



**Department of Energy**  
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**EXPLORATORY STUDIES FACILITY (ESF) TEST PROGRAM EVALUATION OF ACTIVITIES AND IMPACTS RELATED TO TUNNEL BORING MACHINE (TBM) EXCAVATION OF THE BOW RIDGE FAULT AND ASSOCIATED FRACTURED ZONE (ACTION NO. 328) (SCP/B: N/A)**

Thank you for your letter dated February 8, 1995 requesting information pertaining to the TBM intercept with the Bow Ridge fault on January 31, 1995.

In response, we offer the following specific details, as requested: To begin with, the U.S. Department of Energy (DOE) feels that this event did not constitute a significant geologic condition to which the procedure entitled "Reportable Geologic Conditions," Administrative Procedure (AP) 6.14, (which is currently being revised) applied. The DOE fully expected to encounter geological structures and lithologies associated with fault zones, while excavating through the Bow Ridge fault. 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 material (not running ground) within the opening started caving 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 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 extensively used by the ESF TCO and primary test organizations (U.S. Geologic 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.

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Dick Kovach (TCO), Steve 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 m<sup>3</sup> (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 clay-like and silty materials. No open fractures were observed during field investigation.

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.

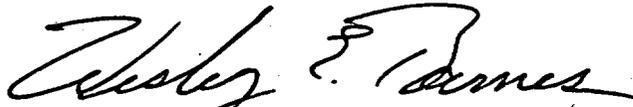
The review of controlling documents (TPPs, Job Packages, and the Test Interference Evaluation component of the Package 2C DIE) indicated that no major impacts to ongoing or proposed testing at the fault should result from these construction and ground support methods implemented, with the exception of 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.

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Secondly, 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 planned alcove.

In conclusion, the geology and lithology encountered within the Bow Ridge fault was expected and had been considered in the design support system. 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 scientists and test managers were on location and provided relevant observations for decision-making. Finally, controlling documents pertaining to test interference and potential loss of data were reviewed prior to approving remedial ground support measures.

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



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OPA:GNC-2563

cc:

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