR requirements are not associated with 10 CFR 60.142(a).

### **Subsurface Compressed Air, CI: BABFAG000**

The Compressed Air System located on the surface provides air to the underground via a piping distribution system. Quantities required for testing are considered, reference the analysis in BABFAG000-01717-0200-000161, Table 1, Equipment Air Demand.

Although 10 CFR 60.142(a) has not been allocated to this configuration item, there are requirements in the ESFDR indicating the need for compressed air to support testing. This set of ESFDR requirements are not associated with 10 CFR 60.142(a).

### **Material and Personnel Handling, CI: BABFCC000**

Material and Personnel Handling is required for underground activities therefore this configuration item represents a utility required for testing in the underground and is provided accordingly.

Although 10 CFR 60.142(a) has not been allocated to this configuration item, there are requirements in the ESFDR indicating the need for material and personnel handling to support testing. This set of ESFDR requirements are not associated with 10 CFR 60.142(a).

### 3.4.42. 10 CFR 60.142(b)

*The testing shall be initiated as early as is practicable.*

This regulatory requirement was written to address the performance confirmation program.

As discussed in SCP 8.3.5.16, the DOE believes that the performance confirmation activities are a subset of the site characterization activities already planned. If site characterization information indicates that additional baseline information is needed, then the baseline phase of the performance confirmation plan will be appropriately modified.

The purpose of the ESF is to provide facilities, underground openings, utilities, and services to support site characterization, including subsurface in-situ testing. The ESF design, construction, operations, and testing will not preclude execution of the performance confirmation plan.

Some or all of these tests may be continued as part of the performance confirmation program if the repository is developed at this site.

In order to not preclude the execution of the performance confirmation plan, it is essential that the integrity of the site be maintained. The ESF has been designed and is being constructed in accordance with 10 CFR 60.15 (c)(1) to limit adverse impacts on the site to the extent practicable, (refer to the response to 10 CFR 60.15 (c)(1)).

#### **Linings and Ground Support, CI: BABEAB000**

It is recognized in Design Input 5.2 of analysis BAB000000-01717-2200-00005 that dual goals of (1) expedient operation of the TBM to construct the ESF and (2) acquisition of scientific data through testing and monitoring must be accommodated.

There are requirements in the ESFDR indicating the need for linings and ground support to maintain access for testing. This set of ESFDR requirements are not associated with 10 CFR 60.142(b). The linings and ground supports are designed for a 100 year maintainable life. The provision of a 100 year maintainable stable opening allows for in situ monitoring over this period (see the TS North Ramp Ground Support Scoping Analysis BABEAB000-01717-0200-00010).

#### **Furnishings, CI: BABEAC000**

10 CFR 60.142(b) is not applicable to this CI.

### North Ramp Excavation and Layout, CI: BABEAD000

It is recognized in Design Input 5.2 of analysis BAB000000-01717-2200-00005 that dual goals of (1) expedient operation of the TBM to construct the ESF and (2) acquisition of scientific data through testing and monitoring must be accommodated.

This CI, as a major component of the ESF, supports the goals and objectives of site characterization by providing access to the potential host medium for in-situ testing.

The ESF excavation layout is consistent with the ESF/GROA interface drawings referenced in the ESFDR Appendix A2.

### Operations Alcoves Excavation and Layout, CI: BABEAE000

Operations alcoves are provided to support ESF activities, including site characterization testing. Operations alcoves are provided to meet safety requirements for underground personnel and to house the necessary utilities and equipment that support ESF activities. The ESF design layouts in Package 2C for location of operations alcoves are consistent with the conclusions reached in the TS North Ramp Alcove and Stubout Location Analysis for configuration and location of operations alcoves so as not to interfere with in situ site characterization testing.

Although 10 CFR 60.142(b) has not been allocated to this configuration item, there are requirements in the ESFDR indicating the need for operations support areas. This set of ESFDR requirements are not associated with 10 CFR 60.142(a).

### Test Alcoves Excavation and Layout, CI: BABEAF000

Design Input 5.4 of analysis BAB000000-01717-2200-00005 indicates that "when a sealing plan is formulated for the North Ramp, further evaluation of potential impact should be performed that incorporate site data on the thermal/mechanical properties of the disturbed zone."

A broad range of testing is proposed to accommodate the potential broad range of conditions that may be encountered in the underground workings. The types and numbers of sealing tests are ultimately dependent on the geology, hydrology, and design of the underground facility. The ESF design is flexible enough to perform characterization and seal component in situ testing.

Test alcoves are provided to allow access to underground areas for testing, house test equipment, and accommodate the utilities required for testing.

Design of test alcoves has considered work space and other in situ testing requirements contained in Los Alamos National Laboratory letter LA-EES-13-LV-03-94-026 and construction monitoring and testing requirements contained in Test Planning Package T-93-2.

**Subsurface Lighting, CI: BABFAC000**

Lighting is required for underground activities therefore this configuration item represents a utility required for testing in the underground and is provided accordingly..

Although 10 CFR 60.142(b) has not been allocated to this configuration item, there are requirements in the ESFDR indicating the need for lighting to support testing. This set of ESFDR requirements are not associated with 10 CFR 60.142(b).

**ESF Subsurface Ventilation, CI: BABFAD000**

Ventilation is required for underground activities therefore this configuration item represents a utility required for testing in the underground and is provided accordingly..

Although 10 CFR 60.142(b) has not been allocated to this configuration item, there are requirements in the ESFDR indicating the need for ventilation to support testing. This set of ESFDR requirements are not associated with 10 CFR 60.142(b).

**Subsurface Water CI: BABFAE000**

A 6 in. diameter piping system is used to provide nonpotable water to meet the combined requirements for construction, testing and fire protection. This includes allowance for support of testing. In addition, see the discussion in the response to 10 CFR 60.15 (c)(1) regarding the tracing of nonpotable water.

Although 10 CFR 60.142(b) has not been allocated to this configuration item, there are requirements in the ESFDR indicating the need for water to support testing. This set of ESFDR requirements are not associated with 10 CFR 60.142(b).

**Subsurface Wastewater, CI: BABFAF000**

The ability to collect and transfer wastewater assists in the prevention of test interference. A permanent sump, storage tank, pumping equipment, and piping will be provided at the tunnel low point to collect any wastewater or ground water encountered due to either natural or accidental events for transfer to the surface for final disposal to support the in situ testing program.

Although 10 CFR 60.142(b) has not been allocated to this configuration item, there are requirements in the ESFDR indicating the need for a wastewater system to support testing. This set of ESFDR requirements are not associated with 10 CFR 60.142(b).

**Subsurface Compressed Air, CI: BABFAG000**

The Compressed Air System located on the surface provides air to the underground via a piping distribution system. Quantities required for testing are considered, reference the analysis in BABFAG000-01717-0200-000161, Table 1, Equipment Air Demand.

Although 10 CFR 60.142(b) has not been allocated to this configuration item, there are requirements in the ESFDR indicating the need for compressed air to support testing. This set of ESFDR requirements are not associated with 10 CFR 60.142(b).

**Material and Personnel Handling, CI: BABFCC000**

Material and Personnel Handling is required for underground activities therefore this configuration item represents a utility required for testing in the underground and is provided accordingly.

Although 10 CFR 60.142(b) has not been allocated to this configuration item, there are requirements in the ESFDR indicating the need for material and personnel handling to support testing. This set of ESFDR requirements are not associated with 10 CFR 60.142(b).