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Responses to RDTME 3.01 Request for Additional Information Received February 28, 2002

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Enclosure 1

PROCEDURE COMPLIANCE

This report was prepared in accordance with the requirements of AP-REG-014, *Information or Material for Regulatory Response.*

SECURITY REVIEW

This report contains no potentially sensitive information. It contains no information that could define a target. It contains no information that could define a specific location. It contains no information that identifies vulnerabilities.

DISCLAIMER

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CONTENTS

Page

ACRONYMS AND ABBREVIATIONS vii

1. BACKGROUND 1

2. INFORMATION AS REQUESTED 1

3. RESPONSES 2
   3.1 GENERAL RESPONSE TO ALL REQUEST AREAS 2
   3.2 SPECIFIC RESPONSE TO ALL REQUEST AREAS 3
      3.2.1 Specific Area 1 3
      3.2.2 Specific Area 2 3
      3.2.3 Specific Areas 3, 5 and 6 4
      3.2.4 Specific Area 4 8

4. CONCLUSION 9

5. REFERENCES 10
   5.1 DOCUMENTS CITED 10
   5.2 CODES, STANDARDS, REGULATIONS, AND PROCEDURES 10
   5.3 SOURCE DATA 10

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ACRONYMS AND ABBREVIATIONS

AMR	Analysis & Model Report
DTN	Data Tracking Number
DOE	U.S. Department of Energy
ECRB	Enhanced Characterization of the Repository Block
ENFE	Evolution of Near-Field Environment
ESF	Exploratory Studies Facility
KTI	Key Technical Issue
NRC	U.S. Nuclear Regulatory Commission
RDTME	Repository Design and Thermal-Mechanical Effects

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1. BACKGROUND

In a Technical Exchange and Management Meeting held between the U.S. Nuclear Regulatory Commission (NRC) and the U.S. Department of Energy (DOE) on February 6-8, 2001, in Las Vegas, Nevada, a number of agreements were issued related to the resolution of the Key Technical Issue (KTI) on Repository Design and Thermal-Mechanical Effects (RDTME) (Reamer and Williams 2001).

Agreement 1, Subissue 3 (Thermal-mechanical effects on underground facility design, and performance) of the RDTME KTI Agreements reads as follows (Reamer and Williams 2001):

> *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 affects 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 REV01, 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.*

In response to this agreement, a *Longevity of Emplacement Drift Ground Support Materials* analysis (BSC 2001a) was provided to the NRC on June 28, 2001 (Brocoum 2001a) and a KTI Letter Report: *Effect of Forced Ventilation on Thermal-Hydrologic Conditions in the Engineered Barrier System and Near Field Environment* was provided to the NRC on April 26, 2002 (Ziegler 2002).

2. INFORMATION AS REQUESTED

After review of the *Longevity of Emplacement Drift Ground Support Materials* analysis (BSC 2001a), the NRC responded with a letter requesting additional information. In a letter dated February 28, 2002 (Schlueter 2002), six specific areas were listed requesting additional information. They are the following:

1. Provide information on the time interval over which the relative humidities in the Exploratory Studies Facility (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.

3. RESPONSES

The following are responses to the NRC's requested information. Responses to Specific Area 3, 5, and 6 have been consolidated into a single response because they are interrelated.

3.1 GENERAL RESPONSE TO ALL REQUEST AREAS

The overall strategy for the design and maintenance of the ground support system within the emplacement drifts includes: 1) analysis of operating conditions, 2) selection of materials to promote longevity, and 3) monitoring and maintenance of the ground support system throughout the preclosure period. Maintenance activities will be performed as needed to assure emplacement drift integrity, as defined in yet-to-be-developed preclosure operating procedures.

The following responses focus on the expected prevalent conditions within the emplacement drifts during the preclosure operational phase (continuous ventilation, heated conditions). These drying conditions may not preclude the presence of liquid phase water in unforeseen locations and circumstances. Such uncertainties created by local conditions will be factored into the ground support design process and the specifications incorporated into the inspection and maintenance program to ensure that the natural and engineered conditions would be within the bounding parameters.

