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WM-10 101

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

FROM: John T. Greeves, Section Leader  
Design Section  
High-Level Waste Technical  
Development Branch  
Division of Waste Management

SUBJECT: OPERATING PLAN ITEM #311211C - BWIP SHAFT  
CONSTRUCTION/QA REVIEW

Attached is the current draft of the staff's review of BWIP shaft construction and quality assurance plans which is scheduled for completion on July 30 (operating plan milestone 311211C). The review is not complete due primarily to a change in work priorities which were requested to meet several unanticipated licensing program needs. Specifically, work required to resolve questions on the quality assurance review plan and development of a technical position on conceptual design information needs in the SCP (i.e., response to DOE questions) has prevented finalizing the subject review. The attached latest draft is for your review. It will be completed by August 26.

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*JTG*

John T. Greeves, Section Leader  
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Draft No. 2 (ISK) 83/07/28/0

PROJECT WM-10

Mr. John H. Anttonen, Assistant Manager  
Office of Assistance 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 and consultants have reviewed the DOE February 23, April 1, and April 29, 1983 letters providing information on exploratory shaft construction and sealing. This information was provided in response to H. Miller's letter of January 13, 1983 on the same subject.

In writing the January 13 letter, the NRC staff had two major concerns about the Exploratory Shaft. One, that adequate provisions are made by DOE to control any adverse safety-related effects from exploratory shaft construction and sealing to avoid compromising subsequent long-term isolation and containment capabilities of the repository. A basic concern here is the effect of exploratory shaft construction on the long-term sealing capabilities. Two, that plans for obtaining site characterization data during shaft construction were developed prior to

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shaft construction. The important point here is that some unique information about site properties (e.g., groundwater response to shaft sinking, availability for visual inspection of basalt flows intersected by the shaft) is obtainable only up to a certain timeframe during shaft construction. Decisions must be made as to the importance and need of this information prior to the time when obtaining such data is precluded.

The NRC staff reviewed the DOE submittals with these two major concerns in mind. As part of the first concern, we struggled with the questions "Do the drilling and construction techniques to be used minimize adverse safety-related effects to the site?" and "Is there anything being done during construction of the shaft which would make it impossible to seal the shaft at permanent closure?" The NRC staff has concluded, based on a review of the DOE information, that DOE has taken provisions to control adverse safety-related effects of exploratory shaft construction on the site. This is based on DOE's decision to: 1) use blind boring (which causes a limited damaged rock zone due to excavation compared to alternative excavation techniques) and 2) plans to remove parts of the steel liner and grout and replace them at permanent closure with a long-term seal. In addition, the staff has some recommendations for additional provisions which could be taken by the DOE program which are

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identified in Attachment 1. As part of the second NRC concern, we struggled with questions such as "Is every attempt being made to maximize the amount of site information which can be gathered during exploratory shaft construction?" and "Is there any needed site information which can only be obtained before or during exploratory shaft construction?"

Information on this topic submitted by DOE was limited but is forthcoming in the near future. Discussions of these questions can be pursued when the outstanding documents mentioned in your response are available for review.

In reviewing the DOE response, the staff notes that there are many outstanding documents yet to be completed. Based on the information needs at different stages of the shaft construction, it is suggested that the following schedule be considered for completion of the outstanding references:

DOE Reference No.

Completion Schedule

5, 14, 17, 26, 27, 35, 37

Prior to drilling of the 144" hole

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2, 18, 28, 32

Prior to penetration of the  
basalt flows

3, 10, 11, 36

Prior to installation of the  
casing

4

Prior to installation of the  
grout

The staff specifically requests DOE to submit DOE references 2, 3, 4, 14, 35 and 37 for NRC review when completed. Additional comments and recommendations by our contractors (Golder Associates and Engineers International) on the information submitted by DOE are attached. If you have any questions covering the NRC staff review, please contact John T. Greeves of my staff at (301) 427-4672.

