



Department of Energy
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EXPLORATORY STUDIES FACILITY (ESF) IMPACTS RELATED TO TUNNEL BORING MACHINE (TBM) EXCAVATION OF THE BOW RIDGE FAULT AND ASSOCIATED FRACTURED ZONE (ACTION 358) (SCPB: N/A)

Thank you for your letter dated February 28, 1995, requesting information pertaining to the TBM intercept with the Bow Ridge fault on January 31, 1995, and our process for evaluating the events associated with this penetration. The U.S. Department of Energy (DOE) believes that this event did not constitute a significant geologic condition to which Administrative Procedure (AP) 6.14, "Reportable Geologic Conditions," (currently being revised and renumbered) applies. The DOE fully expected to encounter geological structures and ground conditions associated with fault zones while excavating through the Bow Ridge fault.

We first offer the following details. Early on January 31, 1995, the TBM operators observed that the conveyor belt had been overloading and the cutterhead amperage had decreased. When workers relaxed the cutterhead, an opening became apparent, as some brecciated rock (not running ground) within the opening started caving in from the top. The DOE's scientists were consulted and worked closely with the ESF Constructor, the Construction Management Office (CMO), the Civilian Radioactive Waste Management System Management and Operating Contractor (CRWMS M&O) Architect/Engineer (A/E) on-site shift representative, and the ESF Test Coordination Office (TCO) to evaluate the geologic conditions and proposed construction activities.

Early Tuesday, January 31, 1995, the ESF Constructor, the CMO, and CRWMS M&O A/E on-site shift representative briefed ESF TCO personnel on ground conditions encountered as the TBM progressed through the fractured rock immediately preceding the Bow Ridge fault, and requested information from the TCO and DOE scientists on the geology. The construction contractor (Reynolds Electrical & Engineering Co., Inc. [REECO]/Peter Kiewit [PK]) and CMO jointly decided to implement specific ground stabilizing

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measures (fibercrete and superlean cement) before proceeding with excavation through the fault zone. The down time associated with the decision and equipment set-up was used by the ESF TCO and primary test organizations (U.S. Geological Survey/U.S. Bureau of Reclamation [USBR] and Sandia National Laboratories [SNL]) to evaluate the fault and the adequacy of existing construction and test controls. Richard Kovach (TCO), Steve C. Beason (USBR), and Scott Carlisle (SNL/Agapito) were asked to inspect the conditions at the heading to determine if the Bow Ridge fault had been encountered. At the cutterhead, the test program representatives were able to look out through the muck buckets to observe conditions at the heading. At the time of inspection, an opening was observed at the top of the cutterhead, about 2-3 meters (m) wider than the tunnel. The opening extended approximately 6 m above the shield of the TBM, tapering to less than 0.5 m near the top of the opening. The opening was a maximum of about 2-3 m wide (normal to the tunnel). The upper 3-4 m of the opening was smooth in appearance. The lower part of the opening was rough-walled and the tunnel face was in matrix-supported, poorly consolidated breccia. The breccia was composed of 2-20 centimeters size fragments of densely welded tuff (derived from the Tiva Canyon tuff) in a matrix of clay- to sand-size material. The breccia at the face exhibited no evidence of secondary mineralization.

Later in the day, the constructor prepared to fibercrete the opening face and then initiated plans to fill the opening with lean or superlean pumpable cement. The TCO concurred with the construction plans, but stressed the requirement for careful accounting by REECO/PK of all construction material placed in or around the opening. A field estimate of 41 m³ (52 yards) of superlean mix was used to partially fill the opening.

A field assessment of potential impacts on planned test activities at the fault (geologic mapping, alcove construction and fault properties testing, hydrochemistry testing, and consolidated sampling) was conducted and documented by the USBR and ESF TCO. The construction activities were preliminarily assessed against testing requirements, and it was concluded that the activities would not pose a significant problem for scientific studies. An alcove is planned to investigate the Bow Ridge fault and will be constructed at a suitable station and at a sufficient distance to avoid any possible contamination or interference from construction materials. The superlean cement was not expected to migrate beyond the immediate opening because the walls are primarily composed of fine-grained materials. No open fractures were observed during the field assessment.

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In addition to the field evaluations, pertinent requirements and controls established for test interference and implementation in the Test Planning Packages (TPP) and Determination of Importance Evaluation (DIE) were carefully reviewed by the ESF TCO and the CRWMS M&O Site Investigations staff responsible for testing related information to the DIE. A general DIE was concurrently developed that considered the construction measures implemented for the opening encountered, and assumed a high likelihood of additional openings and loose, broken ground as the TBM excavation continues through the fault. The evaluations and concurrences of the DIE and testing organizations were documented by the CRWMS M&O and ESF TCO.