Documents previously provided to the NRC (BSC 2001a and Ziegler 2002) describe the expected environmental conditions during the preclosure period and serve as input to the design, monitoring, and maintenance of the ground support system. Details of monitoring, inspection, and maintenance programs for the emplacement drifts will be developed as the program progresses from the conceptual design to the detailed design phase. The DOE will specify structures, systems, and components important to safety and natural and engineered barriers important to waste isolation. These structures, systems, and components will be compatible with the risk-informed, performance-based approach embodied in 10 CFR Part 63. Parameters, measurements, and observations that are appropriate for inclusion in the performance confirmation program will be included in the detailed emplacement drift design based on their importance to repository performance and to addressing the uncertainties in the performance of the ground support systems.

The following responses to the NRC request for additional information take credit for the preclosure ventilation system in limiting conditions conducive to corrosion, including localized moisture occurrences. The DOE studies and tests indicate that wet conditions will be rare and will evaporate rapidly in response to ventilation. Emplacement drifts, during preclosure, are not expected to require extensive maintenance. Corrosion of the ground support system in localized wet spots will be addressed in the detailed design of the ground support components and in the detailed strategy of a monitoring, inspection, and maintenance program.

3.2 SPECIFIC RESPONSE TO ALL REQUEST AREAS

3.2.1 Specific Area 1

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

Response to Specific Area 1–A time interval of 6.5 months was used to measure the relative humidities in the ESF Main Drift. A time interval of 6.5 months was used based on availability of data at the time the *Longevity of Emplacement Drift Ground Support Materials* (BSC 2001a, Section 5.5) analysis was completed. Accompanying this letter report is a CD containing these data and data for temperature and humidity levels collected from other stations within the ESF for comparison.

File MO0104SPATEM00.001 on the accompanying CD contains all the raw data for temperature and humidity levels from Station 34 + 86 on the ESF loop from June 12, 2000, to December 31, 2000, used in the *Longevity of Emplacement Drift Ground Support Materials* analysis (BSC 2001a, Section 5.5). Also included on the accompanying CD is source data file MO0107SPATEM00.002. This Data Tracking Number (DTN) contains frequency of occurrence charts for the hourly temperature and humidity recordings, demonstrating fluctuation and distribution of humidity levels for Station 34 + 86 throughout the period. The data associated with Station 34 + 86 were selected for use in the referenced analysis because this monitoring station is the one located closest to the proposed emplacement drift intake area.

Although the time interval over which the ESF relative humidities used in the *Longevity of Emplacement Drift Ground Support Materials* analysis (BSC 2001a, Section 5.5) spanned only 6.5 months, when comparing this data to recent data spanning a 4-year period, these data represent the range of expected ESF humidities, including periods of 100 percent humidity at the surface. (Surface relative humidity data are contained in data file MO0203SPAESF00.003, discussed in Section 3.2.2.)

For comparison, file MO0104SPATEM00.001 also contains temperature and humidity recordings from three other stations on the ESF loop (Stations: 50 + 35, 57 + 50, and 76 + 70) collected during the year 2000. Accompanying CD file MO0107SPATEM00.002 contains further analysis of these data, charted as frequency of occurrence.

3.2.2 Specific Area 2

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

Response to Specific Area 2–The effects of external environmental conditions on the relative humidity in the ESF Main Drift are negligible, relative to the effects on corrosion rates.

Also contained on the accompanying CD under file MO0203SPAESF00.003 are surface relative humidity recordings for the year 2000 and summaries and plots of surface humidity levels overlain on subsurface plots for the same time periods.

Comparison charts combining ESF temperature and humidity data with surface relative humidity data have been developed to facilitate the comparison of these data. The DTN MO0203SPAESF00.003 compares surface relative humidity data collected from January 1, through December 31, 2000, to ESF data for Stations 34 + 86 and 50 + 35 using weekly comparisons for the period of July 25 through December 24, 2000. Station 34 + 86 was selected for comparison because it is the closest to the proposed emplacement drift intake area (see discussion in Section 3.2.1). Station 50 + 35 was also selected for comparison because it is the next closest station with available data. A comparison of subsurface humidity levels for Stations 34 + 86 and 50 + 35 to surface humidity levels from the rainy period of August 28, through September 4, 2000 is also included in file MO0203SPAESF00.003. This comparison shows that the results for both stations are similar.

