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REVIEW OF ESF SUBSYSTEM DESIGN REQUIREMENTS DOCUMENT FOR TITLE II, REV. 1

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1. INTRODUCTION

The review of DOE's "ESF Subsystem Design Requirements Document for Title II, Rev. 1" (SDRD) has been conducted in accordance with the agreement reached at the NRC/CNWRA RDCO Program Element Technical Direction Meeting on March 27, 1990. The review covers the main text of the SDRD and Appendices A.2, A.3, A.4, A.5, A.6, B, and F.2. This review consists of general and specific comments.

2. GENERAL COMMENTS

(1) This SDRD is based on the January 1, 1989 publication of 10 CFR Part 60. The latest version should be used and cited. Of particular significance is the change in Section 60.15, where paragraph (c) was removed and paragraph (d) was redesignated as paragraph (c).

(2) The primary purpose of the SDRD is to provide design requirements to DOE contractors involved in ESF design. However, with regard to 10 CFR Part 60 requirements, some statements within the SDRD are too broad to provide further definition to designers beyond that which is contained in the regulation. Examples of this are:

(a) "The ESF structures, systems, and components that are incorporated into the repository shall meet the requirements of 10 CFR Part 60." (Performance criterion 6c on p. 6.0-8)

(b) "Performance confirmation testing shall be carried out to meet requirements of 10 CFR 60.140 (b), 140 (c), 140 (d), 141, and 142." (Performance criterion 3e on p. 6.0-6)

(3) The SDRD does not provide clear documentation of how 10 CFR Part 60 requirements are translated into design bases. The converse is also true. That is, design bases (given, for example, in Appendices A.3 and A.4) are not related to relevant 10 CFR Part 60 requirements. It is recommended that the SDRD clearly establish the relationship between the regulatory requirements and the design bases that will be used to assure fulfillment of those requirements.

(4) A rigorous Quality Assurance program was not implemented in the development of this SDRD. Evidences can be found throughout the SDRD. The impact of this deficiency on the ESF design is not clear. But it does raise a concern about the reliability of the SDRD. Some examples are given as follows:

(a) The first sub-tier of Constraint M stated that overburden must be > 200m for the main test level of the ESF (p. 6.6-13). According to 10 CFR 60.122 (b) (5), the favorable condition for the minimum overburden will be 300m. Further, the current planned depth for the main test level is about 320m, based on Fig. 8.4.2-33 of the SCP (p. 8.4.2-181).

(b) Three sub-tiers (vii, viii, and ix) seem to be missing from the Constraint P on p. 6.4-14 or the statements under the constraint need to be renumbered.

(5) The SDRD is in general very poorly organized and unnecessarily redundant. Examples are given as follows:

(a) Portion of a statement was repeated for use as another stand alone statement. Examples of this are:

"The shaft shall be designed to provide stability and to minimize the potential for deleterious rock movement or fracturing that may create a pathway for radionuclide migration. [E6.4PC1d] (O,W,S) [E89]" (Performance criteria 1f, Sub-tier ii, p. 6.4-4) vs

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"The shaft shall be designed to provide stability and to minimize the potential for deleterious rock movement or fracturing that may create a pathway for radionuclide migration. The following are design goals relating to shaft stability. These design goals may be modified pending information obtained during site characterization or from future analyses:

a. Diametrical closure rate in the first shaft to average less than 1 millimeter per year. This closure rate goal applies to the rate after the first year of closure has occurred. [NEV] [TBV]

b. The total diametrical closure in the first shaft is to be less than 3 inches at 100 years. [NEV,E6.4PCid] (O,W,S) [TBV]" (Performance criteria 1f, Sub-tier v, pp. 6.4-4 and 6.4-5)

It appears that Performance criterion 1f, Sub-tier ii is a subpart of performance criterion 1f, Sub-tier v and may be removed. Another example is:

"The design of underground openings and their supports shall consider pillar and openings geometries that limit excessive stress concentrations. [E6.6CG]" (Constraint Q, Sub-tier ii, p. 6.6-17) vs

"The design of underground openings and their supports shall consider pillar and openings geometries that limit excessive stress concentration, changes in rock mass permeability, and changes in rock mass deformability to levels consistent with acquiring adequate and reliable information from site characterization. [NEV,E6.6CG]" (Constraint Q, Sub-tier vii, pp. 6.6-17 and 6.6-18)

(b) Distinguishing "Performance Criteria" from "Constraints" is not always easy. Although a definition for both terms has been provided in the SDRD, a review of the SDRD indicated that, according to the way they were written, some statements may be fitted in both categories. When this happened, a free style strategy seemed to be used for decision making and, in some cases, same or similar statements were listed in both categories for the sake of convenience. An example is that the statement of *"The design of the shaft shall incorporate aspects specifically directed at limiting the potential for adverse impacts on the long term performance of the repository, and construction and operation of the shaft shall be performed in a manner that limits the potential for adverse impacts on the long term performance of the repository"* was listed as Performance criterion 1c, Sub-tier i, p. 6.4-3, and also listed as Constraint B, Sub-tier i, p. 6.4-8.

It would appear that the purpose of the SDRD will be better served if "Performance criteria," "Constraints," and "Assumptions" are consolidated and presented simply as design requirements.

(6) DOE's definition of *"Underground Excavations"* (p. 6.6-1) is different from NRC's definition of *"Underground facility"* (10 CFR 60.2). DOE's definition will need to be revised if ramps become part of the ESF, i.e., to what extent, a ramp will become part of an underground excavation.

(7) The design life for various ESF structures, systems, and components is given by Performance Criterion 2b, p. 6.0-5. Whereas these design lives for permanent structures, systems, and components may satisfy requirements for retrievability and performance confirmation testing, it is not at all clear what the basis for the various design lives is. The technical basis

for these design lives should be stated. 10 CFR Part 60 retrievability requirements are cited directly only once in the SDRD (Performance criterion 6j, p. 6.0-10).

The design life for ESF structures, systems, and components required for performance confirmation testing should be greater than 5 years. For example, according to the design life criteria on p. 6.0-5, the design life for components of the heated room test would be 5 years. It is doubtful that this period is long enough for testing, let alone performance confirmation. A report or documented calculation is required to substantiate such bases, which may otherwise appear to be quite arbitrary.

(8) DOE's definition for "*Shaft System*" is "*those systems, subsystems, and components that are comprised of vertical engineered openings within a circular zone, whose radius is defined by the sum of the radius of the shaft, the liner thickness, and a nominal 5 feet beyond the liner, that connects the surface with the targeted repository horizon.*" It is not at all clear what the basis for the "*5 feet*" is. However, it is clear that potential zone of fracture and in situ permeability changes may extend about 3m (10 ft) into the adjoining rock mass when drill and blast method is used for shaft sinking (see Performance criterion 1f, Sub-tier iv, Items a & b of Section 1.2.6.4, p. 6.4-4, and Performance criterion 3h, Sub-tier iv, Items b & c of Section 1.2.6.5, p. 6.5-6).

(9) DOE is presently performing an extensive study on ESF alternatives. A draft report on this study is to be completed by mid-December 1990 to recommend the preferred ESF option. The current version of SDRD is based on the so-called "*BASE CASE*" option. Should the final selected ESF option be different from the "*BASE CASE*," an extensive revision of the SDRD may be needed. (Note: SDRD has been renamed as ESF Design Requirements.)

