ENCLOSURE

Interaction Record for the
Technical Exchange on the
Exploratory Shaft Facility

On October 4, 1989 staff from the U.S. Nuclear Regulatory Commission held a technical exchange with representatives from the U.S. Department of Energy (DOE) and the State of Nevada. The purpose of the exchange was to discuss the identification of 10 CFR Part 60 requirements that could impact the design of the Exploratory Shaft Facility (ESF). Attachment 1 is a list of attendees.

In particular, the discussions centered on the eleven 10 CFR Part 60 requirements identified in the staff's comment in the Site Characterization Analysis. For these 11 requirements, there was a difference of opinion between DOE and the staff as to whether they were applicable to the ESF design. Attachment 2 is a copy of the DOE slides used during the exchange and Attachment 3 is a copy of the staff's talking points. Overall, all of the participants found the exchange to be beneficial.

No written statement was provided by the State of Nevada for inclusion in this interaction record.

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Edward F Regnier 10/18/89
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ATTACHMENT 1

List of Attendees
October 4, 1989 Technical Exchange

NRC
J. Holonich
J. Peshel
J. Bunting
M. Nataraja
J. Pearring
R. Virgilio
C. Abbate
K. McConnell
W. Ford
D. Gupta
E. Lois

DOE
L. Little
E. Regnier
R. Lahoti
J. Robson
M. Comar

Weston/Jacobs (DOE)
M. Lugo
J. Blair
N. Prasannakumar
H. Bermanis

Sandia National Laboratory (DOE)
A. Stevens

State of Nevada
C. Johnson

Thompson Engineering (Nevada)
J. Thompson

Science Application International, Corporation (DOE)
E. Bryant
S. Smith
C. Pflum
M. Voegle
K. Beall

Center for Nuclear Waste Regulatory Analysis (NRC)
A. Chowdhury
J. Daemen (University of Arizona)

U. S. Geological Survey (DOE)
R. Wallace

Technical Review Board
R. McFarland

Attachment 2
DOE Slides

APPLICABILITY OF 10 CFR 60 REQUIREMENTS

TO THE EXPLORATORY SHAFT FACILITY

U.S. DEPARTMENT OF ENERGY

DOE-NRC TECHNICAL EXCHANGE
OCTOBER 4, 1989

BACKGROUND

- In December 1988, a DOE Technical Oversight Group (TOG) performed a comprehensive evaluation of 10 CFR Part 60 to identify requirements applicable to the ESF.

- 46 of the 157 requirements in Part 60 were found to be applicable.

- General definition of "applicable requirement":

  - A requirement that imposes technical restrictions, criteria, or programmatic constraints that need to be considered in the design, construction, or operation of the ESF, which will eventually be incorporated into the repository

- The TOG Report was used as a basis for the ESF Title I Design Acceptability Analysis (DAA) and was issued as a companion document to the DAA.

ASSUMPTIONS AND CRITERIA FOR DETERMINING PART 60 APPLICABILITY (TOG REPORT, ATTACHMENT G)

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.

ASSUMPTIONS AND CRITERIA FOR DETERMINING PART 60 APPLICABILITY (Cont'd)

- Project 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.

ASSUMPTIONS AND CRITERIA FOR DETERMINING PART 60 APPLICABILITY (Cont'd)

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

Attachment 3
NRC Slides

10 CFR 60.15(d)(4)

SUBSURFACE EXPLORATORY DRILLING, EXCAVATION, AND IN SITU TESTING BEFORE AND DURING CONSTRUCTION SHALL BE PLANNED AND COORDINATED WITH GEOLOGIC REPOSITORY OPERATIONS AREA DESIGN AND CONSTRUCTION.

10 CFR 60.17(c)

THE SITE CHARACTERIZATION PLAN SHALL CONTAIN A CONCEPTUAL DESIGN FOR THE GEOLOGIC REPOSITORY OPERATIONS AREA THAT TAKES INTO ACCOUNT LIKELY SITE-SPECIFIC REQUIREMENTS.

EXPLORATORY SHAFT FACILITY NOT TO BE LICENSED BY NRC.

HOWEVER, IF ESF BECOMES PART OF THE REPOSITORY, ALL ACTIVITIES RELATED TO ESF WILL HAVE TO MEET LICENSING REQUIREMENTS.

THEREFORE, ALL 10 CFR 60 REQUIREMENTS THAT ARE APPLICABLE TO REPOSITORY SHOULD BE CONSIDERED APPLICABLE TO EXPLORATORY SHAFT FACILITY.

APPLICABILITY OF 10 CFR 60 REQUIREMENTS TO ESF DESIGN SHOULD BE ASCERTAINED ACCORDINGLY.

Section: Design Acceptability Analysis

COMMENT 128

Several applicable 10 CFR 60 requirements have not been considered in evaluating the acceptability of ESF Title I design.

