Drill + Blast & preferential pathway

Design Observation

28 July 1993

~~TRIP~~ REPORT ~~OF WILLIAM BOYLE~~

1. Date and Destination: 18-23 July 1993

2. Purpose of Trip: Observe the 90% Design Review for ESF Design Package 2A and visit the ESF construction site.

3. Persons Contacted: Ted Petrie, Jaime Gonzalez, April Gil (DOE), E. Marshall Weaver, Scott Sinnock, J. Peters, Peter Hastings, Rick Nolting (M&O), Gerald Heaney (SAIC), and Phil Justus (NRC).

Did state of NV participate?

4. Summary of Activities:

a. Meeting Topics: There were two main topics for the trip, observe the design review and visit the ESF.

The first topic was to observe the design review for ESF Design Package 2A (the part of the ramp that is approximately 200 to 500' inside Exile Hill) and daily communicate my observations to an M&O contact (E. Marshall Weaver) and DOE managers (Petrie, Gil, and Gonzalez). DOE supplied each of the reviewers and observers a set of controlled design documents (drawings, calculations, etc) that were part of this design package. The documents included Determination of Importance Evaluations (DIE), the Basis for Design (BFD), and assorted specifications. My observations that were discussed with M&O and DOE personnel are described below in the section on Technical/Programmatic concerns.

The second topic was to visit the ESF with the NRC on-site representative and observe the state of the project. While there I discussed the construction with a REECo engineer and Gerald Heaney (SAIC).

b. Site Locations Visited: The DOE office in Las Vegas, the Field Operations Center, and the ESF north portal.

At the DOE office in Las Vegas, a room was made available to me where I could read the design package documents and talk to M&O personnel regarding any questions that arose out of my observations. I also visited the offices of Scott Sinnock and Peter Hastings to discuss the DIE.

At the end of each afternoon, all the observers were given an opportunity to meet with Petrie, Gil, and Gonzalez of the DOE regarding any observations of the design package. I was usually the only observer, although some representatives of DOE Headquarters attended one day. Weaver and Sinnock of the M&O also attended these meetings.

On the way to the ESF site, Phil Justus and I checked in at the Field Operations Center and attended part of meeting on the status of work at the site.

c. Technical/Programmatic Concerns: After review of my notes, it is possible to group my observations into the following ~~four~~ five general concerns

252 BL
243 BR
251 M

Observation based on limited review of small part of design

which are described more fully below:

- Content of the DIE
- Modelling
- Conservatism of the design
- Implementation of the design
- ~~Content of~~ Some Calculations ~~Presentation~~ + regarding the implementation of design

The topic of each of these concerns (except the ~~last~~) was discussed, either generally or specifically, with ~~the~~ M&O personnel and DOE personnel. The one topic not discussed with the M&O and DOE concerns how the design is implemented at the site. I visited the site at the end of my trip and did not communicate with the M&O and DOE, but with REECo and SAIC personnel.

CONTENT OF THE DIE

The DIE I read as part of the design review package was the first I had ever read. An initial reaction that I had was that the DIE did not have much in the way of data or analyses, but seemed to rely upon judgement instead. This impression was reinforced by inclusion in the DIE of a letter from the Technical Project Officer of Sandia, Tom Blejwas, to Dick Bullock of Raytheon in November 1992. Blejwas stated, "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." I explained in the afternoon meetings that I felt more comfortable with data and analyses, rather than judgements.

Technical decisions, potentially input to waste isolation based on judgement rather than data.

There is a specific example from the DIE that I did not discuss with DOE and the M&O, but will present it here as an example. My concern with the lack of analyses and data was not directly with the DIE for safety, because in the absence of analyses and data it had been conservatively assumed that the tunnel support would be important to safety (ITS). My concern is with 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 be true that the construction water may be insignificant to waste isolation, but the argument presented above is unconvincing and may be flawed. The argument does not seem to realize that the matrix water may be essentially immobile, while the construction water is not. I would have been more comfortable with test data (lab or filed) or analyses that would demonstrate that the construction water is insignificant to waste isolation.

MODELLING

My second concern regards modelling a fractured rock mass such as Yucca Mountain with codes that are based on the assumption that the model is a continuum. For some phenomena, a continuum model cannot capture some of the

Lack presentation of analyses to justify design

behavior that is known to exist with a fractured rock mass. For some of the phenomena, some of this non-represented behavior may be important, but it is not being analyzed because it is not represented in a continuum code. This general concern was discussed with the M&O and DOE.