(10) The following reference which supports the ESF design bases (see Appendices A.3, A.4, and A.5) is not currently available.

> Sandia National Laboratories, "Yucca Mountain Project Preliminary Shaft Liner Design Criteria and Methodology Guide," Approval Draft Revision D. SAND 88-7060, Prepared by Parsons Brinckerhoff Quade & Douglas, Inc., for Sandia National Laboratories, Albuquerque, NM., January 1989 Draft.

3. TECHNICAL REVIEW OF MAIN TEXT OF SDRD

3.1 Comment on Introduction

The ESF SDRD does not make a clear statement on whether the performance criteria, constraints, and assumptions given, and applicable regulatory requirements listed in the upper level sections also apply to their subsections. The current version of SDRD does not seem to utilize this 'flow down' applicability approach (e.g., the statement that no constraints apply to geological testing as given in Subsection 1.2.6.8.2, p. 6.8.2-2, or Subsection 1.2.8.4, p. 6.8.4-2, provides such an evidence). If the 'flow down' does not apply, an immediate concern will be the completeness and adequacy of this document. For example, several of the performance criteria and constraints listed in Section 1.2.6.1 and Subsection 1.2.6.1.2 (such as Constraints A, B, C, D, E, F of Section 1.2.6.1, and Performance criterion 1d of Subsection 1.2.6.1.2) should be applicable to Subsections 1.2.6.1.3 and 1.2.6.1.4 also, and probably in Subsection 1.2.6.1.1 as well. DOE will need to provide a clarification on this matter.

p. INTRO-2, Third paragraph from bottom:
Fig. 1, p. INTRO-8, is not included.

3.2 Comment on Section 1.2.6.0

p. 6.0-2, Applicable Regulations, Codes and Specifications
The first sentence could be construed as leaving a great deal of flexibility to the A/E with regard to deciding as to which specific regulations apply. It will need to clarify whether or not the SDRD provides a minimum basis. (i.e., all regulations listed in the SDRD must be applied.) Or the A/E could consider any regulations listed in the SDRD not to be applicable. A basis will also need to be provided if the intent is the latter.

3.3 Comment on Section 1.2.6.4

p. 6.4-13, Section 1.2.6.4 - Constraint M, Sub-tier iii
Maintaining the flexibility of sinking ES-1 into, and/or drift into, the Calico Hills Formation may not be an appropriated sub-tier of Constraint M since it is not clear that, by doing so, it will contribute to the isolation capability of the site. Flexibility to sink into the Calico Hills Formation should consider impact on repository performance, particularly waste isolation. (Comment also applies to Constraint M of Section 1.2.6.6.)

p. 6.4-4, Section 1.2.6.4 - Performance criteria 1f, Sub-tier iv, Items a & b
It is not clear how these criteria are to be implemented, i.e., how to determine whether or not they are satisfied. The SDRD should provide some means for evaluating their performance. (Same comment applies to Performance criteria 3h, Sub-tier iv, Items a & b of Section 1.2.6.5.)

p. 6.4-6, Section 1.2.6.4 - Performance criterion 4b, Sub-tier i
It is not clear why the seismic criteria are excluded. A technical basis for the exclusion should be provided by DOE (Same comment applies to performance criterion 3d, Sub-tier i of Section 1.2.6.5.)

3.4 Comment on Section 1.2.6.5

p. 6.5-15, Section 1.2.6.5 - Constraint R, Sub-tier iii
As least as important as the factors mentioned may be drill collar positioning (accuracy) and drill hole alignment. (Comment also applies to Constraint R, Sub-tier x.)

3.5 Comment on Section 1.2.6.6

p. 6.6-6, Section 1.2.6.6 - Performance criteria 1h, Sub-tier iv, Items a & b
These Performance criteria do not restrict or control blasting very much, if at all. (An average of 12 inch overbreak is very large, even in conventional tunneling.)

p. 6.6-13, Section 1.2.6.6
Something is missing in the first "complete" sentence.

p. 6.6-18, Section 1.2.6.6 - Constraint R, Sub-tiers v, vi, vii
DOE should explain the need for specifying at this time, i.e., prior to excavation experience in the area, such detailed excavation prescriptions.

p. 6.6-18, Section 1.2.6.6 - Constraint R, Sub-tier xi
Although it is recognized that protective blasting is required for the shaft breakouts, the justification given is limited to site characterization. It may deserve pointing out that the shaft breakouts may be the location of major seals, the station plugs (SCP, Fig. 6-78). Waste isolation concerns may be mentioned in this context.

p. 6.6-20, Section 1.2.6.6 - Constraint U, Sub-tier v
It may deserve pointing out that the 115°C limitation may not be sufficiently conservative (NWTRB, 1990, p. 16). A strong, documented technical basis should be provided for such constraints and criteria.

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p. 6.6-21, Section 1.2.6.6 - Constraint V, Sub-tier vi, Item d

While recognizing the logic for prohibiting pressure grouting, this constraint may not be consistent with other constraints, notably Constraint P, Sub-tier i (p. 6.6-15), which requires effective water control and Constraint O, Sub-tier vii (p. 6.6-15) which requires the establishment of a contingency plan to accommodate site specific conditions, such as highly fracture zones, paths with significant water movement. An analysis comparing the relative merits and demerits of these potentially inconsistent constraints may be required.

3.6 Comment on Section 1.2.6.7

p. 6.7-2, Section 1.2.6.7 - Applicable Codes, Regulations, and Specifications

10 CFR Part 60 should be included.

Subsection 1.2.6.7.6

As a minimum the 10 CFR Part 60 requirements imposed as Constraint A in Subsection 1.2.6.7.5 should apply here also.

3.7 Comment on Section 1.2.6.9

Subsection 1.2.6.9.2

It appears as if this section only addresses decommissioning for the case where Yucca Mountain does not become a repository, contrary to the definition in Section 1.2.6.9. Certainly repository sealing is not addressed at all.

4. COMMENT ON SDRD APPENDIX A.2 - ESF Sealing Requirements Imposed By Repository Sealing Requirements

(1) The geometry of the plugs presented here is significantly different from earlier conceptual plug design for Yucca Mountain. The plug geometries as presented here go back to designs of shaft plugs as they were common several decades ago. The plugs are short, essentially thick plates. If subjected to any significant load they will experience significant tensile stresses. The longevity of such plugs, presumably to be constructed of concrete, must be questioned.

(2) The sealing concept as proposed relies on drainage through the rock at several critical locations, e.g., bottom of ES-1 and ES-2, and isolation zones for Ghost Dance Fault and Drill Hole Wash Fault. The reliability will need to be demonstrated of maintaining post-closure drainage capacity through the time period for which performance is required.

(3) From a sealing point of view it may not be desirable to enlarge the excavations at the locations of potentially critical seals. Most repository designs (e.g., WIPP) take the approach of reducing excavation size to the absolute minimum at seal locations. DOE should address the trade-off between (a) keeping excavation size small and, hence, limiting disturbance and (b) enlarging the excavation to allow the seating of a plug into relatively undisturbed, freshly excavated rock.

