November 4, 2003

Joseph D. Ziegler, Director
Office of License Application and Strategy
U.S. Department of Energy
Office of Repository Development
P.O. Box 364629 M/S 523
North Las Vegas, NV 89036-8629

SUBJECT: PRELICENSING EVALUATION OF THE REPOSITORY DESIGN AND THERMAL-MECHANICAL EFFECTS (RDTME) KEY TECHNICAL ISSUE (KTI) AGREEMENT 3.01

Dear Mr. Ziegler:

The U.S. Nuclear Regulatory Commission (NRC) has completed its evaluation of Key Technical Issue (KTI) Agreement 3.01 reached between NRC and the U.S. Department of Energy (DOE) during a technical exchange on Repository Design and Thermal-Mechanical Effects (RDTME) KTI (February 20, 2001). Initially, DOE submitted its response to NRC in its letter dated June 28, 2001. After reviewing the DOE response to RDTME Agreement 3.01, NRC found the information provided by DOE was insufficient to close the agreement and needed additional information from DOE to adequately address the agreement (February 28, 2002). In response to the NRC request, DOE submitted additional information in its letters dated April 26, 2002, and May 13, 2003. The enclosure to this letter provides the summary of the NRC review of DOE's response to the NRC's need for additional information.

It will be useful to recall that the concern expressed by NRC on the humidity conditions within the emplacement drifts arose mainly because of DOE's conclusions that the ground support components made up of carbon steel will not undergo significant corrosion for 300 years. DOE used this conclusion to justify not accounting for mechanical degradation of ground support in its pre-closure stability analysis of emplacement drifts. Additionally, DOE design assumptions suggested that the emplacement drifts would have maintenance-free life of up to 175 years and that a planned maintenance would be needed only if the pre-closure design life is extended to 300 years. These assertions by DOE led to NRC questioning the assumptions made while calculating the humidity conditions that impact the corrosion potential of carbon steel that would be used in the ground support system. However, DOE has made explicit statements during NRC/DOE interactions that a ground support maintenance plan would indeed be in place and such a plan would be presented in the license application. In addition, DOE has proposed changes to the ground support design as presented during the latest technical exchange (May 6-8, 2003) which might render some of the questions raised by NRC moot and raise some additional/different questions. DOE has proposed a four-step design process which includes estimating and accounting for any corrosion potential of the ground support material and planned monitoring and maintenance of the ground support system. With this background, the review of the additional information supplied by the DOE, the NRC concluded that RDTME agreement 3.01 is complete.

If you have any questions regarding this matter, please contact Gregory Hatchett of my staff at 301-415-3315 or by e-mail to GXH@nrc.gov.

Sincerely,

/RA/

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

Project No. WM-00011

Enclosure: NRC Review

cc: See attached distribution list

Letter to J. Ziegler from J. Schlueter dated: November 4, 2003
cc:

A. Kalt, Churchill County, NV
R. Massey, Churchill/Lander County, NV
I. Navis, Clark County, NV
E. von Tiesenhausen, Clark County, NV
G. McCorkell, Esmeralda County, NV
L. Fiorenzi, Eureka County, NV
A. Johnson, Eureka County, NV
A. Remus, Inyo County, CA
M. Yarbro, Lander County, NV
S. Hafen, Lincoln County, NV
M. Baughman, Lincoln County, NV
L. Mathias, Mineral County, NV
L. Bradshaw, Nye County, NV
D. Chavez, Nye County, NV
D. Hammermeister, Nye County, NV
J. Larson, White Pine County, NV
J. Ray, NV Congressional Delegation
B. J. Gerber, NV Congressional Delegation
F. Roberson, NV Congressional Delegation
T. Story, NV Congressional Delegation
R. Herbert, NV Congressional Delegation
L. Hunsaker, NV Congressional Delegation
S. Joya, NV Congressional Delegation
K. Kirkeby, NV Congressional Delegation
R. Loux, State of NV
S. Frishman, State of NV
S. Lynch, State of NV
M. Paslov Thomas, Legislative Counsel Bureau
J. Pegues, City of Las Vegas, NV
M. Murphy, Nye County, NV
M. Corradini, NWTRB
J. Treichel, Nuclear Waste Task Force
K. Tilges, Shundahai Network
M. Chu, DOE/Washington, D.C.
G. Runkle, DOE/Washington, D.C.
C. Einberg, DOE/Washington, D.C.
S. Gomberg, DOE/Washington, D.C.
W. J. Arthur, III , DOE/ORD
R. Dyer, DOE/ORD
J. Ziegler, DOE/ORD
A. Gil, DOE/ORD
W. Boyle, DOE/ORD
D. Brown, DOE/OCRWM
S. Mellington, DOE/ORD
C. Hanlon, DOE/ORD
T. Gunter, DOE/ORD
C. Newbury, DOE/ORD
J. Mitchell, BSC
M. Mason, BSC
S. Cereghino, BSC
N. Williams, BSC
M. Voegele, BSC/SAIC
D. Beckman, BSC/B&A
W. Briggs, Ross, Dixon & Bell
P. Johnson, Citizen Alert
R. Holden, NCAI
B. Helmer, Timbisha Shoshone Tribe
R. Boland, Timbisha Shoshone Tribe
J. Birchim, Yomba Shoshone Tribe
R. Arnold, Pahrump Paiute Tribe

