109

100/MR/85/01/16

WM Record File 109 WM Project 1
Docket No.
PDR ✓
LPDR
JAN 25 1985
Distribution:
-1-
(Return to WM, 623-SS)

Distribution:
WM File: ✓
WMRP f/r
NMSS r/f
CF
REBrowning
MJBell
JBunting
MKnapp
LBarrett
HJMiller
RBoyle
SCoplan
JLinehan
JKennedy
RCook
PPrestholt
TVerma
JGiarratana
MRhodes & r/f

c2
(109)
see pocket 1 for enclosures

Mr. W. J. Purcell
Associate Director
Office of Geologic Repositories
Office of Civilian Radioactive
Waste Management
U. S. Department of Energy
RW-20
Washington, DC 20545

Dear Mr. Purcell:

The Department of Energy's (DOE) Preliminary Draft Project Decision Schedule indicates that DOE will issue three Site Characterization Plans (SCPs) between September 1985 and October 1986. These SCPs will be reviewed by the NRC staff and we will issue a Site Characterization Analysis (SCA) upon completion of each review. However, prior to the SCP submission, the DOE will be making decisions on long lead time items related to exploratory shaft construction and sealing, in situ testing, hydrogeologic testing and other site investigations. These decisions are needed to support DOE plans to initiate shaft construction and other site characterization work soon after SCP issuance to keep schedules that DOE has laid out in the Mission Plan and Project Decision Schedule for meeting requirements of the NWPA.

It is the NRC's policy that absent unresolved safety issues, we will support DOE schedules. As we discussed in our meeting of November 30, 1984, unless NRC and DOE begin consultation soon on a number of long lead time items that underlie DOE's decisionmaking there is risk of delay in DOE schedules. Such consultation is consistent with the NRC/DOE Procedural Agreement on site investigation and site characterization. It states that in formulating plans for activities which DOE will undertake to develop information needed for staff resolution of potential licensing issues, DOE will meet with NRC to provide an overview of the plans so that NRC can comment on their sufficiency. It further states that these discussions will be held sufficiently early so that any changes that NRC comment may entail can be duly considered by DOE in a manner not to delay DOE activities. Specifically there is a need for taking up and resolving items concerning two areas in advance of the SCPs:

1) Site characterization activities that require long lead time commitments for placement of contracts, materials procurement, test siting and scheduling.

2) Assurance that all SCPs are substantively consistent with Reg. Guide 4.17 "Standard Format and Content of Site Characterization Plans for High-Level Waste Geologic Repositories."

The first area includes a number of items. Some of the more critical of these were discussed in earlier letters sent from NRC to each of the DOE projects (see Enclosure 1).

In our discussion on November 30, I stated that we would identify the specific items that NRC staff considers fall into the first category; Enclosure 2 is a list of such items. However, as we also discussed, identifying all items of this sort requires review of DOE's detailed schedules and your input. Thus, close interaction is required to establish a detailed agenda. The Enclosure 2 list is not yet complete but should help to initiate the process of completing an agenda. Our experience in setting up technical meetings with the projects is that a lead time of at least several months is needed. Given your schedule for site characterization there is a possibility that some items are already overdue for resolution. Therefore an early meeting to complete an agenda seems imperative.

If you have any questions do not hesitate to call me. The point of contact to set up a meeting to begin resolution of these issues is Seth Coplan (427-4728).

Sincerely,

Hubert J. Miller, Chief
Repository Projects Branch
Division of Waste Management
Office of Nuclear Materials Safety
and Safeguards

Enclosures:
1. Letters to DOE Projects
2. Items for Resolution Prior to SCP Receipt

OFC	:WMRP:rs	: WMRP	: WMRP	:	:	:
NAME	:MRhodes	: SCoplan	: HJMiller	:	:	:
DATE	:01/25/85	: 01/25/85	: 01/25/85	:	:	:

die ltr to Purcell
fm. Miller 1/25/85
109

ENCLOSURE 1

APR 1 4 1983

'Draft letter'

PROJECT WM-11

Dr. Donald L. Vieth, Director
Waste Management Project Office
DOE Nevada Operations Office
P. O. Box 14100
Las Vegas, NV 89114

Dear Dr. Vieth:

Present schedules indicate that the Department of Energy (DOE) will submit a Site Characterization Plan (SCP) for the Nevada Nuclear Waste Storage Investigations (NNWSI) to the Nuclear Regulatory Commission (NRC) for review early in the last quarter of 1983. Also, exploratory shaft construction will start as early as November 1, 1983. The November 1, 1983 date will precede the NRC staff's comments on the SCP. In view of these schedules, it will be prudent to complete and document the review of certain issues regarding exploratory shaft construction and sealing prior to the start of shaft construction.

Two broad considerations are of concern: (1) that the site characterization activities will not compromise subsequent long term isolation and containment capabilities of the repository and (2) that plans for construction of the exploratory shaft will not preclude the acquisition of adequate information for site characterization. With these broad concerns in mind, a series of activities were initiated to identify and resolve issues concerning the exploratory shaft. First, the NRC evaluated alternative shaft sinking techniques. Our contractor report on this subject is attached (Golder Associates, 1983). Secondly, NRC reviewed the DOE report, "Conceptual Design Report, Exploratory Shaft - Phase I, Nevada Nuclear Waste Storage Investigations." I have attached copies of our contractor's comments (Golder Associates, 1982 and Engineers International, Inc., 1983). In addition, we held a number of preliminary discussions, including telephone conversations and the January 24-25, 1983 NRC-DOE Design Meeting, that addressed the method of construction, sealing, and plans for gathering information related to site characterization. These activities provide a starting point for the more detailed interactions that are now appropriate.

8311300435 6pp

With regard to the first of the two broad concerns mentioned above, 10 CFR 60.11(a) (6)(iii) calls for a description of "provisions to control any adverse safety-related effects from site characterization including appropriate quality assurance programs." Similar language is in section 113 (b)(1) (A)(ii) of the Nuclear Waste Policy Act of 1982.