(4) Note 2 on Details 4 and 5 of the last drawing of this appendix is in direct conflict with Constraint V, Sub-tier vi, Items b & d of Section 1.2.6.6 (pp. 6.6-21/22). This note requires that "*before the repository is developed, the fault zone will be grouted and isolated if necessary.*" The Items b & d, on the other hand, require not to perform pressure grouting during or after construction in the faults or within the limits of the enlarged drift (approximately 150 ft and 126 ft for the Drill Hole Wash Fault and Ghost Dance Fault, respectively) driven through the faults.

5. COMMENT ON APPENDIX A.3 - Thermal Design Basis Load for the ESF

(1) Table 1 in this appendix gives thermal loads at 100 years in terms of strains at various elevations; however, there is no indication as to which strains are compressive and which are tensile.

(2) The presentation of strains in Table 1 is misleading from the following standpoints.

(a) The strains listed are at specific elevations. Maximum strains occur at other elevations.

(b) Table 1 implies constant strains for a rock unit over its entire thickness. It is inconceivable for the nearly 700 ft thick TSw2 unit to have constant strains throughout. The magnitude of thermal strain should be a function of relative distance from a thermal source. Therefore variations in strains within a rock unit should be expected.

(c) The model used to determine strains assumes that the rock mass is homogeneous. Differences can result from differences in thermal expansion coefficients in various units. For comparison see, for example, Fig. 29 of the Sandia Letter Reprot (1989) prepared by Parrish and Brandshaug. The referenced Sandia report (1988b) prepared by J.F.T. Agapito & Associates recommends (p. 9) "that the variation in thermomechanical properties on induced thermal stresses be investigated in a future study."

(3) It is not clear from this appendix or Appendix A.5 how the information is to be used. For example, what criteria will be used to determine acceptable strain levels.

6. COMMENT ON SDRD APPENDIX A.4 — Seismic Design Basis Loads for the ESF

(1) The coordinate directions for Table 1 in this appendix are not given.

(2) The definition of k in the last column of Table 1 is not stated and its significance is not clear.

(3) The appendix requires designers to verify numerous assumptions in designing of the shafts and underground openings. These required verifications are not reflected in the design methodologies presented in SDRD Appendices A.5 and A.6.

6.1 Comment on the Report Entitled "Yucca Mountain Project Working Group Report Exploratory Shaft Seismic Design Basis"

6.1.1 Assumption of Continuous Deformation of Shaft Near-Field Rock

The implicit assumption in the report (Sandia, 1988a) is that the jointed rock mass in which the shafts are to be constructed will exhibit continuum behavior in the modified local stress field around the shaft. Effects such as local slip or separation on joint surfaces is not taken into account. Further, the analysis of dynamic interaction of the peripheral rock mass with the shaft liner assumes continuous deformation of the rock. Under the conditions of dynamic loading imposed on the medium, it is possible that rock deformation will be discontinuous, resulting in highly localized loading of the shaft liner.

6.1.2 Prescription of Design Motions in Terms of Peak Motion Parameters

The ground motions which are to be the basis for shaft design and performance assessment are stated in terms of probable bounds on the orthogonal components of peak acceleration and peak velocity which may be induced by earthquakes and UNEs. However, seismic loading results in cyclic loading of the rock mass. Experiments on jointed rock show that it is the number of excursions of dynamic loading into the plastic range of joint deformation which determine the performance of the joint. A particular effect is that joint peak-residual behavior is modified (Brown and Hudson, 1974; Barton and Hansteen, 1979; Dowding et al., 1983). Further, tuff-like materials demonstrate strength loss under dynamic loading. Both these effects (i.e., shear strength reduction of joints and reduction of material strength) are analogous to fatigue of metals under cyclic loading. These observations suggest that the design basis motions should be prescribed in terms of full time histories of acceleration and velocity, and not merely the peak ground motions (Kana et al., 1989).

6.1.3 Effect of Repetitive Seismic Events

The concept of an individual earthquake and a UNE which are the respective controlling seismic events for the dynamic performance of the shafts is based on the misconception that a single episode of dynamic loading determines the integrity of the excavation near-field rock mass. There are experimental observations, consistent with those for the effect of cyclic loading on joints, which indicate that successive episodes of dynamic loading of excavations in jointed rock result in progressive accumulations of shear deformation at the joints (Brown and Hudson, 1974). Failure of excavations occurs due to collapse in the jointed assembly when the accumulated joint shear displacements permit progressive block failures.

These observations suggest that the ground motion at the site should be specified in terms of the time histories of motion of a range of seismic events of bounded magnitude and duration, and the probable number of these events over the pre-closure and post-closure phases of the life of the repository.

6.1.4 Comparison with SCP Section 8.3.2

Specific tentative goals and expected values for peak acceleration are found in at least three places in Section 8.3.2.

1. On p. 8.3.2.2-28, a tentative goal of "*0.5 to 0.7g with a >10,000-yr return period*" is given for "*peak ground acceleration from probability vs ground motion.*" It is also stated that "*inadequate information exists to establish expected value, but it is anticipated that a value satisfying the goal will be obtained.*"

   It is not clear whether the tentative goal refers to surface or subsurface motion. The magnitude of the value suggests that surface motion is being considered here, but the title for the table "*Performance Parameters and Tentative Goals for Issue 1.11, Configuration of Underground Facilities (Postclosure)*" clearly indicates that the subsurface is being addresses. This matter should be clarified.

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2. On p. 8.3.2.5-13, it is stated that the expected value for the vibratory ground motion (subsurface) is 0.2-0.3g peak acceleration. The tentative goal is "*time histories and response spectra representative of 10,000 yr cumulation slip earthquakes on nearby faults and UNE's (for frequencies between 0.5 and 33 Hz).*"

3. On p. 8.3.2.5-17, the expected tentative goals for seismic loading are given as 0.2-0.3g.

The ESF Seismic Design document repeatedly discusses a design value of 0.3g, which is consistent with the expected values listed in the SCP.

The approach defined by Item 2 of this subsection differs from the approach followed with the ESF Seismic Design document in that it considers "time histories and response spectra" --the time histories are the important difference.

It seems, therefore, that the ESF Seismic Design criteria are not as well formulated as that suggested by Item 2 of this subsection. The tentative goal as stated in Item 2 should be incorporated in the development of seismic design basis for the ESF.

7. COMMENT ON APPENDIX A.6 – ESF Underground Excavations Design Methodology

(1) The design methodology outlined in this appendix is generic in nature and fails to recognize the unique aspects of designing underground excavations which may become part of a nuclear waste repository. In particular, the design methodology outlined includes no mention of 10 CFR Part 60 or other design requirements given in Section 1.2.6.6. There is no check to insure these design criteria are met.

(2) In any design, it is often the details of the methodology which determine the adequacy of the design effort. This appendix provides insufficient detail to give high confidence that a designer would produce an acceptable design, i.e. one that is in compliance with 10 CFR Part 60 requirements.

(3) This appendix does not mention repository performance requirements which in turn may not explicitly be factored into the design methodology.

8. COMMENT ON APPENDIX B – Exploratory Shaft Facility Requirements for Underground Tests and the Integrated Data System (IDS)

8.1 General Comments

(1) It should be noted that tests described in this appendix are nearly identical to those described in the SCP. Consequently, all comments in NUREG-1347 will be valid again here.

(2) The underground geologic setting test assumes drill and blast excavation methods. Refer to previously developed CNWRA comments on the NRC white paper on excavation methods regarding this excavation method.

