

AUG 25 1993

MEMORANDUM FOR: Ronald L. Ballard, Chief
 Geology and Engineering Branch, HLWM

THROUGH: Mysore S. Nataraja, Section Leader

FROM: William J. Boyle, HLGE

SUBJECT: REPORT FOR THE OBSERVATION OF THE 90% DESIGN REVIEW OF ESF
 DESIGN PACKAGE 2A, JULY 19-22, 1993.

Enclosed is the report of my observation of the 90% design review of
 Exploratory Studies Facility (ESF) design package 2A on July 19-22, 1993.

William J. Boyle, HLGE

Enclosure: As stated

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1.0 INTRODUCTION

During July 19-22, 1993, Dr. William J. Boyle, a member of the geotechnical engineering staff of the NRC Division of High-Level Waste Management observed a 90% design review for the Exploratory Studies Facility (ESF) Title II Design, Subsurface Facilities, Design Package 2A. The observation was conducted at the Emerald Springs Holiday Inn and the DOE offices at 101 Convention Center Drive, both in Las Vegas. In addition, after the observation a visit was made with an NRC On-site Representative to the Field Operations Center and the ESF construction site. Participation as an observer of the design review was part of NRC's prelicensing activity, and concerns raised during the observation are documented in this report.

For several reasons, including that the NRC observer had never seen this ESF design package before, the large size of the design package, and the limited time for observations, a limited and quick observation of the design package was performed, in contrast to a detailed review.

2.0 OBJECTIVES

The objective was to observe the review of the design package and identify issues of concern to the NRC related to either the design review process or the technical content of the design package. The observer did not submit written comments related to the design package directly to the design review secretary, but concerns were communicated to a liaison with DOE's Management and Operations (M&O) contractor. When possible, the liaison provided information to immediately address concerns. For those cases when it was not possible to address the concerns, the liaison can submit written comments to the design review secretary that reflect the concerns of the observer. This report contains a description of the concerns of the NRC observer.

3.0 SUMMARY AND CONCLUSIONS

The meetings with DOE personnel, the M&O liaison, and other M&O personnel clarified some issues raised during the observation. However, some concerns were not completely addressed, and have been grouped into the following five general concerns that are described more fully in Section 5.0 of this report:

- The Determination of Importance Evaluation (DIE) seems to rely upon judgment more than it relies upon data and analyses. For those cases for which data can be acquired and analyses performed, NRC staff is generally more comfortable with demonstrations and determinations based on data and analyses rather than those based on judgment alone.
- There is a recognition in the design package that Yucca Mountain is a jointed and faulted rock mass, and the response of the rock mass is affected by the discontinuities such as joints and faults. However, it is not clear that the models used in the analyses in the design package sufficiently represent the possible effects of the discontinuities.
- It is not clearly explained in the design package what is an appropriate level of conservatism to be used in the design to account for uncertainties, and therefore it is not clear that an appropriate level has been used.

- The wording of some of the stipulations in the design package may be sufficiently vague to prevent their implementation during construction.
- The presentation of some calculations may not meet all the requirements of the procedure for performing engineering calculations and analyses.

The main conclusion from the observation of ESF Design Package 2A is that NRC staff should continue to follow the progress of this design review and observe future design reviews to monitor whether the concerns described in this report are limited to this ESF design package, or whether they also exist for other design packages. It is reasonable to expect that a design review observation can generate a list of concerns, because the purpose of a design package review and observation is to identify possible deficiencies. More important to the NRC staff, would be recurrent deficiencies in future design reviews that might be indicative of flaws in the design process.

4.0 PARTICIPANTS

William Boyle was the observer for the NRC. E. Marshall Weaver was the liaison at the M&O. While observing the design review, the following individuals were contacted by the NRC observer: Ted Petrie, Jaime Gonzalez, April Gil (DOE), Scott Sinnock, J. Peters, Peter Hastings, Rick Nolting (M&O), Gerard Heaney (SAIC), Jay Keating (REECO), and Phil Justus (NRC). A list of attendees from the orientation meeting for the design review is also attached.

5.0 DESCRIPTION OF OBSERVATIONS

The design package is for the part of the ramp that will be approximately 200 to 500 feet inside Exile Hill from the ramp portal. DOE supplied each of the reviewers and observers a set of controlled design documents (drawings, calculations, etc) that compose this design package, including Determination of Importance Evaluations, the Basis for Design, and assorted specifications and calculations. A complete list of the documents that were reviewed is given in Section 6.0 of this report.

