

July 3, 2002

Joseph D. Ziegler, Acting Assistant Manager  
Office of Licensing and Regulatory Compliance  
U.S. Department of Energy  
Yucca Mountain Site Characterization Office  
P.O. Box 364629  
North Las Vegas, NV 89036-8629

SUBJECT: THERMAL EFFECTS ON FLOW AGREEMENT 2.07

Dear Mr. Ziegler:

During a Technical Exchange and Management Meeting held on January 8-9, 2001, the U.S. Nuclear Regulatory Commission (NRC) and the U.S. Department of Energy (DOE) reached agreement on a number of issues within the Thermal Effects on Flow (TEF) Key Technical Issue (KTI). By letter dated April 26, 2002, DOE provided information pertaining to TEF Agreement 2.07. The NRC staff has reviewed this information as it relates to the agreement and the results of the staff's review are enclosed.

As noted in DOE's letter of April 26, 2002, TEF Agreement 2.07 has three components. The first component, provide the pre-test predictions for the ventilation tests, was submitted to the NRC by DOE letter dated March 2, 2001. As noted in NRC's letter to DOE dated August 29, 2001, this component of the agreement is complete. The second component of TEF Agreement 2.07, provide the ventilation model, is the subject of the enclosed staff review. The third component of TEF Agreement 2.07, incorporate data collected in laboratory scale ventilation tests in the Ventilation Model Analysis Model Report (AMR), was not submitted at this time but will be included in the final AMR, Rev. 01, as indicated in DOE's letter of April 26, 2002.

In summary, the staff believes the letter report provided with DOE's letter fulfilled its purpose of providing the ventilation model to NRC. Because information related to the third component of the agreement has not yet been submitted, the status of TEF Agreement 2.07 should remain "partly received." If you have any questions regarding this matter, please contact Mr. James Andersen of my staff at (301) 415-5717.

Sincerely,  
/RA/

Janet Schlueter, Chief  
High-Level Waste Branch  
Division of Waste Management  
Office of Nuclear Material Safety  
and Safeguards

Enclosure: As stated  
cc: See attached distribution list

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Letter to J. Ziegler from J. Schlueter dated July 3, 2002

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## NRC Review of DOE Documents Pertaining to Key Technical Issue Agreements

The U.S. Nuclear Regulatory Commission (NRC) goal of issue resolution during the pre-licensing period is to assure that the U.S. Department of Energy (DOE) has assembled enough information on a given issue for NRC to accept a license application for review. Resolution by the NRC staff during pre-licensing does not prevent anyone from raising any issue for NRC consideration during the licensing proceedings. Also, and just as important, resolution by the NRC staff during pre-licensing does not prejudge what the NRC staff evaluation of that issue will be after its licensing review. Issues are resolved by the NRC staff during pre-licensing when the staff has no further questions or comments about how DOE is addressing an issue. Pertinent new information could raise new questions or comments on a previously resolved issue.

This enclosure addresses one NRC/DOE agreement made during the Thermal Effects on Flow (TEF) Technical Exchange and Management Meeting (see NRC letter dated January 26, 2001, which summarized the meeting). By letter dated April 26, 2002, DOE submitted information to partially address TEF Agreement 2.07. The information submitted for this agreement is discussed below.

### **Thermal Effects on Flow Agreement 2.07**

Wording of the Agreement: Provide the Ventilation Model AMR, Rev. 01 and the Pre-Test Predictions for Ventilation Test Calculation, Rev. 00. The DOE will provide the Ventilation Model AMR (ANL-EBS-MD-000030) Rev 01 to the NRC in March 2001. Note that ventilation test data will not be incorporated in the AMR until FY02. The DOE will provide the Pre-test Predictions for Ventilation Tests (CAL-EBS-MD-000013) Rev 00 to the NRC in February 2001. Test results will be provided in an update to the Ventilation Model AMR (ANL-EBS-MD-000030) in FY 02.

NRC Review: The technical issue underlying TEF Agreement 2.07 is provided in NRC's Revision 3 of the Issue Resolution Status Report (IRSR) for the TEF Key Technical Issue (dated November 2000). Subissue 2, open item 6, asks DOE to "[p]rovide data support for the ventilation model by completing the ongoing ventilation test" and "[s]ubsequently, provide model support for the ventilation model by comparison to the test data." At the time of the TEF Technical Exchange and Management Meeting (January 2001), phase 1 ventilation test was complete and phase 2 was ongoing. Phase 3 of the ventilation test (see TEF Agreement 2.06) was planned, but has since been determined by DOE to be unnecessary.