(3) The performance criteria and/or constraints for the underground tests are not presented at the same level of detail. For example, the test matrix, installation method(s), specifications, and even measurement frequency are discussed in detail for the shaft convergence test and TSw1 heater test while none of them were provided in the performance criteria and/or constraints for the demonstration breakout rooms test sequential drift mining test. Representativeness and adequacy are two important considerations for the results of all the underground tests. The performance criteria and/or constraints of each test should be presented in such a way that those two considerations can be evaluated.

(4) The basis for the following are unclear:

(a) Thermomechanical and geochemical alteration of in situ conditions may extend 15m radially from the canister and 20m longitudinally from the collar of the placement hole, p. B-MECH-5-5, Constraint 12.

(b) A hydrologically and chemical altered region may extend as much as 36 ft (11m) from the lines of the heaters, p. B-MECH-6-3, Assumption 5.

(c) A zone of influence extends out to approximately 150 ft longitudinally and 100 ft radially from the test hole array, p. B-HYD-4-3, Constraint 7.

(d) Any water injected could influence a zone 10 meters radially from the hole, p. B-HYD-5-7, Constraint 2.

A strong, documented technical basis should be provided to substantiate the adoption of these values.

8.2 Comment on Underground Geologic Mapping Test

(1) It is not clear from the description in the SDRD to what extent faces of drifts and shafts would be mapped. Section 8.3.1.4.2.2.4 of the SCP indicated that face mapping of drifts would be done only if anomalous conditions were exposed. The policy of face mapping of drifts only if anomalous conditions are exposed may be too restrictive on data gathering activities. In fact, without face mapping such "anomalous conditions" may go undetected and unreported.

The basis for this statement is as follows:

Cording et al. (1975) provide the following reasons for mapping the face of advancing excavations. "*The face of each heading advance in the vicinity of instruments should be mapped. This is particularly important where the sidewalls and arch are covered with shotcrete as they are excavated making it difficult to observe the geology on the walls. Even where the sidewalls and crown are not shotcreted, observations at the heading are useful, because the relation of geology to initial support can best be observed at the time of scaling and initial support placement.*"

Three-dimensional descriptions of fracture systems can be evaluated by systematic mapping of exploratory shafts and drifts, including mapping of some reaches of shaft floor and drift faces. Such mapping or photographic evaluation permits direct characterization of in situ fracture networks instead of being inferred from fractal analyses of surface data.

It is recommended that DOE should consider mapping and/or photographing floors and faces of shafts and drifts over short reaches to characterize fracture networks and provide supplementary information for instrumentation and for correlating required support.

8.3 Comment on Mineralogy Sampling

p. B-GEO-2-2, Assumptions 1a and 1b

The Assumption 1a indicates that 6 tons of bulk rock sample will be collected from each muck round. This means that if 6 ft rounds are used (see p. B-GEO-1-1), that between 1/3 and 1/4 of all muck will be collected. It is not clear if all of this collected material will go to the Sample Management Facility. In any case, where is the facility? Is the space provided adequate? Additionally, Assumption 1b states that if the Lower Topopah Spring Member Vitrophyre is penetrated, all rock excavated will be sent to the Sample Management Facility. The SDRD should provide necessary

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information to ensure that the Sample Management Facility is sufficient to accommodate rock samples collected through this mineralogy sampling activity and contingency plan if the facility is found to be inadequate later.

p. B-GEO-2-3, Assumptions 3 and 4
The intended means of collecting drift wall samples and particular design implications of such sampling methods should be clarified.

8.4 Comment on Shaft Convergence Test

p. B-MECH-1-5, Performance criterion 4
Frequency of measurements will affect shaft sinking progress. It may be worthwhile checking whether the prescribed frequency of measurements has been accounted for in scheduling and related design features. Any design constraints or criteria that are provided to make such measurements less impactive or non-impactive should be noted.

p. B-MECH-1-6, Constraint 1
Depending on what the purpose of these measurements is, it could be questioned whether it is a good idea to excavate with special controlled blasting. The term "special controlled blasting" should be defined here and the difference of this method from the "ordinary" controlled blasting should also be noted. Using a special excavation method could raise concerns about the representativeness of the results.

8.5 Comment on Demonstration Breakout Rooms Test

It is worthwhile to point out that, based on the ESF Alternative Study currently undertaken, other than emplacement drifts, tunnel boring machine is going to be used to construct repository ramps and drifts (including "Tuff Main" drifts) because it offers a performance advantage. While the Demonstration Breakout Rooms test is designed to study the geomechanical behavior of a typical repository sized "Tuff Main" drift, drill and blast method is going to be a primary means for the construction of this room. It makes little sense to do testing in a room constructed by a method that will not be used in the repository ramps and drifts construction.

p. B-MECH-2-1, Performance criterion 3
This performance criterion is very ambiguous. Because of the potentially major implications for shaft sinking progress, this criterion needs to be clarified: Does DOE mean "continuous access" or "access on a continuing or ongoing basis?"

p. B-MECH-2-2, Constraint 3
This constraint is peculiar, and could be counterproductive. It would seem that it could potentially be very instructive to keep on monitoring, especially when nearby mining goes on.

p. B-MECH-2-4, Assumption 2
Two new construction concepts are introduced in this assumption, namely, "full face" and "repository grade." The implication is that different construction specifications may be used. Two parts of this are of concern.

(1) "repository grade" specifications are not discussed or defined, making evaluation impossible; and

(2) the notion that different standards would be applied to different construction areas, all of which must meet repository performance requirements.

The SDRD should include a clear definition of these two terms and associated performance criteria, constraints, and assumptions.

8.6 Comment on TSw1 Heater Test

p. B-MECH-4-4, Constraint 9

This constraint is so broad that its implications are not clear. The SDRD will need to clarify whether this constraint imposes a limit on the thermal load for the test or on test duration.

8.7 Comment on Canister-Scale Heater Test

p. B-MECH-5-4, Constraint 10

This constraint appears insufficient in light of the possible extent of the disturbances identified in Constraint 12.

8.8 Comment on Heated Room Test

No special Design Life criteria, other than the design life of 5 years that has been given in Performance criterion 2b, Sub-tier i, Section 1.2.6.0 on p. 6.0-5, are specified for the room to be used for the heated test. General Comment (6), p. 2 of this review document is valid here. Additionally, the SDRD should also indicate whether or not this test is going to be one of the confirmation tests. In general, confirmation tests require longer test duration. Since the "5 yr" design basis is applied to the heated room, it implies that the test duration for the heated room test will be less than 5 years. A study should be presented to demonstrate that the test duration is sufficient for the heated room test to obtain representative data for performance confirmation.

8.9 Comment on Plate Loading Test

p. B-MECH-10-1, Constraint 1

If the objective of this test is, in part, to "... *evaluate the fracture zone adjacent to the mined openings*" (SCP, p. 8.4.2-127), it may be preferable not to use special controlled blasting, which could make the data with respect to normal repository construction questionable. Moreover, special controlled blasting would require that the approximate location of these plate bearing tests be selected in advance of excavation.