The basic concern here is with the potential adverse effects due to penetration (e.g., exploratory shaft) of the repository horizon during site characterization. A shaft construction process that takes into account long-term sealing aspects is necessary. To the extent that we were able to evaluate such information in the recent (January 1983) Design Meeting, DOE plans appear to be appropriate. However, given the preliminary nature of the information discussed in this meeting, we will need more specific information and plans regarding the construction and sealing of the exploratory shaft.

The documented information needed by the NRC on the exploratory shaft relates to five areas: 1) shaft and seal design considerations, 2) construction plans and procedures, 3) sealing or grouting plans and procedures, 4) construction testing and inspection plans and procedures, 5) plans and procedures for gathering specific information related to site characterization, and 6) quality assurance for all of the above. The general type of information considered necessary by NRC on the above items is presented in the attached list. If DOE considers that other information is also applicable to the basic concerns, this information should also be provided.

We recognize that documented plans for shaft construction and sealing may have to be changed based on experience gained during construction. We would expect to be informed of significant changes to plans or schedules as they occur. This is needed since the NRC staff expects to visit the site and observe excavations and tests as they are done as provided for by 10 CFR 60.11(g).

With regard to the second broad concern mentioned above, we consider it prudent that the plan for obtaining site characterization data during shaft construction be identified before construction proceeds to the point where obtaining such data is precluded. Some significant and unique information about site properties (e.g., groundwater inflow into the shaft; rock strength and consistency) could be obtained during shaft sinking.

While all of the information noted in the attachment need not be documented prior to starting shaft construction, we consider it prudent that it be provided early enough for us to complete our review and for you to make any adjustments necessary as a result of comments we may have.

Please contact me at your earliest convenience to establish a mutually agreeable schedule to work toward resolution of those issues which need to be reviewed prior to exploratory shaft construction and sealing.

Sincerely,

"ORIGINAL SIGNED BY"

Seth M. Coplan, Project Manager
High-Level Waste Technical
Development Branch
Division of Waste Management

Attachments:

1. Golder Associates, Evaluation of Alternative Shaft Sinking Technologies for High Level Waste (HLW) Deep Geologic Repositories, USNRC NUREG/CR-2854, 1983

2. Golder Associates, Letter #77 to Mr. Lud Hartung, 11/3/82

3. Engineers International, Inc., Letter to Mr. Trueman Seamans, 02/24/83

cc: W. Bennett, DOE
J. Fiore, DOE

INFORMATION CONSIDERED NECESSARY REGARDING
EXPLORATORY SHAFT CONSTRUCTION AND SEALING

I. Shaft and Seal Design Considerations

- Provide an analysis of the potential effects of construction of the exploratory shaft on long-term sealing capabilities of the rock mass and identify factors that determine the nature and extent of such effects

- Describe how the selected excavation technique and shaft design accounts for limitations and uncertainties in long term sealing considerations

- Provide design specifications for the shaft construction and show how they deal with the factors affecting sealing

- Describe the seal design and materials

- Discuss the selected locations of any planned explorations or testing to be performed along the length of the shaft. Include discussion of data on sealing characteristics to be gathered and the limitations and uncertainties associated with the data

- Provide drilling history and results of geotechnical testing from the principal borehole, G-4

II. Construction Plans and Procedures

- Identify the acceptance criteria for construction of the exploratory shaft

- Identify procedures used to minimize damage to the rock mass penetrated

- Identify liner construction and placement technique. Include such information as: liner type, liner material testing and placement of liner. This information needs to be fully considered in application of any permanent sealing program

III. Sealing or Grouting Plans and Procedures

- Describe how the seals are expected to perform in sealing the exploratory shaft. Describe tests done, both laboratory and field, to determine their long-term durability and their compatibility, both chemical and physical, to the host rock environment.

- Describe the placement methods.

- Describe remedial methods to be used if sealing methods are not adequate.

IV. Construction Testing and Inspection Plans and Procedures

- Describe test and inspection procedures to be used during excavation (e.g., plumbness of hole, rock mass disturbance etc.) to determine acceptability of the shaft as constructed.

- Describe test and inspection procedures to be used during shaft liner construction. Include information such as grout injection rates, grout bond logs, thermal measurements of grout during curing, and liner instrumentation to be used.

- Describe test and inspection procedures to be used after sealing of the shaft to assess the results of the sealing effort in controlling adverse effects. Include information such as grout strength tests, visual identification of seal conditions, records of water inflow, assessment of seal bond to host rock, and logging of drill holes.

- Describe plans to document the above construction activities.

V. Plans and Procedures for Gathering Specific Information Related to Site Characterization

- Describe test plans and procedures used to obtain adequate data on site characteristics that can be measured either directly or indirectly during construction of the exploratory shaft. For example:

  o Geologic mapping and rock mass characterization of the shaft walls

  o Measurements of rates and quantities of groundwater inflow and collection of groundwater samples for testing

  o Measurements of overbreakage during blasting

  o Rock mechanics testing of samples obtained during drill and blast operations

VI. Quality Assurance (QA)

Administrative Procedures

- Identify the line of responsibility for implementing QA procedures down to and including the Construction Contractor

(10 CFR 50 Appendix B. Criteria I requires that "organizations performing quality assurance functions shall report to a management level such that this required authority and organizational freedom, including sufficient independence from cost and schedule when opposed to safety consideration, are provided")

- Identify the procedures to be used by the Quality Assurance organization for implementing and monitoring the QA program for exploratory shaft design, construction and testing.

WM Record File 426.1 / 36943
WM Dir.
WM Dep. Dir.
WMPI
WMHT LH
WMUR
Others

Golder Associates
CONSULTING GEOTECHNICAL AND MINING ENGINEERS

November 3, 1982

U.S. Nuclear Regulatory Commission
High Level Waste Technical Development Branch
Division of Waste Management
Washington, D.C. 20555

Attention: Mr. Lud Hartung, Project Manager

Subject: Contract No. NRC-02-81-037, Technical Assistance for Repository Design
Letter #77

Note: This review preceded the identification of the unsaturated zone as the preferred horizon for a repository and the change of conventional shaft sinking methods for the exploratory shaft.