cc: (Continued)

R. Clark, EPA

R. Anderson, NEI

R. McCullum, NEI

S. Kraft, NEI

J. Kessler, EPRI

D. Duncan, USGS

R. Craig, USGS

W. Booth, Engineering Svcs, LTD

L. Lehman, T-Reg, Inc.

S. Echols, Esq

C. Marden, BNFL, Inc.

J. Bacoch, Big Pine Paiute Tribe of the Owens Valley

P. Thompson, Duckwater Shoshone Tribe

T. Kingham, GAO

D. Feehan, GAO

E. Hiruo, Platts Nuclear Publications

G. Hernandez, Las Vegas Paiute Tribe

K. Finfrock, NV Congressional Delegation

H. Urban, NV Congressional Delegation

G. Hudlow

A. Elzeftawy, Las Vegas Paiute Tribe

C. Meyers, Moapa Paiute Indian Tribe

R. Wilder, Fort Independence Indian Tribe

D. Vega, Bishop Paiute Indian Tribe

J. Egan, Egan, Fitzpatrick & Malsch, PLLC

J. Leeds, Las Vegas Indian Center

J. C. Saulque, Benton Paiute Indian Tribe

C. Bradley, Kaibab Band of Southern Paiutes

R. Joseph, Lone Pine Paiute-Shoshone Tribe

L. Tom, Paiute Indian Tribes of Utah

E. Smith, Chemehuevi Indian Tribe

D. Buckner, Ely Shoshone Tribe

V. Guzman, Walker River Paiute

D. Eddy, Jr., Colorado River Indian Tribes

H. Jackson, Public Citizen

J. Wells, Western Shoshone National Council

D. Crawford, Inter-Tribal Council of NV

I. Zabarte, Western Shoshone National Council

NRC On-Site Representatives

S. Devlin

P. Johnson, Citizen Alert

If you have any questions regarding this matter, please contact Gregory Hatchett of my staff at 301-415-3315 or by e-mail to GXH@nrc.gov.

Sincerely,

/RA/

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

Project No. WM-00011

Enclosure: NRC Review

cc: See attached distribution list

DISTRIBUTION:

File Center	HLWB r/f	ACNW	PUBLIC	OSR	CNWRA
LCampbell	LChandler	MYoung	LKokajko	DHiggs	BJagannath
ACampbell	BSpitzberg	WMaier, RIV	DBrooks	JMoore	Acoggins
MZobler	GMorell	LRoche	LZaccari		

C:\$ldcfg$\ML033100560.wpd ✳See Previous Concurrence

OFC:	HLWB	DWM	HLWB	HLWB	HLWB
NAME:	MNataraja ✳	TMcCartin	GHatchett	NKStablein	JSchlueter
DATE:	10/28/03	11/03/03	10/28/03	11/03/03	11/04/03

OFFICIAL RECORD COPY

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. Furthermore, 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 addressed issue.