BASIS

The DAA lists fifty-two (52) 10 CFR 60 requirements that are considered in ESF Title I Design Acceptability Analysis (DAA). This list of (52) requirements does not include all applicable 10 CFR 60 requirements. The following requirements are missing from the list and are not considered in the DAA:

- 60.17 Contents of Site Characterization Plan

  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.

- 60.24(a) Updating of Application and Environmental Report

  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. This requirement is applicable to ESF design because it provides guidance regarding scope and possible sequencing of activities.

- 60.113(a)(2) Performance of Particular Barriers After Permanent Closure—Geologic Setting

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

- 60.113(b)(2), (3), and (4) Performance of Particular Barriers After Permanent Closure

  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

- 60.122 Siting Criteria

  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.

- 60.131(a) General Design Criteria for the Geologic Repository Operations Area—Radiological Protection

  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.

- 60.131(b)(4)(ii) General Design Criteria for the Geologic Repository Operations Area—Emergency Capability

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

- 60.131(b)(8) General Design Criteria for the Geologic Repository Operations Area—Instrumentation and Control Systems

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

- 60.131(b)(10) General Design Criteria for the Geologic Repository Operations Area—Shaft Conveyances Used in Radioactive Waste Handling

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

- 60.134 Design of Seals for Shafts and Boreholes

  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).

- 60.143 Monitoring and Testing Waste Packages

  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.

RECOMMENDATION

Design criteria corresponding to the applicable 10 CFR 60 requirements, not considered in the DAA, should be developed and used for the Title II design.

REFERENCE

Lugo, M., et al., Technical Oversight Group for U.S. DOE OCRWM, Office of Facilities Siting and Development. Applicability of 10 CFR Part 60 Requirements to the Yucca Mountain Exploratory Shaft Facility (Technical Oversight Group Report), December 1988.

1.

§ 60.134 Design of seals for shafts and boreholes.

(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.

(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.

[48 FR 28222, June 21, 1983, as amended at 50 FR 29648, July 22, 1985]

2.

§ 60.113 Performance of particular barriers after permanent closure.

(a) *General provisions—*

(2) *Geologic setting.* The geologic repository shall be located so that pre-waste-emplacement groundwater travel time along the fastest path of likely radionuclide travel from the disturbed zone to the accessible environment shall be at least 1,000 years or such other travel time as may be approved or specified by the Commission.

3.

§ 60.122 Siting criteria.

(a)(1) A geologic setting shall exhibit an appropriate combination of the conditions specified in paragraph (b) of this section so that, together with the engineered barriers system, the favorable conditions present are sufficient to provide reasonable assurance that the performance objectives relating to isolation of the waste will be met.

(2) If any of the potentially adverse conditions specified in paragraph (c) of this section is present, it may compromise the ability of the geologic repository to meet the performance objectives relating to isolation of the waste. In order to show that a potentially adverse condition does not so compromise the performance of the geologic repository the following must be demonstrated:

(i) The potentially adverse human activity or natural condition has been adequately investigated, including the extent to which the condition may be present and still be undetected taking into account the degree of resolution achieved by the investigations; and

(ii) The effect of the potentially adverse human activity or natural condition on the site has been adequately evaluated using analyses which are sensitive to the potentially adverse human activity or natural condition and assumptions which are not likely to underestimate its effect; and

(iii)(A) The potentially adverse human activity or natural condition is shown by analysis pursuant to paragraph (a)(2)(ii) of this section not to affect significantly the ability of the geologic repository to meet the performance objectives relating to isolation of the waste, or

(B) The effect of the potentially adverse human activity or natural condition is compensated by the presence of a combination of the favorable characteristics so that the performance objectives relating to isolation of the waste are met, or

(C) The potentially adverse human activity or natural condition can be remedied.

(b) *Favorable conditions.* (1) The nature and rates of tectonic, hydrogeologic, geochemical, and geomorphic processes (or any of such processes) operating within the geologic setting during the Quaternary Period, when projected, would not affect or would favorably affect the ability of the geologic repository to isolate the waste.

(2) For disposal in the saturated zone, hydrogeologic conditions that provide:

(i) A host rock with low horizontal and vertical permeability;

(ii) Downward or dominantly horizontal hydraulic gradient in the host rock and immediately surrounding hydrogeologic units; and

(iii) Low vertical permeability and low hydraulic gradient between the host rock and the surrounding hydrogeologic units.

(3) Geochemical conditions that:

(i) Promote precipitation or sorption of radionuclides;

(ii) Inhibit the formation of particulates, colloids, and inorganic and organic complexes that increase the mobility of radionuclides; or

(iii) Inhibit the transport of radionuclides by particulates, colloids, and complexes.