Gentlemen:

Pursuant to your request (ref. NRC letter #24), this letter report is submitted in accordance with the subject contract, Task 6, Project #17-1, Golder Associates' review of the DOE document entitled, "Conceptual Design Report, Exploratory Shaft - Phase I, Nevada Nuclear Waste Storage Investigations."

We were directed to make a "Best Level of Effort" critical review of the document with regard to:

- o Proposed ES construction techniques
- o Cost estimates
- o Testing plan

This review of the NNWSI Exploratory Shaft Conceptual Design renews our recently-limited involvement on NTS. By way of review, we provide the following reference list:

1. Our letter #15, September 16, 1981, reporting on our visit to the Peer Review at NTS, August 1981 (plus our associated inhouse document 5-70-17 with Appendix A).

2. Our Task 1 report "Identification of Characteristics which Influence Repository Design - Tuff"; Task 2 report "In Situ Test Programs Related to Design and Construction of High Level Nuclear Waste (HLW) Deep Geologic Repositories"; Task 3 report "Evaluation of Alternative Shaft Sinking Techniques for High Level Nuclear Waste (HLW) Deep Geologic Repositories"; and Task 4 report "Relationship of an In Situ Test Facility to a Deep Geologic Repository for High Level Nuclear Waste." (Note that Task 1 report refers to appropriate NRC/DOE agreements reached in topical meetings.)

Rec'd 5 Nov.

3. NRC Technical Position on Borehole and Shaft Sealing and our letter #71, October 13, 1982 reviewing the same.

4. The core (lithologic) logs (USW-H1) reported in our Task 1 report on tuff.

5. NRC's BWIP Design Issues (draft of 10/7/82) as related to shaft sealing to include:

   - What is the maximum expected radionuclide release rate from the engineered system and is this rate in compliance with NRC technical criteria?
   - Is borehole backfill required?
   - Can repository shafts, tunnels and exploratory boreholes be constructed and sealed adequately?
   - How is repository performance expected to be affected by construction of the Exploratory Shaft?

6. NRC 10CFR60, "Disposal of High Level Radioactive Wastes in Geologic Repositories" through proposed regulations of July 7, 1982. In particular, what we understand as "NRC licensing requirements" which are stated in 10CFR60-11(6)(iii), "provisions to control any adverse safety-related effects from site characterization" and performance objectives in 60.111-60.113.

7. Comments by D. Pentz and J. Daemen on Shaft Sealing in our letter #76 of October 25, 1982, following the BWIP Repository Design - Exploratory Shaft Workshop, Oct. 5-6, 1982.

The two major issues for NRC related to our review of the subject report are:

- The ability of the ES to meet the standards of 10CFR60, as outlined in 6 above. Using DOE's words from the Conceptual Design Report (ref. Part II-A4 - page 6):

  > "The ES will not be an NRC-licensed facility; however, extreme care shall be taken during design and construction to assure that nothing is done that will preclude its use as part of a licensed repository at some future date."

- The adequacy and suitability of the proposed underground tests of Phases I and II to meet the requirements for License Application. It is assumed for this review, based on our overall

understanding of the DOE program, that Phases I and II will be accomplished prior to License Application and that At-Depth Testing (ADT) will be accomplished after License Application. Thus, NRC's Safety Evaluation Report and hearings will take place without the benefit of the results of the ADT.

Our review relates primarily to these two issues, with general comments followed by detailed comments attached as Enclosure 1. Our overall view is that the Conceptual Design Report is thorough and professional. The valuable pertinent experience that DOE has at NTS is evident throughout the report. The ability to meet the short-term requirements of 10CFR-60.111 are well documented for a design at this stage of development. Flexibility is built in where appropriate. Both of the questions above, however, are primarily related to long-term performance to which many of the following comments relate.

General Comments

The construction procedures for the exploratory shaft proposed by DOE are consistent with good construction practice as established from shaft drilling programs at NTS and elsewhere. The 98-inch internal diameter steel liner will be grouted into position over its full length, by displacing the drilling mud with grout slurry in stages. The grouting program will be designed to ensure that the design loads of the steel liner are not exceeded during construction.

As noted in our letter #71 (Golder Associates review of NRC Technical Position on Borehole and Shaft Sealing), our review of the NTS Conceptual Design report indicates that DOE is not currently in compliance with the Technical Position as follows:

- Proven sealing techniques have not been developed for the excavation methods selected.
- No detailed provisions have been made for characterizing and sealing the disturbed zone along the entire shaft.
- Validation of seals is not included in the shaft test program.
- Effect of construction on sealability has not been determined before selection of excavation techniques.
- Information required for characterizing strata through which the shaft will be sunk will probably not be available with the assumed blind drilled shaft sinking methods.

- NTS Design Objectives include "Licensability", but since "the ES will not be an NRC-licensed facility," specific provisions to meet licensing requirements are not included in conceptual designs.

As the report states, NRC Technical Positions and regulations do not apply directly to exploratory shafts. However, where DOE anticipates that shafts will become part of a licensed site, they will ultimately need to comply. It is therefore in DOE's interest to comply now with the Technical Position unless they can demonstrate that compliance can be established at a later time.

In summary, it appears that the short-term sealing performance of the shaft will be satisfactory but that there has been no consideration of how to demonstrate the long-term performance of the shaft seal.

There is virtually no discussion of the DOE rationale for the selection of the underground testing program. Golder Associates Task 2 report outlines our rationale for test selection. The purpose of testing is to reduce the level of uncertainty associated with the sites' ability to meet the performance objectives of 10CFR60 and EPA standards, to an acceptable level. Our understanding of the site to date is contained in our Task 1 tuff report (NUREG/CR-2614). In that report we pointed out the lack of critical data available to us and the apparent great variability of material properties, both of which adversely impact our ability to predict performance at this time. Therefore, if this is in reality the case, in order to significantly reduce uncertainty, the following are required:

- sufficient exploratory investigation (from surface or underground) to adequately characterize the repository, and in particular to identify the variability anticipated. It is not clear from the conceptual design report how the limited surface investigations and the 2000-ft. long horizontal holes from the test openings in the vicinity of the ES will adequately define the lateral continuity, homogeneity, etc., of the proposed repository horizon. Furthermore, of course, lack of adequate site characterization implies that the representativeness of properties determined from a test facility will be unknown.