This enclosure addresses one NRC/DOE agreement made during the Repository Design and Thermal-Mechanical Effects (RDTME) Technical Exchange and Management Meeting.[1] After reviewing DOE submitted information[2] to address RDTME Agreement 3.01 NRC requested additional information from DOE needed to complete the agreement.[3] DOE has submitted additional information to the NRC.[4,5]

Repository Design and Thermal-Mechanical Effects Agreement RDTME.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* Analysis/Model Report, ANL–EBS–GE–000003 Rev. 01 (CRWMS M&O, 2000a), and Revision 1 of the *Ventilation Model* Analysis/Model Report, ANL–EBS–MD–000030 (CRWMS M&O, 1999), analysis and model reports. These are expected to be available to NRC in September and March 2001, respectively.

Basis for the Agreement: The analysis of emplacement-drift stability previously provided by DOE to support its site recommendation (CRWMS M&O, 2000b) did not include consideration of any degradation of the ground support system during the preclosure period. DOE asserted in the *Longevity of Emplacement Drift Ground Support Materials Analysis/Model Report* Rev. 01 (CRWMS M&O, 2000a) that the carbon steel ground support system (which consisted of steel sets and occasional rock bolts) would not experience significant corrosion for 300 years. DOE,

---

[1]Reamer, C.W. NRC/DOE Technical Exchange and Management Meeting on Repository Design and Thermal-Mechanical Effects (February 20, 2001)." Letter (February 28) to S. Brocoum, DOE. Washington, DC: NRC. 2001.

[2]Brocoum, S.J. "Transmittal of Reports and Data Addressing Key Technical Issues (KTI)." Letter (June 28) to C.W. Reamer, NRC. Las Vegas, Nevada: DOE. 2001.

[3]Schlueter, J.R. "Repository Design and Thermal-Mechanical Effects Key Technical Issue Agreement." Letter (February 28) to S.J. Brocoum, DOE. Washington, DC: NRC. 2002.

[4]Ziegler J.D. "Transmittal of Report Addressing Key Technical Issues (KTI)." Letter (April 26) to J.R. Schlueter, NRC. Las Vegas, Nevada: DOE. 2002.

[5]Ziegler J.D. "Key Technical Issue (KTI) Repository Design and Thermal-Mechanical Effects (RDTME) 3.01" Letter (May 13) to J.R. Schlueter, NRC. Las Vegas, Nevada: DOE. 2003.

therefore, proposed that the emplacement drift ground support would not require maintenance during a preclosure period of up to 175 years, and that maintenance would be needed only if the preclosure period were to be extended up to 300 years (CRWMS M&O, 2000c). The assertion that the ground support system would not experience significant corrosion during the preclosure period was based on an argument that the corrosion rates would be negligible because the relative humidity within the emplacement drifts would be in the range of 1–40 percent, which is below the critical relative humidity for humid-air corrosion. The information requested in RDTME Agreement 3.01 is needed to establish an acceptable technical basis for excluding corrosion effects from consideration in the design of a maintenance free ground support system.

NRC Review: The DOE submitted two documents *[Longevity of Emplacement Drift Ground Support Materials Analysis/Model Report* Rev. 01 ICN 01(CRWMS M&0, 2001a) and the KTI Letter Report: *Effect of Forced Ventilation on Thermal-Hydrologic Conditions in the Engineered Barrier System and Near Field Environment]* to address Key Technical Issue Agreement RDTME 3.01. After reviewing these documents, the NRC provided DOE with the following additional information needs:

1. Provide information on the time interval over which the relative humidities in the Exploratory Studies Facility (ESF) Main Drift were measured.

2. Provide the 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.

Since the NRC letter forwarding the NRC's additional information needs, DOE has modified its proposed ground support design for the emplacement drifts as presented by DOE at the NRC/DOE Technical Exchange on Repository Design and Thermal-Mechanical Effects Key Technical Issue, which was held in Las Vegas on May 6–8, 2003.[6] The ground support system for the emplacement drifts in the modified design would consist of friction rock bolts (Grade 316 stainless steel split sets/swellex bolts) with stainless steel thin-wall Bernold-style perforated surface sheets.[7] The DOE strategy for the design of a ground support system for the

[6]Schlueter, J.R., "NRC/DOE Technical Exchange on Repository Design and Thermal-Mechanical Effects (May 6–8, 2003)." Letter (May 22) to J.D. Ziegler, DOE. Washington, DC: NRC. 2003.