It is possible to group the concerns about the design package into the following five general topics which are described more fully below:

- Content of the DIE
- Modeling
- Conservatism of the design
- Implementation of the design
- Presentation of some calculations

Each of these topics, except that related to implementation of the design, was discussed, either generally or specifically, with DOE personnel and M&O personnel. The ESF construction site was visited following the observation, and concerns about implementation of the design were communicated to REECO and SAIC personnel, who said they would take the concerns into account when they examined the design package.

Concern 1: CONTENT OF THE DIE

The DIE included as part of Design Review Package 2A is the first DIE read by

the NRC observer. The initial reaction was that the DIE did not appear to have many data or analyses, but seemed to rely upon judgment instead. This impression was reinforced by inclusion in the DIE of a November 1992 letter from Tom Blejwas of Sandia to Dick Bullock of Raytheon. Blejwas states, "However, it must be emphasized that the recommendations that particular items or activities should or should not be considered as important to waste isolation are based primarily on judgment. Therefore, in some cases, it may not be possible to cite applicable references or data to support a particular recommendation; only that based on past experience and current knowledge of the site, a recommendation is tendered." It was explained by the NRC observer in meetings with DOE personnel and M&O personnel that NRC staff are generally more comfortable with data and analyses, rather than judgments, whenever data can be obtained and analyses can be performed.

The concern is not about the DIE for safety, because in the absence of analyses and data it has been conservatively assumed that the tunnel support is important to safety (ITS). The concern relates to the limitations put on activities and materials as a result of the determination of the importance to waste isolation (ITWI). On page 5 of 13 of the Waste Isolation Evaluation, it is stated "During the construction of the tunnel, rock is removed that contains water in the matrix. If the total volume introduced to the host rock as a consequence of the drilling and blasting is less than the volume of water removed by the excavation, then the effects on waste isolation due to the extension of the starter tunnel are expected to be insignificant." It may prove to be true that the construction water used for Design Package 2A may be insignificant to waste isolation, but the reasoning in the DIE, presented above, may be flawed. The reasoning does not seem to acknowledge that the matrix water may be essentially immobile, while the construction water that is introduced is probably not immobile. It is preferable to NRC staff if test data (lab or field) and analyses are used to demonstrate that the construction water that will be used is insignificant to waste isolation.

Another specific example, from the DIE, that is related to the lack of data or analyses, and the use of judgment instead, occurs on page 13 of 27. In the last paragraph it is stated that drill and blast excavation will not cause sufficient damage to create preferential pathways. The statement does not seem to be based on data or analyses, and appropriately qualified people might take exception to the statement, because of the lack of supporting data and analyses.

Concern 2: MODELING

The second general concern discussed with DOE personnel and M&O personnel relates to modeling a fractured rock mass such as Yucca Mountain with computer codes that are based on the assumption that what is being modeled is a continuum. For some phenomena, a continuum model cannot permit the inclusion of some modes of response that are known to exist for a fractured rock mass. For some of the phenomena, some of the non-represented modes of response may be important, but these modes are not being analyzed because they cannot be represented in a continuum code. Therefore, there may be modes of response at Yucca Mountain that could be important, but which may not be analyzed sufficiently.

One specific example, modeling fluid flow, is related to the concern about the

DIE given above. In the ITWI determination, the volume of water in the rock is determined by calculating the volume of water in the matrix continuum. Yet, on page 5 of 13 of the evaluation it is stated, "The only plausible mechanism for significant water movement in 10,000 years ... is through fracture flow." Yet, the design package did not present analyses that represent fluid flow as occurring in fractures.

A second specific example discussed with DOE personnel and M&O personnel is the stability of the ramp roof. In Volume 2 of the Mining Calculations, it is acknowledged that blocks of rock could be a source of instability by falling from the roof, yet analyses are not presented to examine such discrete rock block failures. Instead, the analyses presented for ramp stability utilize a continuum code that cannot model a block fall. When this example was discussed with an M&O engineer, the observation was welcomed and it was said that it would be conveyed to others in the M&O about the possible need to conduct additional analyses that do permit discontinuous behavior of rock blocks.

Another specific concern that was discussed with DOE and M&O personnel is that no dynamic analyses concerning ramp stability are presented, but conservative static analyses are used instead. It is not clear whether this is sufficient. As with the concern about using continuum codes to represent the behavior of discontinuous rock, it is possible that some conservative, static analyses may not sufficiently represent some dynamic aspects, and static analyses alone may not be sufficient. The observation was acknowledged, and M&O personnel said that additional modeling needs would be investigated.