- in situ testing to define pertinent material properties. In Golder Associates Task 4 report (NUREG/CR-2959), an example of an in situ test facility configuration for basalt was presented. Based on our current understanding of conditions at Yucca Mountain, Golder Associates recommends the test program outlined for tuff in the Task 2 report. Such a program should be carried out in an underground test facility at least as large as the example for basalt in the Task 4 report. Test

details for the ES facility are discussed in the DOE report in only the most general of terms. It is therefore not possible to compare the proposed program with the scope of testing outlined in the Task 2 report. However, the proposed test facility has no full-scale tunnels and only about one-fourth of the underground development recommended in the Task 4 report. We therefore consider that based on available data the proposed test program is probably inadequate for License Application.

We trust that you will find these documents useful. Please call if you have any questions or require further discussion.

Sincerely,

GOLDER ASSOCIATES

Richard H. Gates, Ph.D., P.E.
Project Manager

RJB:hd
D244

ENCLOSURE 1
DETAILED COMMENTS

Page	Comment
1 (para. 2)	What will be the basis for selection of the ES location and depth in early FY 83?
1 (para. 2)	We concur with the flexibility of continuing to consider conventional methods of shaft sinking although the assumption is made on page 7 that drilling techniques will be used for the conceptual design. Blind sinking of the ES constitutes the only possibility since bottom access is not available. Conventional drill-and-blast is a most versatile procedure but can experience difficulties in coping effectively with water-producing zones of great thickness. There are concerns about formation damage and the subsequent difficulty of sealing the damaged zone against vertical migration of water. A further concern of conventional sinking is the construction safety aspect. Blind shaft drilling would appear to offer a number of technical and safety aspects, and be capable of dealing with a wide range of rock and groundwater conditions. A prime purpose of the ES will be to demonstrate the technology. The limited damage to the shaft walls has an appeal in relation to shaft sealing, but the method of grouting behind the liner is less direct than that employed in conventional shaft sinking. The influence of the drilling mud on sealability and the effectiveness of mud displacement by the grout are of some concern.
1 (para. 2)	How is limited exploration to be carried out in the shaft during construction for the preferred drilling technique? An advantage of the conventional drill-and-blast procedure is that full wall inspection is permitted during sinking.
4 (para. 4)	We note that the repository may be above the water table. Although 10CFR60 addresses this possibility, new issues will become of considerable interest if DOE selects this option.

Page	Comment
7 (para. 4)	What is the nature of the surface explorations that are currently being carried out at Yucca Mountain? What criteria are being used to select the ES location and the test horizon? If the technical data required to determine the suitability of the site for a repository or TEF have not been fully defined, are the required data for selecting the ES location and the test horizon (from surface exploration) known? If so, what are the data? If not, on what basis was the surface exploration program formulated?
7 (para. 5)	What is the purpose of the confirmatory borehole in the proximity of the ES? Is it part of the initial exploration program? What other borings will be made as part of the exploratory program? What testing will be carried out in the confirmatory borehole? Will the hole be used in an attempt to understand the hydrologic picture (which might be of more interest for long-term performance) of the site? Will specific tests be carried out on the core to investigate drillability, stability, etc?
8 (para. 1)	Will the drilling operations be interrupted at all by exploratory-type experiments, i.e., prior to sinking and grouting the lining? If so, what types of exploration are envisaged?
8 (para. 1)	For the drilled shaft, the shaft itself should be watertight. All water flow into the underground openings will therefore come from the test horizon. If this is located within the welded tuffs below the water table, fracturing should constitute the prime flowpaths. Effective hydraulic conductivities should be sufficiently low that a 100 gpm inflow represents a suitably conservative assumption. For a conventionally sunk shaft, a one-foot thick concrete liner (App. A, pg. 49) for a 12-ft. ID shaft under 1500-ft. hydrostatic head does not represent a hydrostatic liner design. It is not clear from Appendix A whether it is the intention to construct a hydrostatic lining. If so, the liner thickness would probably need to be increased somewhat towards the bottom of the shaft. If not, all ground water control in the shaft would have to be accomplished by grouting the formations themselves.
8 (para. 1)	How will the three (Phase I) holes be located in relation to the potential location of the TEF? What is the significance of the 2000-ft. length holes? Will they pass through the TEF location or not?

Page	Comment
8 (para. 5)	What current technology is available and reasonably proven that would enable the use of other than a steel liner for the drilled shaft; or does the "other lining" reference relate to the concrete liner of a conventionally sunk shaft?
8 (para. 5)	What methods will be applied to prevent cave-in during drilling and to maintain an acceptably straight shaft?
9 (para. 3)	It is not clear how 2000-ft. long horizontal holes drilled from the vicinity of the shaft will provide an adequate basis for an assessment of the lateral continuity of stratigraphic intervals on the scale that is of interest to the final repository. A relatively insignificant area will be opened up by the initial test facility and observation of the performance of this facility will be useful only if there is some understanding of how representative the test region is of the repository horizon as a whole. The 2000-ft. horizontal holes will expand the area of inspection beyond the facility itself, but once again there must be a procedure for relating the properties of the region explored by the horizontal holes to those of the repository zone as a whole. How can we assess the representativeness of the studies associated with the ES program to the entire repository? How will the surface investigations be used to extend the applicability of the test data obtained for the ES facility?
9 (para. 4)	It is not possible to comment on test details within the ES facility as these have not been described, i.e., apparently the test details have not yet been decided upon. Obviously the facility and the core will be geologically/geotechnically/hydrologically mapped and logged respectively, and these data will provide useful information. The mechanical performance of the facility will also provide useful data, but as discussed above, there should be a methodology for evaluating the representativeness of the information. Rock mass strength in relation to field stress may be inferred from the facility performance, and there is an indication that some suitable monitoring (in particular, displacement monitoring) of the facility is to be undertaken.
10 (para. 1)	What test programs are envisaged (if any) to evaluate the efficacy of the shaft seal and the effect of the construction disturbed zone on the adequacy of the seal? From the point of view of long-term containment, it is presumably not sufficient to evaluate the shaft seal by direct observation of water ingress, etc.