The plots supplied under MO0203SPAESF00.003 demonstrate no significant increase in subsurface humidity levels as peak nighttime surface humidity gradually increases, and they show little effect from general 24-hour cyclic fluctuation. Only when heavy rains occurred during the later part of August 2000 did subsurface relative humidity levels exceed 40 percent for brief periods.

3.2.3 Specific Areas 3, 5, and 6

Specific Area 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."

Specific Area 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."

Specific Area 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."

For further clarification of Specific Areas 3, 5, and 6, the NRC states the following in a letter of request for additional information (Schlueter 2002):

> "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 localized 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 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 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 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."

General Response, Applicable to Specific Areas 3, 5, and 6 - The responses to Specific Areas 3, 5, and 6 have been consolidated because they are inter-related, dealing with the occurrence and effects of localized liquid water on the ground support system. Response to Area 4 is provided last.

Reference to the *Drift-Scale Coupled Processes (DST and THC Seepage) Models* analysis and model report (AMR) (CRWMS M&O 2001) has been provided to clarify the water composition used in the longevity analysis (BSC 2001a, Section 4.1.5).

Water Composition: The representative water of the repository horizon used in the *Longevity of Emplacement Drift Ground Support Materials* analysis (BSC 2001a, Section 4.1.5) is based on the water in the fractures or in the rock matrix. This representative water was established in the *Drift-Scale Coupled Processes (DST and THC Seepage) Models* AMR (CRWMS M&O 2001, Section 4, Table 3, and Section 5, Assumption A-3). A copy of this AMR was provided to the NRC on March 30, 2001 (Brocoum 2001b). It is recognized that differences in water chemistries can develop, which may or may not lead to occurrences of localized corrosion. Water composition effects will be addressed in the detailed design of the ground support components and in the detailed strategy of a monitoring, inspection, and maintenance program.

Results from the *In Situ Field Testing of Processes* AMR (BSC 2001b) and the "Effect of Forced Ventilation on Thermal-Hydrologic Conditions in the Engineered Barrier System and Near Field Environment" KTI Letter Report (Ziegler 2002, Enclosure 1) have been provided to demonstrate ESF dry-out experience and calculated dry-out potential within the emplacement drifts during preclosure. Results from these reports are presented to demonstrate that the preclosure ventilation system will limit conditions conducive to corrosion, including localized moisture occurrences, and that wet conditions will be rare and will evaporate rapidly in response to ventilation. The following are factors supporting these responses:

ESF Dry-Out Experience: During and after ESF Main Drift and Enhanced Characterization of the Repository Block (ECRB) Cross-Drift excavation, the moisture conditions along the drifts and the hydrological conditions in the surrounding rocks have been monitored. The AMR *In Situ Field Testing of Processes* (BSC 2001b) documents the data and analysis of both passive monitoring data and active testing of flow and transport processes underground. For the NRC requested information about localized water in the drifts, two relevant results are: 1) observation of a localized damp feature and drying profiles in niches along the ESF Main Drift, and 2) water potential measurements in boreholes along the ECRB Cross-Drift.

Water potential measurements use psychrometers installed within small cavities (0.005 m in diameter) (BSC 2001b) that allowed for quick equilibration with the surrounding tuff (BSC 2001b, Section 6.8.1). The water potential values are expressed as negative pressure head in meters (of equivalent water column), with drier conditions having more negative values. The tuff units in the repository level are fractured, with fractures having low porosity and high permeability and the matrix having substantial porosity and low permeability. Under ventilated conditions, fractures are the main pathways for the moisture removal through air flows, resulting in lower saturation in the rock mass:

- Niches Experience: A wet feature in a brecciated zone associated with the Sundance fault was observed at the end of Niche 3566 right after completion of niche excavation (BSC 2001b, Section 6.1.2.2). The width of the wet feature was approximately 0.3 m (BSC 2001b Figure 6.2.1-1, Section 6.2.1.2). Observation indicated that that feature dried up in hours. There were no observations of other wet features of similar characteristics or greater magnitude at the proposed repository horizon along the excavated drifts. Water potential measurements have been conducted along boreholes at three niches, as documented in *In Situ Field Testing of Processes,* Section 6.8 (BSC 2001b). *In Situ Field Testing of Processes,* Figure 6.8.2-2 (BSC 2001b) illustrates the presence of a prominent dry-out zone of 2 to 3 m into the drift wall, associated with ventilation in the ESF Main Drift. The durations of niche water potential measurements are generally a few days to a few weeks (BSC 2001b, Table 6.8.2-1).