Concern 3: CONSERVATISM OF THE DESIGN

It was mentioned to DOE personnel and M&O personnel that a concern about the conservatism of the design identified in an earlier design review observation for a different design package can also be made for Design Package 2A. In some of the calculations for Design Package 2A, it appears that the designers are relying upon prior experience with mines or tunnels, yet there does not seem to be an acknowledgement that the ESF/repository is neither a mine nor a highway tunnel, and that greater conservatism may be warranted. Even if greater conservatism is not warranted, the design package does not make clear what is an appropriate level of conservatism necessary to compensate for the uncertainties in the design.

A specific example related to the conservatism is the issue of dynamic versus static analyses for the ramp, described in Concern 2 above. On page 13 of 153 of Volume 2 of the Mining Calculations, it is stated that dynamic analyses are not generally done for the design of underground facilities. While this may generally be true for mines and highway tunnels, dynamic analyses are not unprecedented and have been performed for underground designs, in particular for designs of structures that might be subjected to the effects of weapons. Furthermore, there are precedents of performing dynamic geomechanical analyses for those structures, the failures of which could be potential threats to public health and safety, with dams being one example. The design package does not seem to acknowledge that the design methods used for other underground structures, although of interest, may not be sufficient for the ESF/repository because the requirements of the potential repository at Yucca Mountain are different from the requirements of a mine or tunnel.

Another example related to the conservatism of the design is the support for the ramp. As part of the design method for determining the support for the ramp roof and walls, a parameter called the Excavation Support Ratio (ESR) must be chosen. The smaller the value chosen for the ESR, the more support that has to be supplied for the ramp. If all other parameters in the support determination are kept the same, making the ESR smaller should make the ramp safer because more support will be added. It is stated in the Rock Mass Classification Analysis of Volume 1 of the Mining Calculations that an ESR of 1.3 is used. Yet it is also acknowledged in the calculation that major highway tunnels typically use an ESR of 1.0. This could give the appearance that it is less important to have a safe roof in the ESF/repository than it is to have a safe roof in a highway tunnel. Again, the design package does not make clear what is an appropriate level of conservatism.

Concern 4: IMPLEMENTATION OF THE DESIGN

The fourth general concern is related to the implementation of the design in construction, and the stipulations in the DIE that will require monitoring of materials and/or activities in construction. While it is impossible to find fault with the implementation of Design Package 2A because it is not being constructed yet, those parts of the first 200 feet of the starter tunnel that have been constructed give an indication of whether it will be possible to comply with some of the stipulations of the DIE.

One stipulation of the DIE is in a February 2, 1993 memo from Les Shepherd of Sandia to Russ Dyer of DOE that states "... no pressure grouting be done within 50 feet of the two contacts [that is, the contacts between the upper Tiva Canyon Member and the vitric, non-welded Pah Canyon member, and between the Pah Canyon Member and the Topopah Spring Member] during ramp construction." Furthermore it is recommended that no pressure grouting be done within 100 feet of a fault zone. When the ESF construction site was visited by NRC staff, a discussion with a REECO engineer led to the observation that without a clear definition of "pressure grouting", one can only guess at what the stipulation means.

A second stipulation of the DIE is that less than 325,000 gallons of water be used in construction of Design Package 2A, not counting the water used in the shotcrete and grout, because it is believed that shotcrete and grout water is bound in the cement. In a discussion with an SAIC engineer, it was determined that although water use is being metered presently, there is only one water meter and there may not be a method to separate the water used in construction (not counting that used in shotcrete and grout) from the total amount used, which presently does include that used for shotcrete and grout.

Concern 5: PRESENTATION OF SOME CALCULATIONS

The fifth general concern is about the presentation of some of the calculations. This was not discussed in detail with DOE personnel and M&O personnel, but it was mentioned to them that the presentation of the calculations is variable in the level of detail used.

A specific example concerns requirement 5.1.3-I in the M&O's QAP-3-9 for Engineering Calculations and Analyses. This requires, "Complete presentation of the calculation such that anyone appropriately qualified could review the

calculation without recourse to the originator." The design package document titled "Structural Calculations" has calculations that may not meet requirement 5.1.3-I.

