

November 28, 2000

Dr. Stephan J. Brocoum, Assistant Manager  
Licensing and Regulatory Compliance  
U.S. Department of Energy  
Yucca Mountain Site Characterization Office  
P.O. Box 30307  
North Las Vegas, NV 89036-0307

SUBJECT: ISSUE RESOLUTION STATUS REPORT (KEY TECHNICAL ISSUE: THERMAL EFFECTS ON FLOW, REVISION 3)

Dear Dr. Brocoum:

As you know, the staff of the U.S. Nuclear Regulatory Commission (NRC) have developed a program for early resolution of technical issues at the staff level. Revision 0 of this Issue Resolution Status Report (IRSR) on the Key Technical Issue (KTI) of Thermal Effects on Flow (TEF) focused on defining acceptance criteria for staff use in reviewing the treatment of TEF in the U.S. Department of Energy's (DOE's) testing, modeling and performance assessment program areas (letter from N.K. Stablein to S. Brocoum dated November 13, 1997). Revision 1 focused on evaluating DOE's thermohydrologic testing program in the context of the acceptance criteria (letter from M.J. Bell to S. Brocoum dated October 1, 1998). Revision 2 focused on evaluating DOE's modeling and performance assessment program, with respect to TEF, in the context of the acceptance criteria (letter from C.W. Reamer to S. Brocoum dated September 15, 1999). In Revision 3 (enclosure to this letter), the subissues have been revised although their technical scope is unchanged. In addition, the numerous acceptance criteria used in Revision 2 have been consolidated into seven general acceptance criteria in Revision 3. Your staff have been informed of these changes. The subissues, as stated in previous revisions of the IRSR, were developed to provide the relationship between data (thermal testing), process-level modeling and performance assessment. As such, this duplicates the purpose of the general acceptance criteria being developed for the Yucca Mountain Review Plan and used in Revision 3. Also, the subissues were revised to explicitly address features, events, and processes (FEPs) related to TEF. Revision 3 updates the status of issue resolution based on information currently available. At the request of your staff, we have developed a cross-walk of the acceptance criteria, and related open items, between Revisions 2 and 3 of the TEF IRSR. This cross-walk has been provided to your staff and is also in Appendix B of Revision 3 of the TEF IRSR.

Consistent with NRC regulations on prelicensing consultations and a 1992 agreement with the DOE, staff-level resolution can be achieved during prelicensing consultation. The purpose of issue resolution is to assure that sufficient information is available on an issue to enable the NRC to docket the license application. Resolution at the staff level does not preclude an issue being raised and considered during the licensing proceedings, nor does it prejudice what the NRC staff evaluation of that issue will be after its licensing review. Issues are "closed" if the DOE approach and available information acceptably address staff questions such that no information beyond what is currently available will likely be required for regulatory decision

making at the time of initial license application. Issues are “closed-pending” if the NRC staff have confidence that the DOE proposed approach, together with the DOE agreement to provide the NRC with additional information (through specified testing, analysis, etc.) acceptably addresses the NRC’s questions such that no information beyond that provided, or agreed to, will likely be required at time of initial license application. Issues are “open” if the NRC has identified questions regarding the DOE approach or information, and the DOE has not yet acceptably addressed the questions or agreed to provide the necessary additional information in the license application. Pertinent additional information could raise new questions or comments regarding a previously “closed” issue.

Section 5 of the enclosed IRSR summarizes our independent pre-licensing review of some DOE documents supporting the DOE’s Site Recommendation (SR). The staff recognizes the preliminary nature of the draft Analysis and Model Reports (AMRs) and Process Model Reports (PMRs); specifically, they have not been accepted by the DOE. Thus, the staff have not used the information contained in those draft documents to resolve any open subissues in this report. To aid the issue resolution process, however, the staff have reviewed and provided comments on the sufficiency of information in the draft documents to address staff concerns. After a review of the final AMRs and PMRs or other documents that indicate the DOE’s acceptance of the information in the preliminary documents, the staff will consider whether it is appropriate to close the subissues or any portion of the subissues.

Based on information currently available, the subissue related to FEPs is “open”. To close this subissue, the DOE will need to resolve a number of open items. Specifically, the DOE needs to:

- Provide the final list of primary and secondary FEPs.
- Provide the revised FEP screening analysis for thermohydrologic models. The screening analysis documentation should comprehensively address all primary FEPs.
- Give greater visibility to secondary FEPs in the FEP screening documentation.
- Provide a summary of the assumptions related to screening argument for FEPs relevant to thermohydrologic models that need verification and the associated analyses planned to provide that verification.
- Provide traceable references to previous analyses used as the technical basis for screening arguments for excluded FEPs.