Page	Comment
11 (para. 2)	There is no discussion of sealing procedures for the 2000-ft. long exploratory boreholes.
12-19	Scanned only.
21 (para. 1)	Another advantage of drilling versus conventional sinking is the minimization of formation damage and the subsequent improved shaft seal potential.
22 (para. 7)	Difficult to comment on adequacy of 3 days of logging prior to casing without knowing extent and nature of the logging program.
25-28	Scanned only.
30 (para. 2)	The exploratory drifts are smaller in cross-section than the planned repository rooms. Additional useful data would be obtained by constructing the drifts to full cross section.
30 (para. 4)	It is not clear just what loadings are to be measured by strain meters. (Rock bolts? Steel sets?)
30 (paras.5-7)	This discussion is highly theoretical, and more practical and applicable comments should be offered. Other factors need to be considered, e.g., loosening type failures may be enhanced by attempting the type of proportioning and profiling suggested. It is not necessary to shape and orient to achieve maximum stability, but simply adequate stability. Cost factors are also important, e.g., if we need 15-ft. headroom, do we excavate a 30-ft. wide span when only 20 feet is required, just because the horizontal stress is twice the vertical stress? The discussion appears somewhat pointless in this context anyway, as the in situ stress will probably not be known prior to facility development unless hydrofracturing is to be carried out in the shaft confirmatory borehole. No mention is made of this.
30 (para. 8)	Extraction ratio really has no sensible meaning for this configuration because of the limited amount of excavation.
31 (para. 2)	Don't understand the reason for the rather specific recommendations regarding the placement of wire mesh on the sidewalls.
33 (para. 3)	During construction of the adits, trial blasts to evaluate rock damage minimization procedures and profile control should be undertaken.
33-35	Scanned only.

Page	Comment
35 (para. 5)	Strain meters to monitor what loadings?
36-46	Scanned only.
48 (para. 3)	Be more precise than "several months" in discussing conventionally sunk and drilled shaft schedules.
51 (para. 2)	If the shaft is designed to be watertight (backsheeting, etc.) the 1-ft. thickness liner is not sufficiently thick for a hydrostatic liner.
65-74	Scanned only.
76 (para. 2)	How are unacceptable hole deviations to be corrected?
95-96	This section outlines in general terms the shaft grouting program. The report should specifically address shaft seal testing as discussed in the general comments.
124-192	Scanned only.
194 (para. 1)	It should be noted that grouting in the test horizon prior to cutting the casing may substantially alter the rock mass properties in this area and hence the representativeness of the exploratory openings in the vicinity of the shaft.
195 (para. 4)	Provision should be made for full grouting of the rockbolts, following tensioning.
205-224	Scanned only.

RJB:hd
D244

ENGINEERS INTERNATIONAL, INC.

98 E. NAPERVILLE ROAD, WESTMONT, ILLINOIS 60559+1595

TEL: 312/963-3460
TLX: 9106511931
ENG INT WSMT

24 February 1983
Ref. No. 1085-002-008
EXPRESS MAIL B81096697

High Level Waste Technical Development Branch
Division of Waste Management
U. S. Nuclear Regulatory Commission
7915 Eastern Avenue
Mail Stop 623-SS
Silver Spring, MD 20910

Attention: Mr. Trueman Seamans

Subject: Contract No. NRC-02-82-030, Task Order 002 Draft Letter Report

Dear Mr. Seamans:

Engineers International, Inc. (EI) has reviewed the nine documents under Task Order 002, and has prepared specific comments on each document. In addition, a separate attachment has been prepared assessing the rock mass strength of the Topopah Spring member at the Nevada Test Site (NTS). The objective of the document review has been to detail the adequacy of DOE plans to characterize the NTS for a possible geologic repository, and discuss the conformance and non-conformance of the plans with the proposed 10CFR60 rules.

Document 1 - "Conceptual Design Report, Exploratory Shaft - Phase I, Nevada Nuclear Waste Storage Investigations," CA9179-MS, Los Alamos National Laboratory, June 1982.

Document Summary

This document describes the conceptual design of a drilled exploratory shaft and the Phase I site characterization activities to be conducted from the shaft bottom. Ten appendices are included with the document, one of which describes the conceptual design of a conventionally sunk exploratory shaft (appendix A). The term conventional applies to shafts advanced by the drill and blast method. The design is well conceived, and could

provide the basis for a Title I design of a site-specific exploratory shaft for the characterization of a geologic repository in tuff. Phase I investigations are designed to evaluate the suitability of the site for a Test and Evaluation Facility (TEF). The Phase II program will attempt to characterize site suitability for a geologic repository.

General Comments

The present plans, as discussed in the January 24-25, 1983, design workshop, are to construct a 144-inch internal diameter (I.D.) shaft by the drill and blast method. The depth will be about 1500 feet instead of the 3500 feet that is discussed in this report. Hence, appendix A of this report which discusses the design of a conventionally sunk shaft should be expanded to include liner construction and quality assurance requirements to meet 10CFR60 requirements. This is mentioned as one of the difficulties in conventional shaft sinking design and construction.

- Details of the cementing program are yet to be determined, and it is recognized that licensability requirements are a major factor. At present, class A neat cement with 2% calcium chloride is being specified; however, several other cements are being considered to accommodate site-specific conditions.

- The layout of the underground openings for the Phase II site characterization efforts appears to be adequate, and the objective of exploring over 300 acres of the host rock with 16,000 to 24,000 feet of horizontal core is well conceived (page 29).

- Horizontal holes, about 40 feet long, from shaft portholes will provide useful information. Program details should be provided.

- Mean values and the extent of variability of lithologic and structural properties, media properties, hydrology and in situ stress will be determined from the underground program (page 35). This effort will significantly aid site characterization, and details of this effort should be provided in the Site Characterization Report (SCR).

