

February 28, 2002

Dr. Stephan Brocoum, 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: REPOSITORY DESIGN AND THERMAL-MECHANICAL EFFECTS KEY  
TECHNICAL ISSUE AGREEMENT

Dear Dr. Brocoum:

During a Technical Exchange and Management Meeting held on February 6-8, 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 Repository Design and Thermal-Mechanical Effects (RDTME) Key Technical Issue (KTI). By letter dated June 28, 2001, DOE provided a document that pertained to Agreement 3.01 within this KTI. RDTME Agreement 3.01 concerns aspects of the stability of ground support systems. The NRC staff has reviewed the document as it relates to the RDTME KTI and the results of the staff's review are enclosed. In summary, the staff believes additional information is needed regarding DOE's approach to ensuring the in-drift ground support materials will perform their intended function during the pre-closure period; hence RDTME Agreement 3.01 will remain listed as partly received until receipt and review of the requested information and remaining documents called for in this agreement.

After you have reviewed this letter, please contact Mr. James Andersen of my staff to discuss this issue further. He can be reached 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 S. Brocoum from J Schlueter dated: February 28, 2002

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## **NRC Review of a DOE Document Pertaining to the Repository Design and Thermal-Mechanical Effects Key Technical Issue Agreements**

The U.S. Nuclear Regulatory Commission (NRC) goal of issue resolution during this interim 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 importantly, resolution by the NRC staff during pre-licensing does not prejudge what the NRC staff evaluation of that issue will be after it's 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 Repository Design and Thermal-Mechanical Effects (RDTME) Technical Exchange and Management Meeting (see NRC letter dated October 27, 2000, which summarized the meeting). By a letter dated June 28, 2001, DOE submitted a document pertaining to this agreement. The document submitted and the associated Key Technical Issue (KTI) agreement is discussed below:

### **1) Repository Design and Thermal-Mechanical Effects Agreement 3.01**

Wording of the Agreement: Provide the technical basis for the range of relative humidities, as well as the potential occurrence of localized liquid phase water, and resulting effects on ground support systems. The DOE will provide the technical basis for the range of relative humidity and temperature, and the potential effects of localized liquid phase water on ground support systems, during the forced ventilation preclosure period, in the *Longevity of Emplacement Drift Ground Support Materials*, ANL-EBS-GE-000003 Rev 01, and revision 1 of the *Ventilation Model*, ANL-EBS-MD-000030, analysis and model reports. These are expected to be available to NRC in September and March 2001, respectively.

NRC Review: The NRC staff reviewed *Longevity of Emplacement Drift Ground Support Materials* (ANL-EBS-GE-000003, Rev 01, ICN 01) and notes that Assumption 5.5 indicates that the relative humidity of the emplacement drifts will range from 3 to 40 percent. The rationale for this assumption is provided and indicates that the monitored relative humidity at a typical station in the exploratory studies facility (ESF) Main Drift ranges from 8 to 45 percent with a relative humidity less than 40 percent for a cumulative frequency of 99.42 percent. Assumption 5.3 states that the relative humidity necessary for humid air corrosion is in the range of 60 to 80 percent. Thus, DOE concluded that by maintaining the relative humidity of the emplacement drifts below the relative humidity necessary for the initiation of humid air corrosion, significant degradation of the ground support materials by humid air corrosion during the pre-closure period will not occur. During pre-closure, the combination of elevated temperature and ventilation are proposed as the means to reduce the relative humidity in the emplacement drifts as described in Section 6 of the analysis and model report (AMR).

The rationale provided for the low relative humidity is not complete and does not provide information on the time interval over which the relative humidities in the ESF Main Drift were measured. From the information provided, it cannot be determined if the external environmental conditions have an effect on the relative humidity in the ESF Main Drift. Although the AMR indicates that in some localized areas, there is a possibility of dripping water contacting the steel components of ground support, the AMR indicates that the effects of

Enclosure

localized liquid phase water on the ground support systems and estimations of the frequency and location of localized liquid phase water still need to be assessed. The assessment of humid air corrosion correctly identifies that the deposition salts can reduce the relative humidity at which liquid phase water can be present and thereby lower the relative humidity at which atmospheric corrosion can occur. At present, the DOE atmospheric corrosion modeling assumes that the deliquescence point of sodium nitrate determines the relative humidity at which a stable water film can be formed. Mixed salts such as a combination of sodium chloride, sodium nitrate, and potassium nitrate may deliquesce at much lower relative humidities and thereby promote corrosion during pre-closure. The effects of mixed salts is not considered in the corrosion assessment of the ground support materials.

The AMR does not consider the possibility that water may reside in the tight crevices between the drift wall and the steel sets used for ground support. Water that could be trapped in these areas may evaporate more slowly than elsewhere as a result of the lower ventilation rate compared to the average ventilation rate in the drift. The composition of the groundwater is assumed to be similar to the that measured for J-13 with a pH of 8.04 and a low chloride concentration. Potential wetting and dryout of these areas may result in a much more aggressive environment with an increased chloride concentration and a low pH as a consequence of hydrolysis of  $\text{Fe}^{2+}$  cations. An aggressive environment may accelerate the corrosion rate of carbon steel ground support materials.

The assessment of microbial corrosion of the ground support materials is based on the argument that significant microbial activity cannot exist without the presence of a water film. The presence of a water film between the drift support materials and the drift wall is not considered in the assessment of microbial activity.

From interactions with DOE contractors at workshops and technical exchanges, and the information provided in other DOE documents, staff are aware that work is ongoing to address concerns raised in this agreement. NRC Staff will continue to conduct independent activities to provide bases for reviewing this work when the next revision of the AMR becomes available. At this time, agreement RDTME 3.01 is not yet satisfied

Additional Information Needed:

- 1) Provide information on the time interval over which the relative humidities in the ESF Main Drift were measured.
- 2) Provide information on the effects of external environmental conditions on the relative humidity in the ESF Main Drift.
- 3) Provide an assessment of the effects of localized liquid phase water on the ground support systems and estimations of the frequency and location of localized liquid phase water.
- 4) Provide the technical basis for why the effects of mixed salts are not considered in the corrosion assessment of the ground support materials.
- 5) Provide the technical basis for not including the possibility that water may reside in the tight crevices between the drift wall and the steel sets used for ground support.
- 6) Provide the technical basis for why the presence of a water film between the drift support materials and the drift wall is not considered in the assessment of microbial activity.

Status of Agreement: Since DOE has not provided the Ventilation Model AMR as called for in this agreement, the above information can be included in the Ventilation Model AMR, some other document, or can be addressed by an alternate method. Since DOE still has one document to submit per this agreement, RDTME Agreement 3.01 will continue to be listed as "Partly Received."