8.10 Comment on Rock Response Test

Fig. B-MECH-11-(2)

The Section View of the conceptual layout of equipment for the in situ joint shear response test indicates that the normal load to be applied on the joint surface will come from not only the flatjacks but also the hydraulic ram, which is supposed to provide shear load. Consequently, the applied normal stress condition across the joint surface will be different with relatively higher normal stress distribution in the area near the hydraulic ram. The potential impact on the test results is not clear.

8.11 Comment on Evaluation of Mining Methods Test

This test is designed exclusively for evaluating and optimizing drill and blast method. The impact of this test on the waste isolation capability will need to be evaluated given that the long drifts used for this test will become part of the repository. It will be worthwhile to also include evaluation of tunnel boring machine technique since the technique will be used extensively for repository ramps and drifts construction.

p. B-MECH-12-2, Constraint 4
If only peak particle velocities are measured, the resulting evaluation of factors affecting rock damage will be incomplete. Readily available commercial instruments can measure a complete trace of the blast vibrations, providing far more insight into what is happening, and where rock damage may originate.

8.12 Comment on Ground Support Test

If the objective of this test is to evaluate the ground support responses and performance with the goal of developing ground control methodologies for the repository, the evaluation of the thermal effect should also be included. Otherwise the usefulness of the test results will be questionable.

8.13 Comment on Hydrologic Properties Samples

p. B-HYD-1-1, Performance criterion 1
The performance criterion lists a need for rock blocks of relatively large size (> 1 ft), which would not readily be available if the ESF were bored, and may well require special blasting (or mechanical removal) even if the ESF is excavated by blasting. A performance criterion related to sample collection in the bored ESF should be included.

p. B-HYD-1-1, Constraint 1
According to this constraint, the large samples must be collected before dust control water is applied, which implies that special collection procedures (and further delays) are likely to be required. These special collection procedures will need to be included in the SDRD as one of the facility design requirements.

8.14 Comment on Intact Fracture Test

Fig. B-HYD-2-(1)
The fracture shown in the figure is not normal to the core axis, contrary to Performance criterion 3 on p. B-HYD-2-1.

Fig. B-HYD-2-(2)
The proposed sample collection geometry in this figure appears to imply that the fracture plane (or surface) coincides with the central plane of the core, and that the fracture to be sampled is truly planar. Joints in welded tuff frequently are curved and/or undulating. Another problem associated with this sample collection geometry will be the difficulty of aligning the axis of core with the strike/slip of a fracture plane. It is more than likely for a joint to cut across the core after some distance of drilling.

8.15 Comment on Percolation Test

Figures B-HYD-3-(1) to (3) have no associated text. Presumably these are for the Percolation test which is not described.

8.16 Comment on Bulk Permeability Test

These four bulk permeability tests have a very large zone of influence. They have not been accounted for in the SCP interference analysis (Fig. 8.4.2.39, SCP; 1989). They will encumber a very significant fraction of the as yet unencumbered dedicated test area. It is recognized that the duration of these tests may be relatively short (assumed 3 months). The holes of course are permanent. It is less clear how persistent other changes (presumably primarily moisture content changes) may be. Such factors must be considered in the design.

p. B-HYD-4-2, Constraint 6
This constraint states that "*test holes that extend outside the dedicated ESF test area must be coordinated with repository design and performance assessment/sealing requirements.*" No other test lists a similar constraint. While this constraint is appropriate, it may not be complete. A reader may be led to believe that only boreholes which are laterally outside the dedicated test area require coordination. This is because the dedicated test area shown in Appendix A.1 is two-dimensional. Any test holes which extended significantly below the main test level should also be coordinated. In particular, the Calico Hills test lists a core hole about 6 inches in diameter to the water table (p. B-HYD-7-2). No specific constraint is listed for this critical test. Evaluation of such drilling (if performed) must be conducted to ensure that it is consistent with design constraints and criteria, and with the performance objectives of the repository.

8.17 Comment on Calico Hills Test

It is noted in the Functional Requirements of this test that "*the Project does not currently plan to penetrate the Calico Hills unit with ES-1.*" However, flexibility to perform this testing is being maintained. The Performance Criteria for this test states that "*if the ES-1 option to penetrate the Calico Hills is exercised, capability to drift to the Ghost Dance Fault is required.*" It seems that it would be sufficient to maintain the flexibility to drift to the Ghost Dance Fault.

This test could however have major implications for waste isolation. It could establish a direct connection between the repository and the water table, i.e., it could result in a continuous flow channel through a major geological barrier. This test should only be implemented if detailed, comprehensive performance analyses confirm that the test will not unacceptably detract from the waste isolation capacity of the site.

NRC has previously objected to extending ES-1 to the Calico Hills and drifting through the Calico Hills units, if there was a possibility of potential adverse impacts on the waste isolation capability of the site.

DOE (1988a) has committed to consult NRC "*before a decision is made on penetrating the Calico Hills Unit.*"

8.18 Comment on Perched Water Test

p. B-HYD-8-1, Performance criterion 1
According to this performance criterion, construction may be halted for moisture sampling whenever moisture is observed. This obviously could impact ESF construction schedules. The SDRD should provide contingency plan to address this potential impact.

8.19 Comment on Multipurpose-Boreholes

Constraints for the MPBH boreholes are given on pp. B-MPBH-1-1/2. The locations of MP-1 and MP-2 shown in Fig. 8.4.2-19 do not appear to satisfy these constraints when looking at Drawing FS-GA-0160 of the ESF Title I design. Additionally, the basis for these constraints is not clear. DOE should provide substantive technical basis for each of the constraints and criteria that are being described.

pp. B-MPBH-3/4, Assumption 3 and p. B-MPBH-1-2, Constraint 9
Assumption 3 states that the planned two boreholes are expected "*to be drilled to depths approximately equal to the corresponding shafts, unless such depth would require penetration within either two shaft or drift diameters. In this case, a depth just short of two drift or diameters is*

acceptable." It is not clear whether the shafts referred in this assumption and Constraint 9 means the shaft systems as defined in Sections 1.2.6.4 (p. 6.4-1) and 1.2.6.5 (p. 6.5-1). In those sections, the radius of a shaft is defined by the "*sum of the radius of the shaft, the liner thickness, and the nominal 5 feet beyond the liner.*" DOE will need to clarify this uncertainty. If a definition other than that of a shaft system is used for the shafts in this test, DOE will need to provide a sound technical basis to explain why different definitions are needed.

pp. B-MPBH-1-1/4, Constraints 1, 8, & 9 and Assumption 3
The intent of Constraint 1 which states that "*each hole will be approximately 15 to 18m from the corresponding shaft wall*" is not clear. This constraint could be construed as (1) the surface location of the hole with respect to the corresponding shaft or (2) the relative distance with respect to the corresponding shaft wall throughout the entire shaft depth. Potential impacts with respect to the two interpretations are discussed in the following.

(a) Considering the second interpretation:
The separation of 15m (50 ft) to 18m (60 ft) barely satisfies Constraint 9 which imposes a requirement of minimum distance (two shaft diameter) between the hole and shaft. If the shaft design assumes the "*BASE CASE*," the minimum distance required is 48 ft (assuming a 1 ft thickness for the liner). This distance is calculated using the "*shaft system*" concept.

The two drift diameter requirement in Constraint 9 and the requirement in Assumption 3 make the drilling into the main test level extremely difficult, if not impossible. In order to satisfy the two drift diameter requirement, each hole should be at least 55.5 ft from the corresponding shaft wall for a 25 ft wide drift under the assumption that the shaft and drift have the same central axis.