[7]Duan, F. and M. Board. "Ground support Studies and Design Status." Presented at the NRC/DOE RDTME Technical Information Exchange." Las Vegas, Nevada. May 6-8, 2003.

emplacement drifts as described by Board (2003), included in a letter dated April 4, 2003,[8] consists of four steps as follows: (i) develop an initial design using industry practice based on empirical relationships; (ii) evaluate the design through numerical modeling; considering an appropriate range of rock mass properties, loading combinations, environmental conditions, and the repository operational requirements; (iii) estimate corrosion potential and life expectancy of the ground support; and (iv) develop monitoring, inspection, and maintenance programs for the emplacement drifts as the design progresses from the conceptual to detailed phases. The NRC expects this four-step approach to address many of the concerns raised in the RDTME Agreement 3.01.

DOE's response to the requested information included the *In-Situ Field Testing of Processes Analysis/Model Report* (CRWMS M&O, 2001b) and source data files. DOE's responses to the NRC additional information request are individually evaluated.

1. Provide information on the time interval over which the relative humidities in the ESF Main Drift were measured.

   DOE has provided the requested information in the data files MO0104SPATEM00.001 and MO0107SPATEM00.002. The relative humidity was recorded every hour for a period of 6.5 months. Analysis of the data indicate that the relative humidity is typically in the range of 10 to 40 percent. Occasionally, the relative humidity was above 50 percent; however, the duration of these events were less than 24 hours. The information contained in the data files provided by DOE is consistent with the assumed relative humidity in the *Longevity of Emplacement Drift Ground Support Materials Analysis/Model Report*, Rev. 01 ICN 01 (CRWMS M&O, 2001a).

2. Provide the information on the effects of external environmental conditions on the relative humidity in the ESF Main Drift.

   DOE provided information in the data file MO0203SPAESF00.003, a comparison of selected surface and underground relative humidity values intermittently over a 6-month period for two selected stations. No temperature data from the surface station was included in the DOE submittal. DOE's report noted the prominent dampening at underground locations of ground surface diurnal fluctuations in relative humidity. This dampening of relative humidity fluctuations underground was probably due to the dampening of diurnal temperature fluctuations underground. DOE also identified one period of elevated underground relative humidity that was correlated with high ground surface relative humidity, likely corresponding to a storm event. The DOE report concludes that the effects of external environmental conditions on the relative humidity in tunnels and drifts "are negligible, relative to the effects on corrosion rates."

   NRC was also concerned with long term variations in external conditions and their effect on underground environmental conditions. The longer term records from meteorological stations on Yucca Mountain (e.g., CRWMS M&O, 2000d) could provide a better basis for typical relative humidity conditions at Yucca Mountain than the short term records provided in MO0203SPAESF00.003. For example, it is not clear if the average for the year 2000 of 31.1 percent relative humidity from the ESH/IAM Site 1 data provided in

[8]Ziegler, J.D., "Transmittal of a Report Addressing the Strategy for Resolution of Geomechanically-Related Repository Design and Thermal-Mechanical Effects (RDTME) Key Technical Issue (KTI) Agreements." Letter (April 4) to J.R. Schlueter, NRC. Las Vegas, Nevada: DOE. 2002.

MO0203SPAESF00.003 reflects typical conditions at Yucca Mountain. Precipitation records from the nearby Nevada Test Site meteorological station (4JA) suggest that the August 2000 to December 2000 was a drier period than normal for those months.

The assessment of the effect of external environmental conditions on underground relative humidity, however, may not require further analysis depending on two other aspects. One, the magnitude of the temperature increase caused by the emplacement of waste packages has not been factored into the analysis. The relative humidity should decrease because of the heat generated by the waste. Two, the relative humidity threshold for corrosion of the ground support system, specifically the effect on corrosion of intermittent periods of time when that threshold is exceeded. For most metals, including steel, the critical relative humidity for humid air corrosion is approximately 60 percent. Information provided by DOE shows that the relative humidity inside the emplacement drifts should be maintained below the critical relative humidity for humid air corrosion and external environmental conditions should not significantly alter the relative humidity inside the emplacement drifts.

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.