- ECRB Boreholes Experience: Long-term water potential measurements have been conducted with psychrometers left in the boreholes for more than 2 years. Section 6.10.2 of *In Situ Field Testing of Processes* AMR (BSC 2001b) describes the ECRB Cross Drift bulkhead study. The dry-out zones extend 1 to 2 m into the rock of the drift wall in the ECRB and the re-wetting process takes years, as illustrated in *In Situ Field Testing of Processes,* Figure 6.10.2-2 (BSC 2001b). So far there is no conclusive evidence that continuous liquid flow paths are observed within the sealed bulkhead sections. There are, however, observations of liquid water, likely associated with vapor condensations driven by temperature variations. It is apparent from this ongoing study that ventilation significantly reduces the potential for free liquid water in sections outside the bulkheads. Without ventilation, localized water and associated biological activities are more likely to occur.

- Alcoves Experience: Psychrometers and other sensors are also used in active testing activities, including at Alcove 6 for fracture-matrix interaction testing (BSC 2001b, Section 6.6.2.2), Alcove 4 for nonwelded fault testing (BSC 2001b, Section 6.7.2.2.2), and at ECRB Starter Tunnel for construction water migration (BSC 2001b, Section 6.9.2.1). Drying processes are inferred from the sensor responses. Section 6.10 of the *In Situ Field Testing of Processes* AMR (BSC 2001b) summarizes moisture monitoring and water analysis in underground drifts.

While the examples documented in the AMR are primarily about NRC KTI issue (3), they are also related to issues (5) and (6). The crevices between the drift wall and steel sets are similar to fractures within the rock matrix. If fractures around the drifts have low saturation, as inferred by the available data and our current understanding of the unsaturated flow processes, the crevices will also likely have low saturation by the same physical mechanism. The water mainly resides inside the matrix by capillary forces, and the fractures are available for fast drainage of free water.

Biological activities are associated with liquid water. If localized free water exists, mold can grow, as demonstrated in sealed sections behind bulkheads after 4 to 6 months of isolation. In the ESF, where prolonged ventilation has kept the drift dry, live mold has not been observed.

A copy of the *In Situ Field Testing of Processes* AMR (BSC 2001b) is included on the accompanying CD for your review.

<u>Emplacement Drift Ventilation and Dry-Out Potential</u>: Predicted properties of ventilation air in the emplacement drifts during preclosure were provided to the NRC in a KTI letter report, "Effect of Forced Ventilation on Thermal-Hydrologic Conditions in the Engineered Barrier System and Near Field Environment," on April 26, 2002 (Ziegler 2002). The letter report assumed that the emplacement intake air is at a temperature of 25°C with a relative humidity of 30 percent and predicts that the air temperature at 300 years would be 32.5°C, with a relative humidity of approximately 20 percent (Ziegler 2002, Table 10, p. 33). The results provided were for the ventilation air exiting the emplacement drifts.

In comparison to the KTI letter report (Ziegler 2002, Enclosure 1), the average measured ambient ESF ventilation air temperature is in the data provided. This temperature was approximately 25°C at 20 percent relative humidity at Station 50 + 35, and approximately 27°C at 19 percent relative humidity at Station 34 + 86, based on actual ESF data (MO0107SPATEM00.002). Both of these stations are within the ESF Main Drift and not in the ramps.