- An approach to licensability, especially for the proposed 144 inch I.D. shaft, is to construct the shaft in a conventional and expeditious manner, and later upgrading it should it be used as part of the repository (page 54). This approach needs careful analysis. Quality assurance controls and

state-of-the-art lining techniques should be utilized, although these may extend the schedule and increase the cost slightly over conventional and expeditious sinking techniques.

Quality Assurance Considerations

The document describes the basic quality assurance program requirements which must be met in order to comply with 10CFR60. Each participating organization in the exploratory shaft (ES) project is directed to prepare and implement a quality assurance program which is based on the accepted nuclear power plant quidelines (i.e. 10CFR50-Appendix B, and ANSI/ASME NQA-1-1979). The various programs are to be evaluated by the DOE before design or field work begins. The document then identifies critical areas of the quality assurance program, such as:

- Design control
- Construction and operational control

It is also of extreme importance that each quality assurance program for each participating organization be compatible. In other words, if one organization takes samples and another organization tests samples, the methods of establishing sample traceability must complement one another. This should be one of the main objectives of the DOE evaluation.

Also, with respect to Document Control, it must be recognized that numerous changes will be made throughout the project. Everything from conceptual testing programs to final design documents will undergo extensive revision. A key aspect of the quality assurance program must be to provide safeguards against the inadvertent use of obsolete documents.

Document 2 - "Preliminary Design and Definition of Field Experiments for Welded Tuff Rock Mechanics Program," SAND-81-1972 by the Sandia National Laboratory, June, 1982.

Document Summary

This report outlines the objectives, preliminary design and predictive modeling results for five field experiments. In general, all the field experiments are clearly defined in terms of the objectives, physical layout, and performance requirements. The discussion covers the following experiments:

- Small diameter heater experiment
- Unit cell canister scale experiment

PROJECT ~~WM-10~~/LFH/83/04/28/0

- 1 -

JUN 1 5 1983

106

PROJECT ~~WM-10~~

DISTRIBUTION
106
~~WM-10 (101.2)~~
WMHT r/f
NMSS r/f
CF
REBROWNING
MBELL
PALTOMARE
HJMILLER
JIGREEVES
LHARTUNG & r/f
JRHODERICK
RJOHNSON
LCHASE
PDR

WM Record File 106
WM Project 16
Docket No.
PDR ✓
LPDR ✓
Distribution:
(Return to WM, 523-SS)

Mr. J. O. Neff
Salt Repository Program Manager
U. S. Department of Energy
National Waste Terminal Storage
Program Office
505 King Ave.
Columbus, OH 43201

Dear Mr. Neff:

Present schedules indicate that the Department of Energy (DOE) will nominate a salt repository site(s) and submit a Site Characterization Plan (SCP) for the Salt Repository program to the Nuclear Regulatory Commission (NRC) for review in calendar year 1984. In view of this schedule, it will be prudent to complete and document the review of certain issues regarding exploratory shaft construction and sealing issues judged to be common to any salt site and that might require long lead times for data collection and analysis. This should be done prior to start of shaft construction.

Two broad areas of concern are: (1) that the site characterization activities (e.g., constructing an exploratory shaft) will not compromise subsequent long term isolation and containment capabilities of the repository and (2) that plans for construction of the exploratory shaft will not preclude the acquisition of adequate information for site characterization. With these broad concerns in mind, a series of activities were initiated by NRC to identify and resolve issues concerning the exploratory shaft. First, the NRC evaluated alternative shaft construction techniques (Attachment No. 1 is our contractor's report on this subject.) Second, the NRC/DOE/NPO meeting April 19-20, 1983 provided the opportunity for a very preliminary discussion concerning exploratory shaft construction and sealing, more detailed interactions are now in order.

With regard to the first of the two broad concerns mentioned above, 10 CFR 60.11(a)(6)(iii) calls for a description of "provisions to control any adverse safety-related effects from site characterization including appropriate quality assurance programs." Similar language is included in

Section 113 (b)(1) (A)(ii) of the Nuclear Waste Policy Act of 1982. The basic concern here is with the potential adverse effects due to penetration of the repository horizon during site characterization. A shaft construction process that takes the exploratory shaft and the contiguous disturbed zone into account and the associated long-term sealing aspects is necessary. We will need specific information and plans regarding the construction and sealing of exploratory shafts.

The documented information needed by the NRC on an exploratory shaft relates to six areas: 1) long term shaft and seal design considerations, 2) construction plans and procedures, 3) sealing or grouting plans and procedures, 4) construction testing, inspection plans and procedures, 5) plans and procedures for gathering specific information related to site characterization, and 6) quality assurance for all of the above. The general type of i nformation considered necessary by NRC on the above items is presented in Attachment 2. If DOE considers that other information is applicable to these basic concerns, this information should also be provided.

We recognize that documented plans for shaft construction and sealing may be changed based on experience gained during construction. We would expect to be informed of significant changes to plans or schedules as they occur. This is needed since the NRC staff expects to visit sites, observe excavations and tests as provided for by the 10 CFR 60.11(g).

With regard to the second broad concern mentioned above, we consider it prudent that the plans for obtaining site characterization data during shaft construction be identified before construction proceeds to the point where obtaining such data is precluded. Some significant and unique information about site properties (e.g., groundwater inflow into the shaft; rock strength and consistency, etc) could be obtained during shaft construction.

Some of the information noted in Attachment No. 2 need not be documented prior to starting shaft construction. However, we consider it advisable that the information be provided early enough for us to complete our review and for you to make any necessary adjustments as a result of comments we may have.

Please contact me at your earliest convenience to establish a mutually

OFC	WMHT	WMHT	WMHT	WMHT	WMHT	WMHT	
NAME	LHartung:dm	JRhoderick	RJohnson	JTGreeves	LChase	HJMiller	
DATE	05/ /83	05/ /83	05/ /83	05/ /83	05/ /83	05/ /83	

agreeable schedule to work toward the interactions which are necessary prior to exploratory shaft construction and sealing.