(4) Mineral assemblages that, when subjected to anticipated thermal loading, will remain unaltered or alter to mineral assemblages having equal or increased capacity to inhibit radionuclide migration.

(5) Conditions that permit the emplacement of waste at a minimum depth of 300 meters from the ground surface. (The ground surface shall be deemed to be the elevation of the lowest point on the surface above the disturbed zone.)

(6) A low population density within the geologic setting and a controlled area that is remote from population centers.

(7) Pre-waste-emplacement groundwater travel time along the fastest path of likely radionuclide travel from the disturbed zone to the accessible environment that substantially exceeds 1,000 years.

(8) For disposal in the unsaturated zone, hydrogeologic conditions that provide—

(i) Low moisture flux in the host rock and in the overlying and underlying hydrogeologic units;

(ii) A water table sufficiently below the underground facility such that fully saturated voids contiguous with the water table do not encounter the underground facility;

(iii) A laterally extensive low-permeability hydrogeologic unit above the host rock that would inhibit the downward movement of water or divert downward moving water to a location beyond the limits of the underground facility;

(iv) A host rock that provides for free drainage; or

(v) A climatic regime in which the average annual historic precipitation is a small percentage of the average annual potential evapotranspiration.

(c) *Potentially adverse conditions.* The following conditions are potentially adverse conditions if they are characteristic of the controlled area or may affect isolation within the controlled area.

(1) Potential for flooding of the underground facility, whether resulting from the occupancy and modification of floodplains or from the failure of existing or planned man-made surface water impoundments.

(2) Potential for foreseeable human activity to adversely affect the groundwater flow system, such as groundwater withdrawal, extensive irrigation, subsurface injection of fluids, underground pumped storage, military activity or construction of large scale surface water impoundments.

(3) Potential for natural phenomena such as landslides, subsidence, or volcanic activity of such a magnitude that large-scale surface water impoundments could be created that could change the regional groundwater flow system and thereby adversely affect the performance of the geologic repository.

(4) Structural deformation, such as uplift, subsidence, folding, or faulting that may adversely affect the regional groundwater flow system.

(5) Potential for changes in hydrologic conditions that would affect the migration of radionuclides to the accessible environment, such as changes in hydraulic gradient, average interstitial velocity, storage coefficient, hydraulic conductivity, natural recharge, potentiometric levels, and discharge points.

(6) Potential for changes in hydrologic conditions resulting from reasonably foreseeable climatic changes.

(7) Groundwater conditions in the host rock, including chemical composition, high ionic strength or ranges of Eh-pH, that could increase the solubility or chemical reactivity of the engineered barrier system.

(8) Geochemical processes that would reduce sorption of radionuclides, result in degradation of the rock strength, or adversely affect the performance of the engineered barrier system.

(9) Groundwater conditions in the host rock that are not reducing.

(10) Evidence of dissolutioning such as breccia pipes, dissolution cavities, or brine pockets.

(11) Structural deformation such as uplift, subsidence, folding, and faulting during the Quaternary Period.

(12) Earthquakes which have occurred historically that if they were to be repeated could affect the site significantly.

(13) Indications, based on correlations of earthquakes with tectonic processes and features, that either the frequency of occurrence or magnitude of earthquakes may increase.

(14) More frequent occurrence of earthquakes or earthquakes of higher magnitude than is typical of the area in which the geologic setting is located.

(15) Evidence of igneous activity since the start of the Quaternary Period.

(16) Evidence of extreme erosion during the Quaternary Period.

(17) The presence of naturally occurring materials, whether identified or undiscovered, within the site, in such form that:

(i) Economic extraction is currently feasible or potentially feasible during the foreseeable future; or

(ii) Such materials have greater gross value or net value than the average for other areas of similar size that are representative of and located within the geologic setting.

(18) Evidence of subsurface mining for resources within the site.

(19) Evidence of drilling for any purpose within the site.

(20) Rock or groundwater conditions that would require complex engineering measures in the design and construction of the underground facility or in the sealing of boreholes and shafts.

(21) Geomechanical properties that do not permit design of underground opening that will remain stable through permanent closure.

(22) Potential for the water table to rise sufficiently so as to cause saturation of an underground facility located in the unsaturated zone.

(23) Potential for existing or future perched water bodies that may saturate portions of the underground facility or provide a faster flow path from an underground facility located in the unsaturated zone to the accessible environment.

(24) Potential for the movement of radionuclides in a gaseous state through air-filled pore spaces of an unsaturated geologic medium to the accessible environment.

[48 FR 28222, June 21, 1983, as amended at 50 FR 29647, July 22, 1985]

4.

§ 60.17 Contents of site characterization plan.

The site characterization plan shall contain—

(a) A general plan for site characterization activities to be conducted at the area to be characterized, which general plan shall include:

(1) A description of such area, including information on quality assurance programs that have been applied to the collection, recording, and retention of information used in preparing such description.