Sincerely,

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

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ATTACHMENT-1

NRC COMMENTS AND RECOMMENDATIONS  
ON EXPLORATORY SHAFT CONSTRUCTION AND  
SEALING INFORMATION SUBMITTED BY DOE

I. Shaft and Seal Design Considerations

Question:

- 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

Evaluation of DOE Reponse:

DOE stated that the disturbed rock zone (DRZ) created during excavation is the major effect of construction on long-term sealing

capabilities. However, the reference (DOE Reference) used in determining effects of the exploratory shaft on the fractured rock contains only a preliminary evaluation, using assumed generic conditions which, in some cases, are not even applicable to BWIP (e.g., analysis assumes an isotropic stress field). A more detailed analysis of ES construction effects would be beneficial in building confidence that the disturbed rock zone can be predicted accurately using theoretical calculations. DOE also identified the long-term sealing plan to be used at permanent closure. This included removal of some of the steel liner and placing a minimum of six annulus seals. However, in presenting this methodology for seal emplacement, there are several points which need to be addressed. First, the NRC is concerned with the difficulty of removing a steel liner, grout and DRZ at permanent closure, especially in a 6-foot diameter shaft. This is especially true if, according to the DOE response, the major impact on the DRZ is due to stress redistribution. When the steel liner and grout are removed, the rock face will be allowed to relax for the first time without support. The effects of the short-term seals (e.g., grout and chemical seals) on long-term sealing should also be assessed by DOE. The difficulty and the success of removing the chemical seal ring and replace it with a long-term seal needs to be addressed. As part of assessing the effect of the short-term seals on long-term sealing capabilities, the NRC considers it prudent that the short-term (operational) and long-term (permanent closure) sealing material program

should be closely related. For example, most of the grout to be placed to seal the annulus of the shaft during its operational phase will be left in place at permanent closure. Therefore, the staff considers it prudent to utilize candidate long-term sealing materials which have been developed at BWIP (RHO-BWI-C-66 and C-67) or in the ONWI program (ONWI-413) as the materials for the short-term seals. Monitoring the performance of the seal materials during exploratory shaft operations will provide a considerable amount of information that can be used for the design of long-term seals.

Question:

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

Evaluation of DOE Response:

The DOE interpreted long-term sealing considerations (e.g., post-closure) to mean long-term operation (e.g., pre-closure) and responded accordingly. The NRC question refers to post-closure sealing. The NRC recommends that the ES test plan (DOE Reference 2) be available prior to construction of the exploratory shaft and early enough for NRC review. Also, since the DRZ is assumed to be the

primary problem with respect to long-term sealing, its nature and extent should be predicted prior to excavation and examined after construction.

Question:

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

Evaluation of DOE Response:

The DOE provided adequate design specifications for the shaft construction. Long-term sealing considerations will presumably be addressed in future planned reports (DOE References 3 and 11).

Question:

- Describe the grout and chemical seal design

Evaluation of DOE Response:

The grout and chemical seal designs are discussed in general.

Question:

- Discuss the selected locations of the portholes. Include discussion of data on sealing characteristics to be gathered through the portholes and the limitations and uncertainties associated with the data

Evaluation of DOE Response:

The porthole locations (DOE Reference 14) and tests to be performed (DOE Reference 2) are not available for review since these documents are not completed. Therefore, the staff cannot evaluate DOE's response in this area. However, based on information we have seen on this topic, the staff is concerned about the feasibility of drilling portholes in a 6-foot diameter shaft. This includes the logistics of the drilling the portholes as well as obtaining equipment in the size range necessary to be used in the exploratory shaft. Also, the limitations and uncertainties in the portholes data (since it will be a limited measure of the entire rock mass) will have to be assessed by DOE.

## II. Construction Plans and Procedures

### Question:

- Identify the acceptance criteria for construction of the exploratory shaft

### Evaluation of DOE Response:

Specific acceptance criteria for construction of the exploratory shaft were adequately provided in DOE References 6,8,9,13,15 and 16.