   DOE cited two relevant results:

   i. observation of a localized damp feature and drying profiles in niches along the ESF Main Drift; and

   ii. water potential measurements in boreholes along the Enhanced Characterization of the Repository Block drift

   These observations along with the assumption that the contact between steel sets and the wallrock was similar to fractures in the wallrock led to the DOE conclusion that the engineered materials in drifts would be in a dry environment. For the observation of a localized damp feature, DOE has reported that a small wet feature was observed in Niche 3566 after excavation. The feature dried up in hours and no other wet features were observed. This observation supports the inference that the evaporation rate driven by ventilation is much larger than localized percolation rates. The observation of the wet feature also supports the conclusion that exposed rock faces will dry out quickly. Based on long term water potential measurements in the alcoves and Enhanced Characterization of the Repository Block drift, DOE's evaluation indicates that dry out zones extend 2 to 3 meters into the rock. The DOE report also notes that the emplacement drifts will be hotter than the existing conditions in the tunnel, drift, and alcoves. The higher temperatures will cause an additional reduction in the relative humidity of the air mass in the emplacement drifts.

   The observed drying of the localized damp feature and the water potential measurements support DOE's analysis that indicates ventilation of the emplacement drifts would deter the formation of liquid water between the steel sets and the drift wall. The ground support system in the latest repository design has changed, however, from steel sets to rock bolts with a perforated metal drift liner. Depending on the length of rock bolts used, many of the bolts may extend beyond the dry out zone for a significant time period during the preclosure period. Furthermore, the perforated metal liner could decrease the extent of the dry out thickness. The humidity condition around the bolts is not necessarily determined by the information provided by DOE regarding the potential dryness of the emplacement drifts and the surrounding rock. DOE has indicated that the conditions surrounding the rock bolts will

be similar to the condition of fractures which are drier than the conditions of the rock matrix. To assess the environmental conditions surrounding the rock bolts a definition of “dry” is needed.

The rock bolts will be in complete or partial contact with the rock matrix. Thus, the water content and relative humidity of the rock mass are relevant to the determination of the environmental conditions surrounding the rock bolts. DOE properly infers that the relative humidity of the air mass in the drifts should not be used to estimate the relative humidity adjacent to engineered materials in direct contact with the wallrock. Water potential measurements infer water contents in the rock matrix. There are no measurements of water potential, water content, or relative humidity in fractures at Yucca Mountain. DOE uses water potential data to infer a dryout thickness. Data from CRWMS M&O (2001b) indicate that the "driest" measured value in the wallrock was approximately –30 bars. This value of water potential can be shown to correspond to a relative humidity of approximately 98 percent in pore spaces using the standard Kelvin equation for porous media, which is the basis for psychrometers used at Yucca Mountain to measure water potential. Conceptually, the first few centimeters of the matrix probably have a fairly low (large negative value) water potential, such that the relative humidity in the pore space is significantly lowered. Beyond the first few centimeters of depth into the wallrock, the pore space relative humidity is likely high. In the rock matrix near large aperture fractures, the water potential is also likely low. For most of the fractures, the water potential is probably slightly lower than the adjacent matrix, but not enough to lower the relative humidity significantly.

Based on the information provided by DOE, it is not clear that the environment surrounding rock bolts would be maintained at a low relative humidity. DOE has indicated that the need to study the potential impacts of localized liquid phase water on the various ground support materials will be assessed and a strategy for monitoring, inspection and maintenance will be developed as needed. The effect of localized high humidity environments on stability of the engineered support materials should also be assessed. In particular, the analysis of the ground support design should include the effects of rock bolt corrosion.

4. Provide the technical basis for why the effects of mixed salts are not considered in the corrosion assessment of the ground support materials.

   DOE has indicated that the effects of mixed salts was not performed because credit for the performance of ground support systems is limited to the preclosure period. Assessment of the effects of mixed salts on the deliquescence point will be provided in the responses to NRC/DOE KTI Agreements ENFE 2.13 and 2.15. The formation of mixed salts that may deliquesce at lower relative humidity and promote aqueous corrosion of the rock bolts will be evaluated using the information generated to fulfil ENFE 2.13 and 2.15. In addition, the DOE analysis of ground support design and the strategy for monitoring, inspection, and maintenance of the ground support materials should consider the effects of any mixed salts that are expected to form in the vicinity of the rock bolts during the preclosure period.

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.