The ventilation air in the emplacement drifts will have a higher temperature and a lower relative humidity than the ventilation air in the ESF Main Drift. Therefore, the ventilation air in the emplacement drifts will have more capability to remove moisture or water than the ventilation air in the ESF Main Drift. This capability, in turn, offers an even greater potential for the ventilation air in the emplacement drifts to dry out the rock surrounding the drifts than that found in studies conducted in niche boreholes along the ESF Main Drift. The same is true for the drift boreholes along the ECRB Cross-Drift discussed in *In Situ Field Testing of Processes* (BSC 2001b).

Response to Specific Area 3

It can be concluded from studies, ESF experience and measurements that preclosure ventilation will limit conditions conducive to corrosion, localized moisture occurrences and wet conditions will be rare, and moisture will evaporate rapidly in response to ventilation. However, this may not preclude all occurrence of localized liquid water. If localized liquid water were present, the corrosion mechanism would be aqueous corrosion instead of dry oxidation, which is the predominant corrosion mechanism for steel components in the emplacement drifts during preclosure (BSC 2001a). The need to study potential impacts of localized liquid phase water on various ground support materials will be addressed in the detailed design of the ground support components and strategy for monitoring, inspection, and maintenance of the materials, as needed.

Response to Specific Area 5

The ubiquity of dryout due to ventilation, as shown by countless measurements, ESF experience, and the similarity of tight crevices between the drift wall and steel sets used for ground support to the fracture apertures discussed above, is the technical basis for not including such crevices in the *Longevity of Emplacement Drift Ground Support Materials* analysis (BSC 2001a). However, this condition may not preclude all occurrences of water residing in tight crevices. Corrosion of the ground support system in localized wet spots will be addressed in the design of the ground support components and in the detailed strategy of a monitoring/inspection/maintenance program.

Response to Specific Area 6

The dryout argument discussed in the general response suggests that there will be no water films. More importantly, the presence of mold in unventilated areas, and its absence in identical ventilated areas, and the fact that the drifts will be ventilated, also suggests that there will be no microbial activity.

3.2.4 Specific Area 4

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

For further clarification of this issue, the NRC states in a letter (Schlueter 2002):

> "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 preclosure. The effects of mixed salts is not considered in the corrosion assessment of the ground support materials."

Response to Specific Area 4–The effects of mixed salts corrosion was not considered in the *Longevity of Emplacement Drift Ground Support Materials* analysis (BSC 2001a) because credit for the performance of the ground support systems is limited to the preclosure period. During preclosure, continuous ventilation and high temperatures will limit the accumulation of dusts containing salts and the occurrences of water, limiting the conditions for mixed salts corrosion. However, information being generated to fulfill KTI Agreements Evolution of Near-Field Environment (ENFE) 2.13 and ENFE 2.15 will also be used to characterize chemical environments on ground support materials. KTI Agreements ENFE 2.13 and ENFE 2.15 read as follows, respectively:

> *Provide documentation regarding the deposition of dust and its impact on the salt analysis. The DOE will provide documentation of dust sampling in the Exploratory Studies Facility, and analysis of the dust and evaluation of its impact on the chemical*

environment on the surface of the drip shield and waste package, in a revision to the Engineered Barrier System: Physical and Chemical Environment Model AMR (ANL-EBS-MD-000033), expected to be available in FY02.

Provide the additional data to constrain the interpolative low relative humidity salts model. The data should provide the technical basis as to why the assumption of the presence of sodium nitrate is conservative, when modeling and experimental results indicate the presence of other mineral phases for which the deliquesence point is unknown. The DOE will provide additional information to constrain the low-relative humidity salts model. The information will include the deliquescence behavior of mineral assemblages derived from alternative starting water compositions (including bulk water compositions, and local variations associated with cement leaching or the presence of corrosion products) representing the range of potential water compositions in the emplacement drifts. This information will be documented in a revision to the In-Drift Precipitates/Salts Analysis AMR (ANL-EBS-MD-000045), expected to be available in FY02.