We note that the DOE is currently revising all AMRs on FEPs. We expect that our comments on your existing FEP analysis will be addressed in the revised reports. We will review your FEP screening analysis to determine its completeness and whether an adequate technical basis has been provided for those FEPs associated with TEF that you have screened out from the performance assessment. Your FEP analysis and our review of the analysis will provide the best near-term opportunity to resolve FEP related open items within the TEF KTI.

Based on information currently available, the subissue related to thermal effects on temperature, humidity, saturation, and flux is “open”. To close this subissue, the DOE needs to resolve a number of open items. Specifically, the DOE needs to:

- Complete thermohydrologic modeling for the current repository design.

- Include the process (FEP) referred to as the “cold trap effect” in the Multi-Scale Thermohydrologic Model (MSTHM). Subsequently, provide model support for implementation of the “cold trap effect” model by comparison with past observations such as condensation in the Enhanced Characterization of the Repository Block (ECRB) cross-drift under the thermal gradient imposed by the tunnel boring machine (TBM).
- Provide traceable references to MSTHM model input and output to allow review of such aspects as boundary and initial conditions and to confirm the mass balance of model results.
- Consider measuring losses of mass and energy through the bulkhead of the drift-scale test (DST).
- Address: (i) the potential for unmonitored mass and energy flow through test boundaries of the cross-drift thermal test (CDTT); and (ii) the effect of unmonitored mass and energy flow through test boundaries of the CDTT on the usefulness of test results before the test begins. Consider designing and conducting the CDTT so as to avoid unmonitored mass and energy flow through test boundaries.
- Provide data support for the ventilation model by completing the ongoing ventilation test. Subsequently, provide model support for the ventilation model by comparisons to the test data.
- Evaluate data uncertainty and propagate this uncertainty through the thermohydrologic model abstraction. Sources of data uncertainty to be evaluated include: i) measurement error, bias, and scale-dependence in the saturation, water potential, and pneumatic pressure data used for model parameter calibration; (ii) heterogeneity and spatial variability in thermohydrologic properties; and (iii) variability in model results using the various property sets found to be valid for thermohydrologic modeling.
- Evaluate model uncertainty as seen in results from various alternative conceptual models such the equivalent continuum model (ECM), dual permeability model (DKM), and active fracture model (AFM), and propagate this uncertainty through the thermohydrologic model abstraction.
- Provide model support by predicting thermohydrologic results of the CDTT to verify the thermohydrologic model abstraction adequately represents the potential thermohydrologic conditions expected in the proposed repository.

The bases for open items related to the two subissues are discussed in Sections 5.2 and 5.3 of the IRSR. These open items should form the basis for discussions at the upcoming technical exchange scheduled for the week of January 8, 2001, in Livermore, CA.

We did receive formal comments from you on Revision 2 of the TEF IRSR (letter dated March 22, 2000, from S. Brocoum to C.W. Reamer) and we would welcome your formal comments on Revision 3. We have addressed your comments on Revision 2 of the TEF IRSR in this revision. We would like to note that we continue to have very successful interactions with the DOE project personnel on the thermal testing program and appreciate the opportunity to attend the various thermal testing workshops. The enclosure should be viewed as a status report that provides the staff's most current views on documents related to thermohydrology affecting the repository at Yucca Mountain that support the DOE's SR.

We welcome a dialogue on this subject with the DOE, the U.S. Nuclear Waste Technical Review Board, State of Nevada, and other interested parties. If you have any questions about

S. Brocoum

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this letter, please contact Jeffrey Pohle of my staff at (301) 415-6703, or via internet mail service ([jap2@nrc.gov](mailto:jap2@nrc.gov)).

Sincerely,

***/ra by David Brooks for:/***

C. William Reamer, Chief  
High-Level Waste Branch  
Division of Waste Management  
Office of Nuclear Material Safety  
and Safeguards

Enclosure: Issue Resolution Status Report (Key Technical Issue : Thermal Effects on Flow, Revision 3)

cc: See attached list

S. Brocoum

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C. William Reamer, Chief  
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Division of Waste Management  
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cc: See attached list

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