Sincerely,

"ORIGINAL SIGNED BY"

Lawrence Chase, Project Manager
High-Level Waste Technical
Development Branch
Division of Waste Management

Attachment:

1. Golder Associates, Evaluation of Alternative Shaft Sinking Technologies for High Level Waste (HLW) Deep Geologic Repositories, USNRC NUREG/CR-2854, 1983

2. Information considered necessary regarding exploratory shaft construction and sealing.

DesireeM 83/05/20
DesireeM 83/06/13

*See previous concurrences

OFC	WMHT	WMHT	WMHT	WMHT	WMHT	WMHT
NAME	LHartung:dm*	JRhoderick*	RJohnson*	JTGreeves*	LChase*	HJMiller
DATE	05/ /83	05/ /83	05/ /83	05/ /83	05/ /83	05/ /83

JUN 15 1983

PROJECT WM-10/LFH/83/04/28/0

Please contact me at your earliest convenience to establish a mutually agreeable schedule to work toward the interactions which are necessary prior to exploratory shaft construction and sealing.

Sincerely,

"ORIGINAL SIGNED BY"

Lawrence Chase, Project Manager
High-Level Waste Technical
Development Branch
Division of Waste Management

Attachment:

1. Golder Associates, Evaluation of Alternative Shaft Sinking Technologies for High Level Waste (HLW) Deep Geologic Repositories, USNRC NUREG/CR-2854, 1983

2. Information considered necessary regarding exploratory shaft construction and sealing.

DesireeM 83/05/20

OFC	WMHT	WMHT	WMHT	WMHT	WMHT	WMHT
NAME	LHartung:dm	JRhoderick	RJohnson	JTgreeves	LChase	HJMiller
DATE	05/ /83	05/24/83	05/24/83	06/ /83	06/13/83	06/ /83

6/13/83

ATTACHMENT 2

JUN 1 5 1983

INFORMATION CONSIDERED NECESSARY REGARDING EXPLORATORY SHAFT CONSTRUCTION AND SEALING

I. Shaft and Seal Design Considerations

- Provide an analysis of the potential effects of construction of the exploratory shaft on long-term sealing capabilities of rock mass and identify factors that determine the nature and extent of such effects.

- Describe how the selected excavation technique and shaft design accounts for limitations and uncertainties in long term sealing considerations.

- Provide design specifications for the shaft construction and show how they deal with the factors affecting sealing.

- Describe the seal design and materials.

- Discuss the selected locations of any planned explorations or testing to be performed along the length of the shaft. Include discussion of data on sealing characteristics to be gathered and the limitations and uncertainties associated with the data.

II. Construction Plans and Procedures

- Identify the acceptance criteria for construction of exploratory shafts.

- Identify procedures used to minimize damage to the rock mass penetrated and specific plans to mitigate these effects if applicable to a proposed site.

- If a liner is used, identify liner construction and placement techniques. This information needs to be fully considered in application of any permanent sealing program.

III. Sealing and Grouting Plans and Procedures

- Describe how the seals are expected to perform in sealing exploratory shafts. Describe tests done, both laboratory and field, to determine their long-term durability and their compatibility, both chemical and physical, to the host rock environment.

- Describe the placement methods, including the limitations and uncertainties of the methods.

- Describe remedial methods to be used if sealing methods are found to be inadequate.

IV. Construction Testing and Inspection Plans and Procedures

- Describe test and inspection procedures to be used during excavation to determine acceptability of the shaft as constructed.

- Describe test and inspection procedures to be used during shaft liner construction. Include information such as grout injection rates, grout bond logs, thermal measurements of grout during curing, and liner instrumentation to be used.

- Describe test and inspection procedures to be used after sealing of the shaft to assess the results of the sealing effort in controlling adverse effects. Include information such as grout strength tests, visual identification of seal conditions, records of water inflow, assessment of seal bond to host rock, and logging of drill holes.

- Describe plans to document the above construction activities.

V. Plans and Procedures for Gathering Specific Information Related to Site Characterization

- Describe test plans and procedures used to obtain adequate data on site characteristics that can be measured either directly or indirectly during construction of the exploratory shaft. For example:

  o Geologic mapping and rock mass characterization of the shaft walls

  o Measurements of rates and quantities of groundwater inflow and collection of groundwater samples for testing

  o Measurement of mud loss and control of zones of high mud loss

  o Measurements of overbreakage during blasting

  o Rock mechanics testing of samples obtained during drill and blast operations

VI. Quality Assurance (QA)

- Identify the line of responsibility for implementing QA procedures down to and including the Construction Contractor (10 CFR 50 Appendix B. Criteria I requires that "organizations

performing quality assurance functions shall report to a managment level such that this required authority and organizational freedom, including sufficient independence from cost and schedule when opposed to safety consideration, are provided").

- Identify the procedures to be used by the Quality Assurance organization for implementing and monitoring the QA program for exploratory shaft design, construction and testing.

WM Record File 101.2
WM Project WM-10
Docket No.
PDR ✓
LPDR ✓
Distribution:
JAN 13 1983
- 1 -
(Return to WM, 623-SS)

PROJECT WM-10

DISTRIBUTION
WM-10 (101.)2
WMHT r/f
NMSS r/f
CF
REBROWNING
MJBELL
PALTOMARE
HJMILLER
JTGREEVES
JERHODERICK &r/f
RJWRIGHT
WOLMSTEAD
PDR

PROJECT WM-10

Mr. John H. Anttonen, Assistant Manager
Office of Assistant Manager for Project
and Facility Management
Department of Energy
825 Jadwin Ave.
P. O. Box 550
Federal Building, Room 663
Richland, WA 99352

Dear Mr. Anttonen:

The NRC staff now has under review the Site Characterization Report (SCR) for the Basalt Waste Isolation Project (BWIP), which was submitted to the NRC on November 12, 1982. In view of our understanding that DOE plans to start exploratory shaft construction as early as possible, and potentially before completion of our draft analysis of the SCR, we want to bring to your attention additional information the NRC staff considers necessary in the area of exploratory shaft construction and sealing, above that included in the SCR.