Constraints 1 and 8 are not consistent. Constraint 1 implies a possibility of 10 ft drilling deviation from vertical at any depth while Constraint 8 allows a 28 ft deviation at 1050 ft (323m) depth.

(b) Considering the first interpretation:
The worse scenario for the drilling of an MPBH hole is that, during drilling, the hole deviates continuously from vertical toward the corresponding shaft. Assuming that the axis of deviation is a straight line, an MPBH hole can only be drilled to a depth of 450 ft without violating the requirement in Assumption 3, if the 18m (60 ft) separation distance is used. This raises a serious concern as to whether or not the intended objectives for the multipurpose-boreholes testing can be met.

It is necessary for the SDRD to make clear the intent of Constraint 1 and address the concerns discussed above to ensure an adequate ESF design.

8.20 Comment on Scientific Manpower Requirements for Testing

p. B-IS-3-5, Performance criteria 3c and 3d
These performance criteria note numerous alcoves along the shaft. These probably should be taken into account in any performance assessments that calculate flows through or along the shaft. They have not been accounted for in previously published analyses of ESF impact on waste isolation (e.g., Fernandez et al., 1987).

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8.21 Comment on Water System Design Requirements for ESF Testing

Control on water inflow appears to be fairly loose. Performance Criterion 3 appears to imply that all water inflows will be measured. Assumption 5 suggests that this requirement may be relaxed. No control provisions are mentioned for accidental (e.g., pipe rupture) releases. Appropriate revisions for the performance criteria, constraints, and assumptions associated with the water system design requirements to account for the above mentioned concerns are necessary.

9. COMMENT ON SDRD APPENDIX F.2 - Cross Reference 10 CFR Part 60 to ESF SDRD

(1) This appendix lists 10 CFR Part 60 requirements which have been directly referenced in the ESF SDRD. Review of this appendix and the main text of the SDRD reveals that several regulatory requirements are cited in the main text but not listed in Appendix F.2. These requirements include 10 CFR 60.72 (a) & (b), 10 CFR 60.113 (a) (2), 10 CFR 60.113 (b) (2), (3), & (4), 10 CFR 60.122 (b) (5), and 10 CFR 60.142 (a), (b), (c), & (d). It is not clear whether or not these cited requirements should be considered as included in the SDRD. Table 1 provides a complete cross reference of 10 CFR Part 60 to the ESF SDRD for the convenience of referencing. (Note that only the requirements, which are characterized as "*applicable*" in the draft TP on Coordinating the ESF Design with the Design of the Geologic Repository, are included in the table.)

In Comment 128 of NUREG-1347 (U. S. NRC, 1989), the NRC staff indicated that the DOE in doing the evaluation of the ESF Title I design did not consider 11 of the regulatory requirements from 10 CFR Part 60 which are identified as applicable by NRC. Only three of them are included in this version of SDRD. (Note that the cited requirements are counted as included in the SDRD.) The requirements not included in the SDRD are 10 CFR 60.17 (a), (b), & (c), 10 CFR 60.24(a), 10 CFR 60.122 (a), (b), & (c) [except for 10 CFR 60.122 (b) (5)], 10 CFR 60.131 (a), 10 CFR 60.131 (b) (4) (ii), 10 CFR 60.131 (b) (8), 10 CFR 60.131 (b) (10), and 10 CFR 60.143 (a), (b), (c), & (d). In a letter to Mr. J. Linehan dated February 27, 1990, in response to the comment, DOE provides a rationale for not including these 11 regulatory requirements. Appendix A to this review document includes the DOE's rationale. It would seem that NRC will need to prepare a formal response to either accept or rebut the DOE's rationale. Other requirements which are considered as applicable to ESF design in the draft TP on ESF design coordination and not included in the SDRD are 10 CFR 60.2, 10 CFR 60.113 (a) (1) (i), 10 CFR 60.131 (b) (6), and 10 CFR 60.133 (c).

(2) 10 CFR 60.74 (a) states that "*DOE shall perform, or permit the Commission to perform, such tests as the Commission deems appropriate or necessary for the administration of the regulations in this part. These may include tests of:*

(1) Radioactive waste,

(2) The geologic repository including its structures, systems, and components,

(3) Radiation detection and monitoring instruments, and

(4) Other equipment and devices used in connection with the receipt, handling, or storage of radioactive waste."

Table 1 Cross Reference of Applicable 10 CFR Part 60 to the ESF SDRD

Applicable Part 60 Requirements to ESF Sesign	ESF SDRD Sections									
	6.0	6.1	6.2	6.3	6.4	6.5	6.6	6.7	6.8	6.9
60.2										
60.15(b)	FF, FP FC				FP, FC	FP, FC	FC		FC, CP	
60.15(c)(1)	FP, FC	FP, FC	CC		FP, FC	FP, FC	FC	FC	FC, CP	
60.15(c)(2)	FC				FC	FC	FC		FC, CP	
60.15(c)(3)	FC				FC	FC	FC		FC, CP	
60.15(c)(4)	FF, FC						FC			
60.16					FC	FC				
60.17(a)										
60.17(b)										
60.17(c)										
60.21(c)(1) (ii)(D)	FP				FC	FC	FC			
60.21(c)(1) (ii)(E)	FP									
60.21(c)(11)	FC	FC			FC	FC	FC			
60.24(a)										
60.72(a)	CP									
60.72(b)	CP									
60.74(a)	FC				FC	FC	FC	FC	FC	
60.74(b)	FC				FC[1]	FC	FC		CP	
60.111(a)	FP									
60.111(b)(1)	FP									
60.111(b)(3)										
60.112	CP				FC	FC	FC		FC	CP
60.113(a)(1) (i)										
60.113(a)(1) (ii)(A)							FC		FC	
60.113(a)(1) (ii)(B)							FC			
60.113(a)(2)										CP
60.113(b)(2)										CP

Table 1 (continued)

Applicable Part 60 Requirements to ESF Design	ESF SDRD Sections									
	6.0	6.1	6.2	6.3	6.4	6.5	6.6	6.7	6.8	6.9
60.113(b)(3)										CP
60.113(b)(4)										CP
60.122(a)(1)										
60.122(a)(2)										
60.122(b)							CC[2]			
60.122(c)										
60.130	FC	FC			FP,FC	FP,FC	FP,FC	CC		
60.131(a)										
60.131(b)(1)	FC									
60.131(b)(2)	FP,FC									
60.131(b)(3)	FP,FC				FC	FC	FC			
60.131(b)(4)(i)	FC				FP,FC	FP,FC				
60.131(b)(4)(ii)										
60.131(b)(6)										
60.131(b)(8)										
60.131(b)(9)	FP,FC				FP	FP				
60.131(b)(10)										
60.133(a)(1)	FC				FP,FC	FP,FC	FP,FC		FC	
60.133(a)(2)	FC				FC	FC	FC	FC		
60.133(b)					FP,FC	FP,FC	FP,FC	FC		
60.133(c)										
60.133(d)	FP	FC			FP,FC	FP,FC	FP,FC	FC	FC	
60.133(e)(1)					FC	FC	FP,FC			
60.133(e)(2)		CP			FP,FC	FP,FC	FP,FC		FC	
60.133(f)		FC			FP,FC	FP,FC	FP,FC			
60.133(g)					FP,FC	FP,FC	FP,FC	FP		
60.133(h)					FC	FC	FC			FC
60.133(i)	FC				FC	FC	FC			
60.134(a)	FP,FC				FC	FC	FC			
60.134(b)	FP,FC				FC	FC	FC			