   DOE’s assessment of the formation of localized liquid phase water is described in item #3. Data provided by DOE suggests that ventilation leads to dry out extending into the rock. Dry out of the rock would likely reduce the possibility for the formation of water in the crevices between any steel sets and the rock. The recent change in DOE’s proposed design for emplacement drift ground support, however, raises additional questions regarding the range

of environmental conditions to which the rock bolts will be exposed. It is unclear if the information provided by DOE can be used to estimate the environmental conditions controlling the corrosion of rock bolts. In addition, it is not clear if the rock bolts would become conduits for the transfer of water into the excavated drift or undergo periodic wetting and dryout which may alter the concentration of dissolved species in the water contacting the rock bolts.

Based on the information provided by DOE, it is not clear ventilation would prevent the possibility that water may reside in the crevices surrounding rock bolts. DOE has indicated, however, that the potential impacts of localized liquid phase water on the various ground support materials will need to be assessed. The environment in contact with the rockbolts should be included in DOE's strategy for monitoring, inspection and maintenance of the drift support materials.

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.

   DOE's response indicates that microbial activity requires the presence of liquid water which is assessed in the response to item #3. Based on the information provided by OE, it is not clear that ventilation would prevent water contact with the rock bolts that may lead to microbial induced corrosion. DOE has indicated, however, that the potential impacts of localized liquid phase water on the various ground support materials will need to be assessed.

Additional Information Needs: No additional information is necessary.

Status of Agreement: Recent information presented in the Repository Design and Thermal Mechanical Effects technical information exchange[9] indicates that the design of the emplacement drift support system has changed and steel sets will be replaced by stainless steel rock bolts. Thus, the information provided by DOE to address RDTME 3.01 does not include any discussion of DOE's approach for including the corrosion of rock bolts in its assessment of the ground support performance. DOE, however, indicated that potential ground support corrosion would be included in its ground support analysis and would be considered by DOE in developing a monitoring and maintenance plan for the emplacement drifts. DOE also indicated that this information (i.e., corrosion of ground support materials, the effect of such corrosion on ground support performance, and how this effect is considered in the monitoring and maintenance plan for emplacement drifts) will be provided in subsequent reports that would be available to NRC. Taking into consideration that the DOE has: (1) provided information on the relative humidity measurements as requested; (2) stated that the effect of mixed salts will be addressed in the responses to NRC/DOE KTI Agreements ENFE 2.13 and 2.15 (which will be reviewed by the staff as it applies to the proposed new proposed ground-support design); and (3) developed a design strategy for the emplacement drift ground support that includes providing a monitoring and maintenance plan for the emplacement drifts, NRC considers this agreement complete.

REFERENCES

[9]Schlueter, J.R. "NRC/DOE Technical Exchange on Repository Design and Thermal-Mechanical Effects (May 6–8, 2003)." Letter (May 22) to J.D. Ziegler, DOE. Washington, DC: NRC. 2003.

Board, M. "Resolution Strategy for Geomechanically-Related Repository Design and Thermal-Mechanical Effects (RDTME)." Las Vegas, Nevada: Bechtel SAIC Company, LLC. 2003.

CRWMS M&O. *"Ventilation Model."* ANL–EBS–MD–000030 Rev. 01. Las Vegas, Nevada: CRWMS M&O. 1999

———. "Longevity of Emplacement Drift Ground Support Materials." ANL-EBS-GE-000003 Rev. 01. Las Vegas, Nevada: CRWMS M&O. 2000a.

———. "Total System Performance Assessment of the Site Recommendation." TDR-WIS-PA-000001 Rev. 00 ICN 01. Las Vegas, Nevada: CRWMS M&O. 2000b.

———. "Ground Control System Description Document." SDD-GCS-SE-000001 Rev. 01. Las Vegas, Nevada: CRWMS M&O. 2000c.

———. "Yucca Mountain Site Description." TDR-CRW-GS-000001 Rev. 01 ICN 01. North Las Vegas, Nevada: TRW Environmental Safety Systems, Inc., CRWMS M&O. 2000d.

———. "Longevity of Emplacement Drift Ground Support Materials." ANL-EBS-GE-000003 Rev. 01 ICN 01. Las Vegas, Nevada: Bechtel SAIC Company, LLC. 2001a

———. "In Situ Field Testing of Processes." ANL-NBS-HS-000005 Rev. 01. Las Vegas, Nevada: CRWMS M&O. 2001b.