An approach is being developed to estimate the deliquescence point and resulting aqueous solution composition for given starting salts using results from the EQ3/6-based analyses. These studies will establish the constraining environment of mixed salts occurrence in the emplacement drifts during preclosure. They will be an essential starting point in determining if the effects of mixed salts would have an impact on the corrosion assessment of the ground support materials in the current *Longevity of Emplacement Drift Ground Support Materials* analysis (BSC 2001a). These studies and responses to Agreements ENFE 2.13 and ENFE 2.15 are currently scheduled for completion and submission to the NRC in February 2004. If the results of these studies conclude that the occurrence of mixed salts is probable during the preclosure period, the effects of mixed salts on corrosion will be addressed in the detailed design of the ground support components and in the detailed strategy of a monitoring, inspection, and maintenance program.

4. CONCLUSION

Direct comparisons of existing surface temperature and humidity data to subsurface data from two different monitoring stations over a 6.5-month period, demonstrate that subsurface relative humidity levels show insignificant effects from diurnal fluctuation and slightly exceed 40 percent relative humidity only during periods of prolonged rain at the surface. When comparing this data to recent data spanning a 4-year period, these data represent a similar range of expected subsurface temperature and relative humidities.

In general, the conditions in the emplacement drifts during preclosure will be dry. Based on observations in the ESF, wet conditions will be rare and will evaporate rapidly in response to ventilation. Corrosion of the ground support system in localized wet spots will be addressed in the design of the ground support components and in the detailed strategy of a monitoring/inspection/maintenance program.

5. REFERENCES

5.1 DOCUMENTS CITED

Brocoum, S.J. 2001a. "Transmittal of Reports and Data Addressing Key Technical Issues (KTI)." Letter from S.J. Brocoum (DOE) to C.W. Reamer (NRC), June 28, 2001, TCG-1345. ACC: MOL.20010810.0100.

Brocoum, S.J. 2001b. "Transmittal of Analysis and Model Reports (AMR) and Other Items Addressing Key Technical Issue (KTI) Technical Exchanges." Letter from S.J. Brocoum (DOE) to C. W. Reamer (NRC), March 30, 2001. TCG-0972. ACC: MOL.20010529.0119.

CRWMS M&O (Civilian Radioactive Waste Management System Management and Operating Contractor) 2001. *Drift-Scale Coupled Processes (DST and THC Seepage) Models*. MDL-NBS-HS-000001 REV 01. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.20010314.0003.

BSC (Bechtel SAIC Company) 2001a. *Longevity of Emplacement Drift Ground Support Materials*. ANL-EBS-GE-000003 REV 01 ICN 01. Las Vegas, Nevada: Bechtel SAIC Company. ACC: MOL.20010613.0246.

BSC 2001b. *In Situ Field Testing of Processes*. ANL-NBS-HS-000005 REV 01. Las Vegas, Nevada: Bechtel SAIC Company. ACC: MOL.20020108.0351.

Reamer, C.W. and Williams, D. R. 2001. Summary Highlights of NRC/DOE Technical Exchange and Management Meeting on Repository Design and Thermal-Mechanical Effects. Meeting held February 6-8, 2001, Las Vegas, Nevada. Washington, D.C.: U.S. Nuclear Regulatory Commission. ACC: MOL.20010307.0511 through MOL.20010307.0521.

Schlueter, J.R. 2002. "Repository Design and Thermal-Mechanical Effects Key Technical Issue Agreement." Letter from J.R. Schlueter (NRC) to S.J. Brocoum (DOE), February 28, 2002. ACC: MOL.20020614.0233.

Ziegler, J.D. 2002. "Transmittal of Report Addressing Key Technical Issues (KTI)." Letter from J.D. Ziegler (DOE) to J.R. Schlueter (NRC), April 26, 2002, TCG-1031. ACC: MOL.20020708.0185.

5.2 CODES, STANDARDS, REGULATIONS, AND PROCEDURES

10 CFR (Code of Federal Regulations) 63. Energy: Disposal of High-Level Radioactive Wastes in a Geologic Repository at Yucca Mountain, Nevada. Readily available.

5.3 SOURCE DATA

MO0104SPATEM00.001. ESF Temperature and Humidity Monitoring Record. Submittal date: 04/02/2001.

MO0107SPATEM00.002. Summary of ESF Temperature and Humidity Monitoring Record. Submittal date: 07/20/2001.

MO0203SPAESF00.003. ESF Temperature and Humidity Monitoring Record. Submittal date: 03/20/2002.