Table 1 (continued)

Applicable Part 60 Requirements to ESF Design	ESF SDRD Sections									
	6.0	6.1	6.2	6.3	6.4	6.5	6.6	6.7	6.8	6.9
60.137		FC			FC	FC	FC	FC	FP,FC	
60.140(b)	CP				FC	FC	FC		CP	
60.140(c)	CP				FC	FC	FC		FC,CP	
60.140(d)(1)	CP								FC,CP	
60.141(a)	CP						FC	FC	CP	
60.141(b)	CP				FC	FC	FC		FP	
60.141(c)	CP				FC	FC	FC		CP	
60.141(d)	CP				FC	FC	FC		CP	
60.141(e)	CP						FC		CP	
60.142(a)	CP								CP	
60.142(b)	CP								CP	
60.142(c)	CP								CP	
60.142(d)	CP								CP	
60.143(a)										
60.143(b)										
60.143(c)										
60.143(d)										
60.151	FP									
60.152	FP									

NOTE: FF--Corresponding requirement is quoted in "FUNCTIONAL REQUIREMENTS" and listed in Appendix F.2.
FP--Corresponding requirement is quoted in "PERFORMANCE CRITERIA" and listed in Appendix F.2.
FC--Corresponding requirement is quoted in "CONSTRAINTS" and listed in Appendix F.2.
CP--Corresponding requirement is cited in "PERFORMANCE CRITERIA" but not listed in Appendix F.2.
CC--Corresponding requirement is cited in "CONSTRAINTS" but not listed in Appendix F.2.
1---Corresponding requirement is quoted but not listed in Appendix F.2.
2---Only 10 CFR 60.122 (b) (5) was cited.

This regulation has been quoted as a constraint in six out of the nine major sections of the SDRD. However, several regulatory requirements relevant to radiological safety, such as 10 CFR 60.131 (a), 10 CFR 60.131 (b) (4) (ii), 10 CFR 60.131 (b) (10), and 10 CFR 60.143, are excluded from the current version of the SDRD for the reason that "*Currently, no radioactive wastes are planned to be used in the ESF during site characterization*" (see Appendix A to this review document). It is not clear how this constraint [10 CFR 60.74 (a)] can be complied with if, at a later date, either DOE or NRC determines that it is necessary to conduct tests in the ESF using radioactive wastes. Nor is the extent clear of the impact of including the above mentioned requirements in SDRD and ESF design to accommodate radioactive waste tests at a later stage. It is recommended that, unless there is a high likelihood that radioactive wastes will not be used in future tests, criteria should be selected that will produce a design which is sufficiently robust and/or adaptable that such testing can be accommodated, if necessary.

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APPENDIX A

28

APPLICABILITY OF 10 CFR 60 REQUIREMENTS TO THE EXPLORATORY SHAFT FACILITY

U.S. DEPARTMENT OF ENERGY

JANUARY 1990

ASSUMPTIONS AND CRITERIA FOR DETERMINING PART 60 APPLICABILITY

Basic Assumptions:

- Portions of the ESF will eventually become part of the geologic repository.

- The ESF design shall not jeopardize the integration of the ESF into the geologic repository.

- The four permanent items in the ESF, namely, 1) underground openings, 2) shaft liners, 3) operational seals, and 4) ground support shall be designed and constructed to be incorporated into the repository and must be designed to have a maintainable life and quality as specified for the repository.

- Any component of the ESF, or any activities relating to that component, which could have an effect on waste isolation shall be subject to the requirements of 10 CFR 60 Subpart G.

- DOE is currently conducting an analysis for identifying items important to safety or waste isolation in the ESF. In view of this, adopt a conservative approach on the applicability of requirements relevant to important to safety or waste isolation.

- The ESF shall be designed to accommodate the Site Characterization Program and the Performance Confirmation Program.

- ESF temporary surface facilities are not expected to be part of the repository permanent facility.

- The two exploratory shafts will become future permanent ventilation intake shafts for the waste emplacement area.

Basic Criteria:

- Does the requirement impose restrictions on the design, construction or operation of the ESF?

- Does the requirement impact the design of any structures, systems, or components which may affect the waste isolation capability of the site?

- Does the requirement impose restrictions which, if not considered, may affect the future licensability of the site?

- Is the ESF component which is subject to the requirement, to be redesigned or replaced in the final repository design and construction?

- Does the requirement impose programmatic constraints on the ESF program?

ADDITIONAL REQUIREMENTS IDENTIFIED BY NRC
(SCA COMMENT 128)

60.17:	Contents of Site Characterization Plan
60.24(a):	Updating of Application and Environmental Report
60.113(a)(2):	Pre-waste-emplacement groundwater travel time
60.113(b)(2),(3),(4):	Factors NRC will consider in case-by-case evaluation of performance objectives
60.122:	Siting criteria
60.131(a):	General design criteria for radiological protection
60.131(b)(4)(ii):	Onsite facilities for emergencies
60.131(b)(8):	Instrumentation and control systems
60.131(b)(10):	Shaft conveyances used in radioactive waste handling
60.134:	Design of seals for shafts and boreholes
60.143:	Monitoring and testing of waste packages

10 CFR 60.17
CONTENTS OF SITE CHARACTERIZATION PLAN

NRC Rationale:

- The ESF will be used to obtain information called for by (a) the SCP, (b) the waste package program, and (c) the repository design.

- As such, this requirement could potentially affect ESF requirements.

DOE Rationale:

- This section does not directly impose requirements on the ESF since it only briefly identifies the required contents of the SCP, referring specifically to plans and descriptions that need to be provided in that document.

- The SCP and its supporting study plans identify the parameters that need to be considered in ESF design, construction, and operation.

10 CFR 60.24(a)
UPDATING OF APPLICATION AND ENVIRONMENTAL REPORT

NRC Rationale:

- o This section requires various applications (e.g., license application) to be as complete as possible in light of information that is reasonably available at the time of docketing.
- o This requirement is applicable to ESF design because it provides guidance regarding scope and possible sequencing of activities.

DOE Rationale:

- o This section does not directly impose requirements on the design, construction and operation of the ESF since its focus is directed to providing for updating the license application and accompanying documents.
- o It provides indirect guidance to the extent that the license application must be as complete as possible in terms of the information required for NRC to make a determination.
- o The SCP provides the plans with respect to what needs to be considered in the ESF design.

10 CFR 60.113(a)(2)
PRE-WASTE-EMPLACEMENT GROUNDWATER TRAVEL TIME

NRC Rationale:

- This regulation is applicable because the ESF design could impact the location of the disturbed zone boundary.

DOE Rationale:

- While the design, construction, and operation of the underground workings of the ESF could affect the location of the disturbed zone boundary, this requirement directs determination of groundwater travel time from wherever that boundary ends up being. This is effectively a siting criterion applicable to the geologic setting, but does not directly impose requirements on the ESF.

- The requirement to minimize impacts to the disturbed zone is generally covered by 60.15(d), not 60.113(a)(2).