One of the important considerations in developing and carrying out site characterization programs is that the site characterization activities not compromise subsequent long term isolation and containment capabilities of the repository. This concern has been articulated in 10CFR60.11(a)(6)(iii), which calls for a description in the SCR of "provisions to control any adverse safety-related effects from site characterization including appropriate quality assurance programs." Similar language is in section 113 (b)(1)(A)(ii) of the Nuclear Waste Policy Act of 1982. However, the SCR does not provide or reference detailed information concerning construction and sealing programs for the exploratory shaft and associated quality assurance (QA) and testing procedures as they relate to this concern. A design and construction quality assurance plan is mentioned but not presented (see pg. 14.3-73 of SCR).

It should be noted that the NRC staff identified the need for early attention in this area on several occasions over the past year (NRC letter of Aug. 6, 1982, Wright to Squires, and of Nov. 5, 1982, Miller to Anttonen). In meetings over the past year, the staff also reviewed concerns regarding shaft construction techniques (September, 1981) and

OFC	:WMHT	:WMHT	:WMHT	:WMHT	:OELD	:WM RSB	:
NAME	:JRhoderick:ls	JGreeves	:RJWright	:HJMiller	:WOlmstead	:REBrowning	: :
DATE	:83/01/13	:01/ /83	:01/ /83	:01/ /83	:01/ /83	:01/13/83	:

shaft sealing issues (October 4-6, 1982). However, detailed information discussed in these meetings has not been included in the SCR and we are unable to determine whether or not information and plans discussed in the recent workshop are firm.

The basic concern here is with the potential adverse effects due to penetration (e.g., exploratory shaft) of the repository horizon during site characterization. A shaft construction process that takes into account long term sealing aspects is required. The documented information needed by the NRC on the exploratory shaft relates to five areas: 1) shaft and seal design considerations 2) construction procedures to be used, 3) sealing or grouting procedures, 4) testing and inspection procedures, and 5) quality assurance for all of the above. The general type of information considered necessary by NRC on the above items is presented in the attached list. If DOE considers other information is also applicable to the basic concern, this information should also be provided. To the extent we were able to evaluate such information in the recent (October, 1982) design workshop, DOE plans seemed to be appropriate, but there is no documentation in the SCR.

We recognize that documented plans for shaft construction and sealing may have to be changed based on experience during construction and we should be informed of significant changes as they occur. Also, we presume that as meeting the requirements in the new Nuclear Waste Policy Act impacts your schedules, you will inform us of schedule changes. Among other reasons, this is needed since NRC staff expects to visit the site and observe excavations and tests as they are done as contemplated by 10 CFR 60.11(g).

In addition, we consider it prudent that the plan for obtaining site characterization data during shaft construction be identified before construction proceeds to the point where obtaining such data is precluded. Some significant and unique information about site properties (e.g., groundwater response to shaft sinking; rock strength and consistency; and feasibility of using blind boring as a construction technique) could be obtained during shaft sinking.

While all of the information noted in the attachment need not be documented prior to starting shaft construction, we consider it prudent that it be provided early enough for us to complete our review and for you to make any adjustments necessary as a result of comments we may have. For example, grout designs may not be complete now, but could be

OFC	WMHT	WMHT	WMHT	WMHT	OELD	WM	
NAME	JRhoderick:ls	JGreeves	RJWright	HJMiller	WOlmstead	REBrowning	:
DATE	83/01/13	01/ /83	01/ /83	01/ /83	01/ /83	01/ /83	

provided well in advance of grouting the liner. We are willing to discuss those areas with you.

Please contact me at your earliest convenience regarding this matter.

Sincerely,

Hubert J. Miller, Chief
High-Level Waste Technical
Development Branch
Division of Waste Management

Enclosure:
As Stated

cc: F. Coffman, DOE
W. Ballard, DOE

See previous concurrences for Rhoderick, Greeves, Wright, Miller and Olmstead

OFC	:WMHT	:WMHT	:WMHT	:WMHT	:OELD	:WM	:
NAME	:JRhoderick:	ls JGreeves	:RJWright	:HJMiller	:WOlmstead	:REBrowning	: :
DATE	:83/01/13	:01/ /83	:01/ /83	:01/ /83	:01/ /83	:01/ /83	:

any adjustments necessary as a result of comments we may have. Please contact me at your convenience regarding this matter.

Sincerely,

Hubert J. Miller, Chief
High-Level Waste Technical
Development Branch
Division of Waste Management

Enclosure:
As Stated

cc: F. Coffman, DOE
W. Ballard, DOE

OFC	:WMHT	:WMHT	:WMHT	:WMHT	:OELD	:WM	:
NAME	:JRhoderick:isk	:JGreeves	:RJWright	:HJMiller	:WOlmstead	:REBrowning	: :
DATE	:82/12/28	:01/ /83	:01/ /83	:01/ /83	:01/ /83	:01/ /83	:

ENCLOSURE 2

DRAFT ITEMS FOR RESOLUTION PRIOR TO SCP RECEIPT

Item

1. Exploratory Shaft and Underground Test Facility

   a. Locations
   b. Method of construction
   c. Sealing methods
      1. short term
      2. long term
   d. Exploratory Shaft Test Plans
   e. Impact on other site characteristics activities
   f. Designs

2. Hydrology Testing

   a. Number and placement of hydrology testing and head monitoring wells
   b. Choice of drilling fluid for hydrology wells
   c. Suite of tests to be performed including methodologies
   d. Objectives-major questions to be addressed by testing (esp unsat zone)

3. Geology and Geophysics
   a. Geophysical Surveying
   b. Geological Mapping and Trenching
   c. Borehole drilling, coring, and sampling
   d. Seismic Networks
   e. Geodetic Surveys
   f. Conceptual Models for data gathering

4. Geochemistry
   a. Long term lab tests
   b. Long term data collection (rock/mineral chemistry)
   c. Field testing (tracer tests)
   d. Number and location of rock and water chemistry samples

5. Waste Package
   a. Integration into overall disposal system i.e. transportation, MRS, repository, etc. (constraints on design)
   b. Uniform vs. Local corrosion
   c. Effects of radiation

6. Performance Assessment Plan and Use

7. Quality Assurance, particularly those issues raised in the QA site visits

8. Issues Raised by NRC during EA Reviews

9. Format and Content Guide for SCPs

NOTE: This list is a draft for discussion