In addition, calculations in the design package document titled "Mechanical Calculations" did not have signatures in the "Checked By" block. It is not clear if this check is to take place prior to the 90% design review, or if it is done as part of the design review, or if it is done after the review.

A final specific observation is related to the dates of the calculations, some of which were only days before the design review. It is possible to envision that some of the calculations are being done at the last moment, and may be rushed, which may help account for the uneven level of detail in the calculations.

6.0 LISTING OF DOCUMENTS AVAILABLE FOR REVIEW

The following documents were examined as part of the observation of Design Package 2A:

- Determination of Importance Evaluation
- Basis for Design
- General Requirements Specification Sections
- Sitework Specification Sections
- Concrete Specification Sections
- Conveying Systems Specification Sections
- Mechanical Specification Sections
- Electrical Specification Sections
- Study (this concerned the justification for a flatter ramp slope)
- Structural Calculations
- Mechanical Calculations
- Mining Calculations Volume 1
- Mining Calculations Volume 2

**90% DESIGN REVIEW - PACKAGE 2A
ATTENDANCE LIST
19 JULY 1993**

No.	NAME	COMPANY	TITLE
1	John Peters	M&O/MK	Principal Mining Engr.
2	Jerry Naaf	M&O/MK	ESF Engr. Super Sub-Surface
3	Peter Hastings	M&O/Duke	DIE Manager
4	Hector R. Montalvo	M&O/FD	Lead Civil/Structual Engr.
5	Robert W. Kirk	M&O/Duke	Engineer (DIE Group)
6	William I. Boyle	US NKC	Geotechnical Engineer
7	Jim Grubb	State	Engineer
8	Robert Justice	M&O QA	Quality Engineering Manager
9	John J. Clarke	M&O MK	ESF Assist.Engr
10	Levent Ozdemir	CSM	Professor
11	Richard Fournier	TRW	Review Secretary
12	Grey Smith	TRW	Systems Engineer
13	Robert Saunders	M&O	Subsurface Excavation Lead Engineer
14	Jaime Gonzalez	DOE	Engineer ESF BR
15	Vernon E. Poe	Mineral Co.	Dir. Nuclear Project
16	T. Truong	DOE	Engineer
17	Ken Herold	M&O/MR	Lead Civil/Struct.
18	Ron Oliver	LANL	ESF Testing
19	Neal Pettit	M&O	ESF Sr. Engr.
20	Richard G. Kaish	LANL	ESF Testing
21	Ed McCann	SAIC	Environment
22	Scott Sinnock	M&O	Design Leader
23	Dan Buston	M&O	Systems Engineer
24	W. Larry Clem	M&O	Systems Engineer

No.	NAME	COMPANY	TITLE
25	Kenneth R. Keener	M&O	DCC Manager
26	Gary Teraoka	TRW	Requirements
27	Hemendra N. Kalia	Los Alamos	Technical Advisor - ED ED/YMPO
28	William P. Law	M&O	Systems Engineer
29	P.E. Sperry	NW TRB	Consultant
30	M.S. Rindskopf	M&O	Systems Engineer
31	Dan McKenzie	M&O	ESF PE Staff
32	Keith Roberts	M&O	Sr. Staff
33	Randolph L. Schreiner	RSN	Sr. P/E. Systems
34	Dana J. Rogers	M&O	RR P/E Sub Surf.
35	Raymond A. Mele	M&O/WCFS	Sr. Project Engineer
36	Bernard Verna	DOE	Engineer
37	Tom Fortner	DOE	Construc. MGR
38	Bob Sandifer	M&O/TRW	MGDS Dev. Mgr.
39	Phil Justus	U.S. NRC	On-Site Representative
40	Dan Zerga	Weston	Mine Eng.
41	Dennis Bechtel	Clark CO.	Coordinator
42	T. Arul Mozht	Weston	Systems Engineering
43	Ray Nations	M&O	Sr. Mgr. Safety
44	Jim Friant	CSM	Prof. Research
45	Ronald E. Smith	WCFS	Sr. Consultant
46	James L. Robertson	TRW	Specialty Eng. MGR
47	Glenn Vawter	M&O/TRW	Dep. Site Manager
48	Tom Leonard	REECo	Const. Dept. Mgr.
49	Ronnie Jarriel	TRW	Reliability Engineer
50	Jim Replogle	DOE	ESF BRDN
51	Don Vanica	M-K	Mechanical Lead
52	Jack Nesbitt	M&O	ESF Sr. PE