The review of controlling documents (TPPs, Job Packages, and the Test Interference Evaluation component of the Package 2C DIE) indicated that no major impacts to ongoing or proposed testing at the fault should result from these construction and ground support methods implemented, with the exception of some unavoidable loss of access for peripheral mapping and sample collection. No test-related controls have been compromised by the construction activities.

This assessment is based on two primary considerations. First, the lateral impact of fibercrete and superlean mix placement in the main TBM ramp is expected to be minimal, with chemical and physical effects localized at the point of placement. Second, the flexibility provided in the test plans for alcove location and final depth off the main ramp allow planned tests to be designed and located in a manner which will minimize or eliminate interference from ramp construction and ground support. Although some loss of geologic mapping capability (full periphery) and rock sampling opportunity will be realized, the anticipated loss is accepted as necessary to ensure tunnel safety, and can be compensated for through additional sampling and geologic evaluation of the alcove that has been planned.

In conclusion, the geology and ground conditions encountered within the Bow Ridge fault was expected as a possibility, and had been considered in the tunnel support system for Design Package 2C. Running ground was not the mechanism of ground failure near the fault. Once again, the occurrence did not constitute a significant geologic condition reportable per AP 6.14, which is currently being revised to Yucca Mountain Site Characterization Project Administrative Procedure (YAP) 30.27. Upon finalization of YAP 30.27, we will forward a copy to your office. The DOE's scientists and test managers were on site and at hand to provide relevant observations for decision making. Finally, controlling documents pertaining to test interference

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and potential loss of data were reviewed prior to approving remedial ground support measures. We respond to your itemized questions from your February 28, 1995, letter in an enclosure.

We appreciate your concern and should you have any further questions regarding this occurrence, please contact Dennis R. Williams at (702) 794-7968.



Wesley E. Barnes
Project Manager

AMSL:TWB-2800

Enclosure:
Questions from 2/28/95
Letter; and DOE Responses

cc w/encl:
M. R. Knapp, NRC, Washington, DC
J. E. Cantlon, NWTRB, Arlington, VA
G. N. Cook, YMSCO, NV

Q: What is the process for scientific discovery so that the operators of the TBM are communicating findings and opportunities for research investigation to DOE scientists?

A: DOE ensures opportunities to investigate the impacts of geologic conditions encountered during excavation, that may or may not be reportable per our procedure YAP-30.27, by close cooperation between the Test Coordination Office, the construction contractor, the Civilian Radioactive Waste Management System/Management and Operating contractor's architect/engineer supervisor, and the Construction Management Organization. Co-locating these staff on the construction site, and radio communications with the tunnel boring machine operator allow all of the proper parties to be involved in the decisions required to maintain a safe facility for characterization.

Q: Are there quality assurance procedures in place to ensure that reportable geologic conditions are in fact reported? Are the quality assurance procedures effective and timely?

A: DOE developed the Reportable Geologic Conditions procedure (YAP-30.27) to apply to the site characterization phase of the pre-licensing period. There is no requirement for such a procedure now, but DOE believed that one would be useful as a good management practice for this open program.

DOE believes the procedure is effective, although the type of threshold conditions for which the procedure was designed have never been obtained. These might be, for example, discovery of natural gas or petroleum shows from boreholes, discovery of precious metal veins, copious quantities of water entering ESF drift(s), discovery of a basaltic intrusion or dike, or anomalous ambient heat fluxes. These conditions greatly depart from what we might expect to encounter given what is now known about the site, and given that we are in a stage of discovery called site characterization.

With respect to timeliness, to date DOE has invoked this procedure only once, after the Little Skull Mountain earthquake in June 1992. At that time, DOE stated in the correspondence with our evaluation that it was being invoked due to media attention, and that this event did not meet the explicit criteria for invoking the procedure, because earthquakes are not unexpected in the southern Great Basin. In any event, this evaluation and report was made available within 30 days of the event, which DOE considers timely.

ENCLOSURE

Q: If a DOE scientist finds a condition that could be considered to disqualify the site, what is the process for notification and investigation? Who gets involved?

A: The process for evaluation and notification is defined in Revision 0 of "Reportable Geologic Conditions," which was made available to Eureka County in the correspondence that documented the evaluation DOE undertook for the Little Skull Mountain earthquake (Letter, Roberts to Holonich, dated 7/22/92), for which P. Goicoechea, Eureka County, received a copy with enclosures.

Q: Is the use of the TBM facilitating the collection and analysis of data or are the safety hazards of faulting and falling rock mandating that the tunnel be reinforced rather than studied?

A: The purpose of the ESF is twofold: (1) access to the underground, and (2) characterization. DOE's first priority is to ensure that a safe facility is available to allow access to the scientists and technicians who are characterizing the rock mass. When decisions need to be made about the type of roof support that may be needed given certain ground conditions, the testing community is involved in this decision through the Test Coordination Office.