(2) A description of such site characterization activities, including the following—

(i) The extent of planned excavations;

(ii) Plans for any onsite testing with radioactive material, including radioactive tracers, or nonradioactive material;

(iii) Plans for any investigation activities that may affect the capability of such area to isolate high-level radioactive waste;

(iv) Plans to control any adverse impacts from such site characterization activities that are important to safety or that are important to waste isolation; and

(v) Plans to apply quality assurance to data collection, recording, and retention.

(3) Plans for the decontamination and decommissioning of such area, and for the mitigation of any significant adverse environmental impacts caused by site characterization activities, if such area is determined unsuitable for application for a construction authorization for a geologic repository operations area;

(4) Criteria, developed pursuant to section 112(a) of the Nuclear Waste Policy Act of 1982, to be used to determine the suitability of such area for the location of a geologic repository; and

(5) Any other information which the Commission, by rule or order, requires.

(b) A description of the possible waste form or waste package for the high-level radioactive waste to be emplaced in such geologic repository, a description (to the extent practicable) of the relationship between such waste form or waste package and the host rock at such area, and a description of the activities being conducted by DOE with respect to such possible waste form or waste package or their relationship; and

(c) A conceptual design for the geologic repository operations area that takes into account likely site-specific requirements.

[51 FR 27163, July 30, 1986]

5.

§ 60.113 Performance of particular barriers after permanent closure.

(b) On a case-by-case basis, the Commission may approve or specify some other radionuclide release rate, designed containment period or pre-waste-emplacement groundwater travel time, provided that the overall system performance objective, as it relates to anticipated processes and events, is satisfied. Among the factors that the Commission may take into account are:

(2) The age and nature of the waste, and the design of the underground facility, particularly as these factors bear upon the time during which the thermal pulse is dominated by the decay heat from the fission products;

(3) The geochemical characteristics of the host rock, surrounding strata and groundwater; and

(4) Particular sources of uncertainty in predicting the performance of the geologic repository.

6.

§ 60.143 Monitoring and testing waste packages.

(a) A program shall be established at the geologic repository operations area for monitoring the condition of the waste packages. Waste packages chosen for the program shall be representative of those to be emplaced in the underground facility.

(b) Consistent with safe operation at the geologic repository operations area, the environment of the waste packages selected for the waste package monitoring program shall be representative of the environment in which the wastes are to be emplaced.

(c) The waste package monitoring program shall include laboratory experiments which focus on the internal condition of the waste packages. To the extent practical, the environment experienced by the emplaced waste packages within the underground facility during the waste package monitoring program shall be duplicated in the laboratory experiments.

(d) The waste package monitoring program shall continue as long as practical up to the time of permanent closure.

7.

§ 60.24 Updating of application and environmental report.

(a) The application and environmental report shall be as complete as possible in the light of information that is reasonably available at the time of docketing.

8. **§ 60.131 General design criteria for the geologic repository operations area.**

(a) *Radiological protection.* The geologic repository operations area shall be designed to maintain radiation doses, levels, and concentrations of radioactive material in air in restricted areas within the limits specified in Part 20 of this chapter. Design shall include:

(1) Means to limit concentrations of radioactive material in air;

(2) Means to limit the time required to perform work in the vicinity of radioactive materials, including, as appropriate, designing equipment for ease of repair and replacement and providing adequate space for ease of operation;

(3) Suitable shielding;

(4) Means to monitor and control the dispersal of radioactive contamination;

(5) Means to control access to high radiation areas or airborne radioactivity areas; and

(6) A radiation alarm system to warn of significant increases in radiation levels, concentrations of radioactive material in air, and of increased radioactivity released in effluents. The alarm system shall be designed with provisions for calibration and for testing its operability.

9. (b) *Structures, systems, and components important to safety—*

(4) *Emergency capability.*

(ii) The geologic repository operations area shall be designed to include onsite facilities and services that ensure a safe and timely response to emergency conditions and that facilitate the use of available offsite services (such as fire, police, medical and ambulance service) that may aid in recovery from emergencies.

10. (8) *Instrumentation and control systems.* The design shall include provisions for instrumentation and control systems to monitor and control the behavior of systems important to safety over anticipated ranges for normal operation and for accident conditions.

11. (10) *Shaft conveyances used in radioactive waste handling.* (i) Hoists important to safety shall be designed to preclude cage free fall.

(ii) Hoists important to safety shall be designed with a reliable cage location system.

(iii) Loading and unloading systems for hoists important to safety shall be designed with a reliable system of interlocks that will fail safely upon malfunction.

(iv) Hoists important to safety shall be designed to include two independent indicators to indicate when waste packages are in place and ready for transfer.