There are three components to TEF Agreement 2.07. The first component, providing the "Pre-Test Predictions for Ventilation Tests" was provided by DOE to NRC on March 2, 2001. As noted in NRC letter to DOE dated August 29, 2001, this component of the agreement is complete. The second component of TEF Agreement 2.07, providing the "Ventilation Model" Analysis and Model Report (AMR) (ANL-EBS-MD-000030, Revision 01), is the subject of the review comments herein. The third component of TEF Agreement 2.07 is to update the "Ventilation Model" AMR using the data collected in laboratory scale ventilation tests to validate the ventilation model; this component remains open.

TEF Agreement 2.07 is primarily concerned with initial conditions in the drift and wallrock at the start of the post-closure period. The ventilation model simulates the effects of forced ventilation during the pre-closure period. Certain aspects of the ventilation conceptual model are important for pre-closure, and other aspects are important for post-closure. Two related

Enclosure

agreements from the Repository Design and Thermal Mechanical Effects (RDTME) KTI are not discussed in this enclosure. RDTME Agreements 3.01 and 3.14 address ventilation efficiency throughout the repository as it affects pre-closure issues. The review of the DOE report herein will be constrained to topics important for establishing initial conditions for the post-closure period.

The following report was provided by DOE to fulfill the second component of TEF Agreement 2.07: "KTI Letter Report Effect of Forced Ventilation on Thermal-Hydrologic Conditions in the Engineered Barrier System and Near Field Environment," Revision 00, dated March 6, 2002. The DOE report was intended by DOE to provide timely information abstracted from the "Ventilation Model" AMR Revision 01. TEF Agreement 2.07 specified that DOE would provide the "Ventilation Model" AMR Revision 01, which will still be provided once it completes the DOE review process.

The DOE report primarily describes the validation of the ventilation model. Two models have been used. The ANSYS® software package was used in Revision 00 of the "Ventilation Model" AMR. ANSYS includes sensible heat transfer in the in-drift submodel and is linked to a conduction-only wallrock submodel. Latent heat transfer is approximated by modifying thermal properties of the rock near the boiling point. The MULTIFLUX software package was developed to better handle the details of important physical processes associated with ventilation. It has the capability of handling mass transfer across the driftwall boundary and in the wallrock. Also, phase changes, and thus latent heat transfer, are directly included in the MULTIFLUX code. In MULTIFLUX, a ventilation submodel for a drift is indirectly linked to the thermohydrologic NUFT code for the wallrock. The linkage is through a response surface, though, an iteration loop in MULTIFLUX improves the linkage between the ventilation submodel and NUFT.

The DOE report includes an extensive section on validation of the ventilation model. The validation process included a comparison against analytical solutions and comparisons between the alternative models represented by the ANSYS and MULTIFLUX software packages. Results using the more complex representation in the MULTIFLUX code generally supported conclusions reached using the simpler representation in the ANSYS code. However, the DOE report only provides a partial validation of the ventilation model. NRC concurs with statements made in the DOE report (e.g., page 16) that the last step of the validation is to incorporate laboratory ventilation test data into the validation process. DOE intends to include this information in the final "Ventilation Model" AMR (Rev. 01). The NRC staff will continue to monitor the usage of test data to support the ventilation model.

Since the time of the TEF Technical Exchange and Management Meeting of January 2001, the NRC staff has completed a ventilation submodule directly linked to the thermohydrologic MULTIFLO code. The results of NRC simulations suggest that values of time-integrated ventilation efficiency support the DOE usage of a constant heat load reduction factor of 70 percent in the Multiscale Thermohydrologic Model. Different emplacement and repository designs may warrant a change to the heat load reduction factor. Use of time-averaged (i.e., constant) heat reduction factors does lead to over-predictions of heat removal by ventilation early in the pre-closure period. The over-prediction, however, does not significantly affect temperature and relative humidity conditions at the start of the post-closure period. Both the DOE (MULTIFLUX) and NRC ventilation models produced higher time-averaged ventilation efficiency values than reflected by the constant 70 percent heat load reduction. The NRC staff believes, however, that uncertainties in the ventilation models disallow usage of constant heat load reduction factors higher than 70 percent without further clarification of those uncertainties.

In summary, the NRC staff has reviewed the DOE KTI letter report on ventilation and has determined that the second component of TEF Agreement 2.07 is complete. The first component, pre-test predictions for phase 1 and 2 laboratory ventilation tests, was previously completed. Incorporation of laboratory ventilation test data into the ventilation model is the third component of TEF Agreement 2.07, which will be documented in "Ventilation Model" AMR Revision 01 due in FY02 according to the agreement. The NRC staff looks forward to, and will monitor, the incorporation of laboratory data into the validation process for the ventilation model. The NRC staff concurs with DOE that TEF Agreement 2.07 remains "Partly Received."

Additional Information Needed: None

Status of Agreement: TEF Agreement 2.07 remains "Partly Received."