One specific example concerns fluid flow and the issue cited above. Regarding the ITWI determination, the volume of water in the rock is determined by calculating the volume in the matrix continuum. Yet on page 5 of 13 of the evaluation it is stated that, "The only plausible mechanism for significant water movement in 10,000 years ... is through fracture flow." Fluid flow through fractures is largely discontinuous and for certain problems it strains credulity to accept a continuum model for such fracture flow. Yet no analyses are presented that represent the flow as occurring in fractures, not even a simplified parallel plate model.

The specific example cited above was not discussed with the M&O and DOE, but the following second specific example was discussed with the M&O and DOE. This examples concerns the stability of the ramp roof. In Volume II of the Mining Calculations, it is admitted that roof falls could be a potential source of instability, yet no analyses are presented to examine such a roof failure. Instead, the only analyses presented utilize a continuum code that cannot permit a roof fall. When this was discussed with an M&O engineer, Rick Nolting, he welcomed my observation and said that he would use it to convince his supervisors to conduct additional analyses that do permit discontinuous behavior of rock blocks.

I also made the observation to Nolting that no dynamic analyses had been used for ramp stability, but that conservative static analyses had been used instead. I questioned whether this was sufficient. As with concern of using continuum codes to represent the behavior discontinuous rock, I observed that no matter how conservative some static analyses are, they may not represent at all some dynamic aspects, and may in fact not be sufficient. Nolting acknowledged this and said that he would discuss modelling with his supervisors.

CONSERVATISM OF THE DESIGN

I conveyed to the M&O and DOE that I shared an observation concerning the conservatism of the design made by Banad Jagannath for an earlier design review of a different design package. In places, it appears that the design is relying upon prior experience with mines or tunnels, yet does not seem to make an explicit acknowledgement that the ESF/repository is not a mine or a highway tunnel, and that greater conservatism may be warranted.

As a specific example, consider the question of dynamic versus static analyses for the ramp cited above. On page 13 of 153 of Volume II of the Mining Calculations, it is stated that dynamic analyses are not generally done for design. While this may generally be true, dynamic analyses are not unprecedented and have been performed for underground design, particularly involving structures that might be subjected to nuclear blasts. More to the point though, is the failure to acknowledge that what has been done for other underground structures, that although of interest, may not be sufficient because of the unprecedented nature and requirements of the potential repository at Yucca Mountain.

Another specific example again concerns the support of the ramp. This example was not discussed with the M&O and DOE, but it is another manifestation of not considering the repository differently from mines and tunnels. 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. In essence, the smaller this number becomes, the more support that has to be added. If all other parameters in the support determination are kept the same, making the ESR smaller makes 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 that highway tunnels would typically use an ESR of 1.0. It is possible to interpret this situation that it is believed that it is more important to have a safer roof in a highway tunnel than it is in the ESF/repository.

IMPLEMENTATION OF THE DESIGN documentation of how design stipulations met - no clear criteria

My fourth area of concern regards the implementation of the design in construction. I identified certain 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 package 2A because it is not being constructed yet, the first 100 feet of the starter tunnel give an indication of easily some of the stipulations of the DIE can be met.

One stipulation of the DIE in a february 2, 1993 memo from Les Shepherd of Sandia to Russ Dyer of DOE is that ".. no pressure grouting be done within 50 feet of the two contacts [my note: the upper Tiva canyon - vitric, non-welded Pah Canyon member, and 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 I visited the sight, I asked a REECo engineer how he interpreted this stipulation, and he admitted that without a clear definition of "pressure grouting" he could only guess at what the stipulation meant.

A second stipulation of the DIE is that less than 325000 gallons of water be used in construction of package 2A, not counting the water used in the shotcrete and grout, because this water is felt to be bound in the cement. When I mentioned this to Gerald Heaney of SAIC QA, he stated that presently although water use is being metered, there is only one water meter and there is no practical way to separate the water used in construction (not counting shotcrete and grout) from the total amount used, which presently does include that used for shotcrete and grout.

d. Technical/Programmatic Safety Significance of New Concerns: SEE THE SECTION ABOVE.

e. Listing of Documents Reviewed: *

5. Conclusions and Recommendations:

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