### Question:

- Identify procedures used to minimize damage to the rock penetrated

### Evaluation of DOE Reponse:

DOE identified that the blind boring excavation generally results in less damage to the rock than drill and blast techniques (DOE Reference 1). DOE should also develop procedures for controlled blasting when used at shaft breakout.

Question:

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

Evaluation of DOE Response:

The DOE has identified liner design and materials specifications (DOE References 13 and 15) and field welding procedures (DOE Reference 9). Details on liner handling, aligning, and running will be available in the near future (DOE Reference 5). The documents appear to be complete.

### III. Seal or Grouting Plans and Procedures

Question:

- Describe how the grouts and chemical seal 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.

Evaluation of DOE Response:

The DOE described the expected performance during operations of the grouts and chemical seal (DOE Reference 7). However, this is only discussed generically and qualitatively. The long-term durability of these materials is not discussed but will be presented by DOE in Reference 4. The compatibility of the materials used for the short-term (and long-term) seals and the host rock environment should also be addressed by DOE.

Question:

- Describe the placement methods to be used including the limitations and uncertainties of the methods

Evaluation of DOE Response:

The DOE described the casing cementing specification (DOE Reference 6). The procedure for grout emplacement will be available in the near future (DOE Reference 10). Since the sealing area to be tested by porthole examination will be limited, it is important that adequate control of the placement methods be maintained. This includes proper QA/QC during construction and adequate contingency planning prior to placement of the annulus seal.

Question:

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

Evaluation of DOE Response:

The DOE described proposed remedial actions for problems which DOE believes are most likely to be encountered (DOE Reference 21), based on experience at the Amchitka Mining Operation (DOE Reference 20). The staff is concerned that sealing problems might not be detected based on the limited amount of information that will be available from porthole investigations. The ES test plans (DOE Reference 2) will presumably discuss seal problem detection.

## IV. Testing and Inspection Plans and Procedures

Question:

- Describe test and inspection procedures to be used during drilling (e.g., plumbness of hole, drill mud loss, drill bit inspection, etc) to determine acceptability of the shaft as constructed and to obtain adequate information on this construction technique

Evaluation of DOE Response:

The DOE identified procedures to be used during drilling. The NRC is concerned that several of these procedures are not yet complete. Several of these outstanding references (DOE References 18 and 26) identify procedures that measure parameters (e.g., drill mud loss, drill bit inspection) which are very useful in understanding site characteristics. The NRC staff recommends these procedures be completed prior to shaft construction.

Question:

- Describe test and inspection procedures to be used after completion of drilling and during the sealing of the shaft. Include information such as caliper surveys, grout injection rate, grout level sensor, cement bond log, thermal measurements during curing etc.

Evaluation of DOE Response:

The DOE identified procedures to be used after completion of drilling. The NRC recommends these procedures be completed prior to the activity and within a timeframe which allows for adequate review prior to implementation of the procedures.

Question:

- 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, physical logging of drill holes, photo or T.V. camera methods in all portholes

Evaluation of DOE Response:

Review of the DOE response will be done when the necessary DOE references are available for review.

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

Question:

- 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 Will hydrologic conditions [heads] in nearby drill holes be measured during shaft construction to help understand bulk hydrologic properties?
  
  - o Will the following be monitored: Sampling of drill cuttings, bit thrust, torque, rate of advance, slurry weight, speed of rotation, pumping pressure, water inflow? This information can be used to detect and/or explain anomalies encountered?
- Identify all parameters to be measured and methods of measurement.

Evaluation of DOE Response:

Review of the DOE response will be done when the necessary DOE references are available for review.

VI. Quality Assurance (QA)

Administrative Procedure

Question:

- 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")

Evaluation of DOE Response:

The DOE adequately identified the lines of responsibility for the QA program from Rockwell down through the construction manager (DOE References 22 and 23). Lines of responsibility for QA up through DOE will be identified in the future (DOE Reference 35 and 37).

Question:

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

Evaluation of DOE Response:

The DOE has adequately identified procedures for monitoring and implementing the QA program.

Additional comments from NRC contractors on the DOE responses are attached for your information.