10 CFR 60.113(b)(2),(3),(4)
FACTORS NRC WILL CONSIDER IN CASE-BY-CASE EVALUATION OF PERFORMANCE OBJECTIVES

NRC Rationale:

- These requirements are applicable to the ESF design, as the ESF design should allow gathering of information necessary to evaluate factors which bear upon:

  - the time during which the thermal pulse is dominated by decay heat from the fission products

  - geochemical characteristics of the host rock

  - sources of uncertainty in predicting the performance of the geologic repository

DOE Rationale:

- This section does not directly impose requirements on the ESF. This section serves to provide flexibility with respect to the numerical limits pertaining to the performance objectives for the engineered barrier system and the geologic setting, as stipulated in 60.113(a).

- The need for the ESF to allow gathering of information relevant to the factors listed in this section of Part 60 come from the scope of the site characterization program, which is defined in the SCP, and related study plans.

10 CFR 60.122
SITING CRITERIA

NRC Rationale:

- This requirement is applicable, as it provides detailed descriptions of the information which must be obtained (largely in ESF) to assess the adequacy of the site and to assess other adverse conditions.

- In particular, 60.122(c)(1) imposes a design criterion on the location of underground accesses.

DOE Rationale:

- This section does not directly impose requirements on the ESF since it addresses favorable and potentially adverse conditions which are to be used as siting criteria applicable to the geologic setting.

- The requirement to evaluate the existence of potentially adverse conditions, including 10 CFR 60.122(c)(1) is addressed in program requirements documents and the SCP and its related study plans.

- Evaluation of the location of underground accesses with respect to flooding potential is being considered as part of the ESF design process in accordance with 10 CFR 60.133(d).

10 CFR 60.131(a)
GENERAL DESIGN CRITERIA FOR RADIOLOGICAL PROTECTION

NRC Rationale:

- This requirement is applicable because it imposes requirements on all components of the ventilation systems, not just mechanical equipment.
- DOE's statement that "Compliance with the specified criteria is a function of equipment design and operational procedures, which imposes future requirements on equipment and operation, but not on the ESF permanent components" (Attachment I, p. 32) is too narrow.
- See, also, Attachment J (TOG's Members' Statement, filed by D. Michlewicz).
- Also, 10 CFR 60.15(d)(4) requires coordination of subsurface excavation with the geologic operation area design and construction.
- As currently planned, ESF shafts and drifts will be part of ventilation system for the repository.

DOE Rationale:

- This section, in particular 60.131(a)(1), needs to be considered to the extent that the ESF must be designed such that it does not preclude the repository from meeting these requirements. It should be noted that compliance with these requirements is primarily a function of equipment design and operating procedures for the purpose of radiation protection, which imposes future requirements on equipment and operations.
- It should be noted that, while the NWPA requires the NRC to concur on the need to use radioactive material during site characterization, the use of such material is not subject to NRC licensing requirements, as stipulated in 60.7. DOE radiological safety orders would be applicable.
- Currently, there is no plan to use radioactive wastes in the ESF during site characterization.

10 CFR 60.131(b)(4)(ii)
ONSITE FACILITIES FOR EMERGENCIES

NRC Rationale:

o See Attachment H, p. 7. (TOG report).

"60.131(b)

This paragraph applies only to items important to safety. The stated requirements can, therefore, only apply to the ESF after incorporating it into the GROA plus the finding then that an item is important to safety.

60.131(b)(4) provides for emergency capability for items important to safety, with concurrent full control over radioactive material. (6.0 C(J), 6.0 C(M))."

DOE Rationale:

o This section does not impose requirements on the ESF since it addresses requirements that are applicable only to repository operations and would not affect the design of ESF permanent components.

o The section requires that the geologic repository operations area (GROA) include onsite facilities and services for responding to radiological emergencies and that facilitate the use of available offsite services for that application.

o The ESF will include similar facilities or services in accordance with non-radiological safety requirements.

o It should be noted that, while the NWPA requires the NRC to concur on the need to use radioactive material during site characterization, the use of such material is not subject to NRC licensing requirements, as stipulated in 60.7. DOE radiological safety orders would be applicable.

o Currently, there is no plan to use radioactive wastes in the ESF during site characterization.

o It should also be noted that, as explained in the TOG Report, Attachment H of that report was only a preliminary evaluation of Part 60 applicability which eventually led to the final position in Attachment I of the same report.

o Also, the statement on page 7 of Attachment H, referred to by NRC, actually was meant to refer only to 60.131(b)(4)(i) and not to (ii).

10 CFR 60.131(b)(8)
INSTRUMENTATION AND CONTROL SYSTEMS

NRC Rationale:

- This requirement is applicable, because it could impact ESF design by requiring allowances for instrumentation and control systems.

DOE Rationale:

- This section does not directly impose requirements on the ESF since it addresses requirements that are applicable only to repository operations and would not affect the design of ESF permanent components.
- The section requires that instrumentation and control systems be provided to monitor the behavior of systems important to safety over the anticipated ranges for normal operation and for accident conditions.
- The extent to which this requirement would need to be considered in ESF design is to ensure that the ESF design does not preclude the addition of instrumentation and control systems. However, the inclusion of such a requirement is not expected to provide any additional flexibility in design beyond what already exists.

10 CFR 60.143
MONITORING AND TESTING OF WASTE PACKAGES

<u>NRC Rationale:</u>

- This requirement is applicable for the same reasons that 60.131(b)(10) is applicable - namely, that 10 CFR 60.74 requires flexibility in testing.

<u>DOE Rationale:</u>

- This section does not impose requirements on the ESF since it addresses performance confirmation monitoring and testing that is specifically applicable to the waste packages.
- Currently, no radioactive wastes are planned to be used in the ESF during site characterization.
- Likewise, in the future, the ESF portion of the geologic repository operations area will not contain waste packages.

10 CFR 60.131(b)(10)
SHAFT CONVEYANCES USED IN RADIOACTIVE WASTE HANDLING

NRC Rationale:

- If radioactive wastes are to be placed in the ESF, then this requirement is applicable.

DOE Rationale:

- This section does not impose requirements on the ESF since it addresses requirements for hoists important to safety that are used for radioactive waste handling.
- Currently, radioactive wastes are not planned to be used in the ESF during site characterization.
- It should be noted that, while the NWPA requires the NRC to concur on the need to use radioactive material during site characterization, the use of such material is not subject to NRC licensing requirements, as stipulated in 60.7. DOE radiological safety orders would be applicable.

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10 CFR 60.134
DESIGN OF SEALS FOR SHAFTS AND BOREHOLES

NRC Rationale:

- This requirement is applicable, because it provides design guidance relative to future sealing requirements.

- The SCP recognizes the relevance of this requirement in Section 8.3.3 (see, for example, p. 8.3.3.2-52, Table 8.3.3.2-9b).

DOE Rationale:

- This section does not directly impose requirements on the ESF since it addresses requirements that are applicable to the design of postclosure seals so that they don't become preferential pathways that could compromise the isolation capability of the geologic repository. The extent to which this would need to be considered in ESF design is to ensure that the design does not preclude the repository from meeting these requirements.

- Nevertheless, the requirement that the ESF design facilitate permanent closure is stipulated by inclusion of 60.21(c)(11).